		L	T	P	C
118ENT01	TECHNICAL ENGLISH	2	0	0	2

COURSE 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   9

Listening - Ink talks and gap exercises - **Speaking** – Asking for and giving directions - **Reading** – short technical texts from journals and newspapers - **Writing** - definitions – instructions – checklists – recommendations - **Vocabulary Development** - technical vocabulary -**Language Development** – parts of speech – articles – word formation.

UNIT II   9

Listening - longer technical talks - **Speaking** – process description - **Reading** – longer technical texts – **Writing** – graphical representation - **Vocabulary Development** - vocabulary used in formal letters/emails and reports - **LanguageDevelopment** – tenses - voices - numerical adjectives – question tags.

UNIT III   9

Listening - listening to classroom lectures - **Speaking** – introduction to technical presentations - **Reading** – longer texts both general and technical and practice in speed reading – **Writing** – process description using sequence words and sentences - **Vocabulary Development** - Misspelled words – one-word substitution - **Language Development** - embeddedsentences – singular and plural nouns - compound nouns – editing.

UNIT IV   9

Listening - Listening to documentaries and making notes - **Speaking** – mechanics of presentations - **Reading** – reading comprehension – **Writing** - email etiquettes - job application – cover letter – Résumé preparation - essay writing - **Vocabulary Development** – synonyms and antonyms – paraphrasing - **Language Development** – modals – conditionals.

UNIT V   9

Listening - TED talks - **Speaking** – brainstorming and debate – **Reading** – reading and understanding technical articles– **Writing** – reports - minutes of a meeting - **Vocabulary Development**- verbal analogies - phrasal verbs - **Language Development** - concord - reported speech.

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course learners will be able to:

CO1   Read technical texts and write area- specific texts effortlessly.

CO2   Listen and comprehend lectures and talks in their area of specialization successfully.

CO3   Speak appropriately and effectively in varied formal and informal contexts.

CO4   Understand the basic grammatical structures and its applications.

CO5   Write reports and winning job applications.

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.

3.   Uttham Kumar. N. Technical English I (with work book). Sahana Publications, Coimbatore, 2016.

REFERENCE BOOKS

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.

      Students can be asked to read Tagore and Chetan Bhagat for supplementary reading.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2										2	2		
CO2	3	2			2			1				2	2		1
CO3	3	2			2							2	2	2	1
CO4	3	2			2							2		2	1
CO5	3	2						1				2		2	

118PPT05	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I   ALGORITHMIC PROBLEM SOLVING   9

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

UNIT II   DATA, EXPRESSIONS, STATEMENTS   9

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

UNIT III   CONTROL FLOW, FUNCTIONS   9

Conditionals: Boolean valuesand operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV   LISTS, TUPLES, DICTIONARIES   9

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

UNIT V   FILES, MODULES, PACKAGES   9

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

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1   Develop algorithmic solutions to simple computational problems

CO2   Read, write, execute by hand simple Python programs.

CO3   Structure simple Python programs for solving problems.

CO4   Decompose a Python program into functions.

CO5   Represent compound data using Python lists, tuples, dictionaries.

TEXT BOOKS

1. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated forPython3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

2. Guido van Rossum and Fred L. Drake Jr, —An Introduction to Python – Revised and updated for Python 3.2,Network Theory Ltd., 2011.

REFERENCE BOOKS

1. John V Guttag, —Introduction to Computation and Programming Using Python'', Revised and expandedEdition, MIT Press, 2013

2. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming in Python: An Inter-Disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

3. Timothy A. Budd, —Exploring Python‖, Mc-Graw Hill Education(India) Private Ltd., 2015.

4. Kenneth A. Lambert, —Fundamentals of Python: First Programs‖, CENGAGE Learning, 2012.

5. Charles Dierbach, —Introduction to Computer Science using Python: A Computational Problem-Solving Focus,Wiley India Edition, 2013.

6. Paul Gries, Jennifer Campbell and Jason Montojo, —Practical Programming: An Introduction to ComputerScience using Python 3‖, Second edition, Pragmatic Programmers, LLC, 2013.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3			2					2		2			
CO2			2							2		2			1
CO3			2							2		2		2	
CO4	3	3	2		2					2		2			1
CO5			2							2		2		2	
CO6			2							2		2			

118PHP07	ENGINEERING PHYSICS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To understand the practical concepts of Interference and diffraction.
- To understand the concept of velocities of sound in different liquids.
- To get better knowledge of modulus of elasticity.
- To understand the concepts of thermal conductivity.
- To understand the concepts of viscosities of liquid

LIST OF EXPERIMENTS

1. (a) Determination of laser parameters – Wavelength.

    (b) Particle size determination using Diode Laser.
2. Determination of thickness of a thin wire-Air wedge method.
3. Determination of velocity of sound and compressibility of liquid- Ultrasonic interferometer.
4. Determination of wavelength of mercury spectrum-Spectrometer grating.
5. Determination of thermal conductivity of a bad conductor-Lee's disc method.
6. Determination of Young's modulus of the material –Non uniform bending.
7. Determination of viscosity of liquid – Poiseuille's method.
8. Spectrometer- Dispersive power of prism.
9. Determination of Young's modulus of the material - Uniform bending.
10. Tensional pendulum- Determination of Rigidity modulus.

COURSE OUTCOMES

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

CO1 Understanding the moduli of elasticity by determining Young's modulus and Rigidity modulus of a beam and cylinder respectively.

CO2 Understanding the phenomenon of diffraction, dispersion and interference of light using optical component.

CO3 Acquiring knowledge of viscosity by determining coefficient of viscosity of a liquid.

CO4 Measuring the parameters of ultrasound propagating through a liquid.

CO5 Understanding the phenomenon of heat transfer through conductors and bad conductors by determining thermal conductivity.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	2		2											
CO3	3	2		3											
CO4	3	2		3											

	CO5	2	1											

118PPP08	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To write, test, and debug simple Python programs.

- To implement Python programs with conditionals and loops.

- Use functions for structuring Python programs.

- Represent compound data using Python lists, tuples, dictionaries.

- Read and write data from/to files in Python.

LIST OF EXPERIMENTS

1. To Implement python scripts using Variables and operators
2. To Demonstrate Operator precedence to evaluate an expression
3. Display grade of a student using elif statement
4. Implement Floyd triangle using for loop
5. Checks the given number is prime or not using while loop
6. Compute the GCD of Numbers using functions
7. Finding factorial of a given number using recursive function.
8. Takes a list of words and returns the length of longest one using strings
9. To perform linear and binary search using strings
10. To implement list as arrays (multiply 2 matrices)
11. To demonstrate use of list & related functions
12. To demonstrate use of tuple, set& related functions
13. To demonstrate use of Dictionary& related functions
14. Finding most frequent words in a text read from a file
15. Programs that take command line arguments (word count)

PLATFORM NEEDED

Python 3 interpreter for Windows/Linux

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1   Write, test, and debug simple Python programs.
CO2   Implement Python programs with conditionals and loops.
CO3   Develop Python programs step-wise by defining functions and calling them.
CO4   Use Python lists, tuples, dictionaries for representing compound data.
CO5   Read and write data from/to files in Python.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1		3			2					2		2			

CO2			2							2		2		2	
CO3			2							2		2		2	
CO4	3	3	2		2					2		2			
CO5			2							2		2			

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			L	T	P	C
218ENT01	COMMUNICATIVE ENGLISH		2	0	2	3

COURSE OBJECTIVES

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

UNIT I 9

Listening - conversation - Speaking – introducing oneself - exchanging personal information - Reading – comprehension. Writing - paragraph - Vocabulary Development - synonyms and antonyms - Language Development – consonants &vowels - phonetic transcription.

UNIT II 9

Listening - telephonic conversation - Speaking – sharing information of a personal kind – greeting taking leave - Reading – short stories – The Gift of the Magi, A Service of Love and The Last Leaf by O. Henry – Writing – developing hints - Vocabulary Development – everyday vocabulary - Language Development – British andAmerican English - infinitive and gerund.

UNIT III 9

Listening – class memory quiz - Speaking – impromptu - Reading – magazines – Writing – agenda proposals - Vocabulary Development - important words used in speaking and writing - Language Development – typesof sentences - information and emphasis.

UNIT IV 9

Listening – interviews of famous persons - Speaking – story narration - Reading – case study – Writing – invitation letter- quotation letter - Vocabulary Development – listening and reading vocabulary - Language Development – cause andeffect – purpose and function.

UNIT V 9

Listening - a scene from a film - Speaking - role play - Reading – jigsaw – Writing – essay writing Vocabulary Development-business vocabulary - Language Development - degrees of comparison real English phrases.

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course learners will be able to:

CO1   Comprehend conversations and talks delivered in English.

CO2   Participate effectively in formal and informal conversations; introduce themselves and their friends and express opinions in English.

CO3   Read short stories, magazines, novels and other printed texts of a general kind.

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CO4 Write short paragraphs, essays, letters and develop hints in English.

CO5 Approach the global market with self-confidence

TEXT BOOKS

1. Board of Editors. Using English A Coursebook for Undergarduate Engineers and Technologists. OrientBlackSwan Limited, Hyderabad: 2015.
2. Richards, C. Jack. Interchange Students' Book-2, New Delhi: CUP, 2015.
3. Uttham Kumar, N. Communicative English (with work book). Sahana Publications, Coimbatore, 2019.

REFERENCE BOOKS

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

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		1		2	2								2		
CO2	1		2	2	2					2				2	1
CO3			2	3	2									2	1
CO4		2	1		3								1		
CO5	3									3		2			1

218GET03	ENVIRONMENTAL SCIENCE AND ENGINEERING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To study the nature and facts about environment.
- To finding and implementing scientific, technological, economic and political solutions to environmentalproblems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision thesurrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.

UNIT I   NATURAL RESOURCES   14

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

UNIT II   ECOSYSTEMS AND BIODIVERSITY   8

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

UNIT III   ENVIRONMENTAL POLLUTION   10

Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marinepollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – solid waste management: causes, effects and control measures of municipal wastes – role of

an individual in prevention of pollution – pollution case studies – disastermanagement: floods.

UNIT IV   SOCIAL ISSUES AND THE ENVIRONMENT   7

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

UNIT V   HUMAN POPULATION AND THE ENVIRONMENT   6

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

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1   Gain knowledge about environment and ecosystem.

CO2   Learn about natural resource, its importance and environmental impacts of human activities on natural resource.

CO3   Gain knowledge about the conservation of biodiversity and its importance.

CO4   Aware about problems of environmental pollution, its impact on human and ecosystem and control measures.

CO5   Learn about increase in population growth and its impact on environment.

TEXT BOOKS

1. Benny Joseph, Environmental Science and Engineering ', Tata McGraw-Hill, New Delhi, 2006.
2. Gilbert M. Masters, Introduction to Environmental Engineering and Science ', 2nd edition, PearsonEducation, 2004.
3. Dr. G. Ranganath, Environmental Science and Engineering, Sahana Publishers, 2018 edition.

REFERENCE BOOKS

1. Dharmendra S. Sengar, Environmental law ', Prentice hall of India PVT LTD, New Delhi, 2007.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2					2	3						2		
CO2	2					2							3		1
CO3	2					2	3						2		
CO4	2				1	2	3						2		1
CO5	2				1	2	3						2		

215CAT05	CIRCUIT THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To enable the student to learn the major components of a circuit theory.
- To know the correct andefficient ways of handling electrical circuits.

UNIT I   BASIC CIRCUITS CONCEPTS AND ANALYSIS   9

Circuit elements, ideal sources (independent and dependent), linear passive element R, L and C; V-I relationshipof circuit elements; sinusoidal voltage and current- RMS value, Average value, form factor, power and power factor; Ohm's Law – Kirchoff's Laws; analysis of series and parallel circuits: Network reduction; voltage and current division, source transformation, star/delta transformation.

UNIT II   MULTI DIMENSIONAL CIRCUIT ANALYSIS & NETWEORK THEOREMS   9

Node voltage analysis of multi node circuit with current sources and Mesh-current analysis of multi node circuits with voltage sources for DC and AC circuits. Network Theorems for DC and AC circuits: Thevenin's theorem- Norton's theorem – Superposition theorem – Maximum power transfer theorem – Reciprocity theorem- compensation theorem – substitution theorem- Millman's theorem- Tellegen's theorem.

UNIT III   RESONANCE AND COUPLED CIRCUITS   9

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

UNIT IV   TRANSIENT RESPONSE FOR DC CIRCUITS   9

Source free response of RL and RC circuits; forced (step) response of RL and RC circuits; source free response ofRLC series circuit; forced (step) response of RLC series circuit; forced response of RL, RC and RLC series circuitto sinusoidal excitation; time constant and natural frequency of oscillation of circuits. Laplace Transform application to the solution of RL, RC & RLC circuits: Initial and final value theorems and applications.

UNIT V   ANALYSING THREE PHASE CIRCUITS   9

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

TOTAL:45 PERIODS

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

CO1   Recognize the different combinations of circuit elements and solving the circuit by applying basic circuital laws irrespective of the type of steady state source given.

CO2   Analyse electrical circuits by applying theorems.

CO3   Understand the concepts of series and parallel resonance.

CO4   Recall the basic concepts of laplace transform and thus analyse the transient behavior of electrical Circuits

CO5   Explain the way of generation of alternating voltage and the response of single phase

circuits and three phase circuits employing balanced and unbalanced loads.

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",TMH publishers, 6th edition, New Delhi, 2002.
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", Tata McGrawHill, 2007.
3. Ravish R Singh, "Network Analysis and Synthesis", McGraw Hill, 2013.

REFERENCE BOOKS

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., NewDelhi, 1996.

2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum'sseries,Tata McGraw- Hill,New Delhi 2001.

3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, 1999.

4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, 2003.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3					1								1	
CO2	3		1		2							1	2		
CO3	3		1		2							1	2		
CO4	3					1						1	2		
CO5	3				2	1						1	2	1	

218BSE07	PHYSICS OF SEMICONDUCTOR	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES

- To study the basic theory of structure of crystalline materials.
- To understand the essential principles of electrical properties of materials.
- To get the better knowledge of Physics of semiconductor materials.
- Become proficient in magnetic and dielectric properties of materials.
- To understand the essential concepts of nanomaterial devices and applications

UNIT I   CRYSTALLOGRAPHY   9

Crystal structures- Parameters- Bravais lattice - Calculation of number of atoms per unit cell - Atomic radius - Coordination number - Packing factor for SC, BCC, FCC, HCP and Diamond cubic structure - NaCl, ZnS structures(qualitative). Miller indices- unit cell approach.

UNIT II   ELECTRICAL PROPERTIES OF MATERIALS   9

Classical free electron theory-Expression for electrical conductivity-Thermal conductivity, Expression-Wiedemann- Franz law-Success and failures-Quantum free electron theory-Particle in a finite potential well-Tunneling-Particle in athree dimensional box-degenerate States-Fermi-Dirac statistics-Density of energy states-Energy bands in solids.

UNIT III   SEMICONDUCTOR PHYSICS   9

Intrinsic Semiconductors-Energy band diagram-direct and indirect band gap semiconductors - Carrier concentration inintrinsic semiconductors-extrinsic semiconductors-Carrier concentration in N-type & P-type semiconductors (qualitative) –Einsein'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 IV   OPTICAL PROPERTIES OF MATERIALS   9

Classification of optical materials - Absorption emission and scattering of light in metals, insulators and semiconductors(concepts only) – photo current in a P-N diode – solar cell – LED – Organic LED – Laser diodes – Optical data storage techniques.

UNIT V   NANOMATERIAL DEVICES   9

Nano materials: Introduction – Synthesis – Plasma arcing – Chemical vapour deposition – Electro deposition – BallMilling – Sol-Gel method – Spin coating method- photo current in a P-N diode – Solar cell – LED- Properties of nanoparticles and their applications.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1   Have the necessary understanding on the functioning of crystalline in solids of materials.

CO2   Gain knowledge on classical and quantum electron theories, and energy band structures.

CO3   Acquire knowledge on basics of semiconductor physics and its applications in various devices.

CO4   Get knowledge on magnetic and dielectric properties of materials and theirapplications.

CO5   Understand the basics of nanodevices and applications.

TEXT/ REFERENCE BOOKS

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1. Donald Askeland, "Materials Science and Engineering", Cengage Learning IndiaPvt Ltd., 2010.
2. Kasap S.O., "Principles of Electronic Materials and Devices" Tata Mc Graw-Hill2007.
3. Pierret R.F, "Semiconductor Device Fundamentals", Pearson 2006
4. W.D.Callister and D.G.Rethwisch, "Materials Science and Engineering", JohnWiley & Sons,Inc., NewJersey (2010).
5. Hanson G.W., "Fundamentals of Nanoelectronics", Pearson Education 2009.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3													1	
CO2	3	2	1										1		
CO3	3	2	2										2	2	1
CO4	3	2	1										2	2	1
CO5	2	1											2	1	

218CYP07	ENGINEERING CHEMISTRY LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- Students will be conversant with the estimation of various compounds using volumetric and instrumental analysis.

LIST OF EXPERIMENTS

1. Estimation of Total hardness by EDTA
2. Determination of percentage of calcium in Lime Stone by EDTA
3. Estimation of chloride in water sample
4. Estimation of alkalinity of Water sample
5. Determination of DO in Water (Winkler's Method)
6. Determination of Rate of Corrosion of the given steel specimen by weight loss method (Without inhibitor)
7. Determination of Rate of Corrosion of the given steel specimen by weight loss method (With inhibitor)
8. Conduct metric titration (Simple acid base)
9. Conduct metric titration (Mixture of weak and strong acids)
10. Conduct metric titration using $BaCl_2$ vs Na_2SO_4
11. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)
12. PH titration (acid & base)
13. Determination of water of crystallization of a crystalline salt -Copper sulphate
14. Preparation of Bio-Diesel by Trans etherification method.
    A minimum of TEN experiments shall be offered.

COURSE OUTCOMES

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

CO1 Carry out the volumetric experiments and improve the analytical skills.

CO2 Understand the maintenance and usage of analytical instruments and thereby develop their skills in the field of engineering.

CO3 Understand the principle and handling of electrochemical instruments and Spectrophotometer.

CO4 Apply their knowledge for protection of different metals from corrosion by using different inhibitors.

REFERENCE BOOKS

1. Arthur I. Vogel's, "Quantitative Inorganic Analysis including Elementary Instrumental Analysis",ELBS, Group, 7th Edition, 2000.
2. Dr. K .Sivakumar, "Engineering Chemistry lab manual", S.S publishers, 2016.

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COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2													
CO2	3	2		2											
CO3	3	2		3											
CO4	2	1													

218EPP08	ENGINEERING PRACTICE LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES
- To get the knowledge on welding techniques and its types.
- To do the fitting operation on a given material. (Specimen)
- To carry out sheet metal operation.
- To know the principle involved in plumbing work.
- To do the carpentry work on a given work piece.

LIST OF EXPERIMENTS

WELDING:

Study of Electric Arc welding and Gas welding tools and equipment's.

Preparation of Arc welding and Gas welding models:

i)Butt joint   ii) Lap joint   iii) T - joint.

FITTING:

Study of fitting tools and operations.

Preparation of fitting models:

i) V-fitting   ii) Square fitting

SHEET METAL WORK:

Study of sheet metal tools and operations

Preparation of sheet metal models:

i) Rectangular Tray   ii) Funnel

PLUMBING WORKS:

Study of pipeline joints and house hold fittings.

Preparation of plumbing models:

Basic pipe connections with PVC and GI pipe fittings.

CARPENTRY:

Study of wooden joints and tools used in roofs, doors, windows, furniture.

Preparation of carpentry models:

i) Lap joint   ii) Dovetail joint   iii) T-Joint

DEMONSTRATION ON: ELECTRICAL ENGINEERING PRACTICE

Study of Electrical components and equipments

Residential house wiring using switches, fuse, indicator, lamp and energy meter.

ELECTRONICS ENGINEERING PRACTICE

Study of Electronic components –Resistor, color coding, capacitors etc

Soldering practice –components soldering in simple electric circuit & testing continuity

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COMPUTERHARDWARE AND SOFTWARE PRACTICE

Study of PC Hardware, Internet & World Wide Web and Productivity tools including Word, Excel,

PowerPoint and Publisher.

COURSE OUTCOMES

The students will be able to

CO1   Prepare simple Lap, Butt and T- joints using arc welding equipments.

CO2   Prepare the rectangular trays and funnels by conducting sheet metal operation.

CO3   Prepare the pipe connections and identify the various components used in plumbing.

CO4   Prepare simple wooden joints using wood working tools.

CO5   Demonstrate basic electrical, electronic and computer components based on their physical
          parameters and dimensions.

TEXT BOOKS:

1.   Ranganath. G & Channankaiah, "Engineering Practices Laboratory Manual", S.S. Publishers,
       2014.

2.   Jeyapoovan.T & Gowri S "Engineering Practice Lab Manual", Vikas publishing house pvt.ltd,
       2016.

REFERENCE BOOKS

1.   Kannaiah.P & Narayana.K.L, "Manual on Workshop Practice", Scitech Publications, 2015.

2.   Ramesh BabuV, "Engineering Practices Laboratory Manual", VRB Publishers Private
       Limited,Chennai, Revised Edition, 2014.

3.   Peter Norton, "Introduction to Computers", 7th Edition, Mc Graw Hill, 2010.

4.   Bawa. H.S, "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2009.

5.   David Anfinson and Ken Quamme, "IT Essentials PC Hardware and Software Companion
       Guide",CISCO Press, Pearson Education, Third Edition, 2008.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3		1	2					2				2	3	
CO2	3	2	2	2					2				2		1
CO3	3	2	2	2					2				2	3	
CO4	3	1	2	2					2				2		1
CO5	2		2							2		2		3	

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218EDP09	ELECTRON DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- To provide exposure to the students with hands on experience on various electrical circuit laws andexperiments.

LIST OF EXPERIMENTS

1. Verification of Kirchoff's laws and ohms laws.
2. Verification of Thevenin's and Norton's Theorem.
3. Verification of Superposition Theorem.
4. Verification of Maximum Power Transfer theorem.
5. Verification of Reciprocity theorem
6. Verification of Mesh and Nodal analysis.
7. Transient response of RL and RC circuits for DC input.
8. Frequency response of series and parallel resonance circuit.
9. Characteristics of PN junction diode and Zener diode Characteristics.
10. Common Emitter and Common Base input-output Characteristics
11. FET and SCR Characteristics

COURSE OUTCOMES

Upon Completion of this course, students will be able to:

CO1 Select the suitable range of meters and rheostats for the given circuit and set the appropriate values of circuit elements and energy sources as per the requirement.

CO2 Apply basic circuital laws to confirm the practical values of the current through and voltage across different elements of the circuit with that of the theoretical values.

CO3 Apply theorems to simplify the electric circuits.

CO4 Illustrate the transient response and frequency response of RLC circuits.

CO5 Study the characteristics of Common Electron Devices.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3														
CO2	3	2			1								3	2	
CO3	2	2											2	3	1
CO4	2	2													
CO5	3	2			1								3	2	

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(Common to all branches of B.E. / B.Tech. Degree Programmes) - Regulation 2015

Course Objectives
- To develop z-transform techniques which analyze the discrete time signals.
- To solve certain linear differential equations using the Laplace transform technique which has applications in control theory and circuit theory.
- To introduce Fourier series analysis which is central to many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are aperiodic.

UNIT I   Z – TRANSFORM   9+3

z-transform - Elementary properties and applications - Inverse z-transform – Convolution theorem (statement and applications only) - Initial and final value theorems (Statement and applications only) - Solution of difference equations by applying z-transform using partial fractions, residue theorem and convolution theorem methods only.

UNIT-II   LAPLACE TRANSFORM   9+3

Laplace transform – Conditions for existence –Basic properties (without proof) – Laplace Transform of elementary functions, derivatives and integrals, unit step function and impulse functions, periodic functions. Definition of Inverse Laplace transform – Convolution theorem (Statement and applications only) – Initial and final value theorems (Statement and applications only) – Solution of linear ordinary differential equations of second order with constant coefficients using Laplace transform techniques.

UNIT III   FOURIER SERIES   9+3

Dirichlet's conditions – General Fourier series – Change of scale - Odd and even functions – Half-range Sine and Cosine series – Parseval's identity – Harmonic Analysis.

UNIT IV   BOUNDARY VALUE PROBLEMS   9+3

Classification of Partial Differential Equations – Method of separation of Variables – Solutions of one dimensional wave equation and One-dimensional heat equations – Applications using Fourier series solutions in Cartesian coordinates - Steady state solution of two-dimensional heat equation.

UNIT V   FOURIER TRANSFORM   9+3

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

TOTAL: 45+15=60 PERIODS

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Course Outcomes

CO 1: Gaining the concept of analysis of linear discrete system using Z-transform approach.
CO2: Applying Laplace transform techniques to solve ordinary differential equations which have an application in many engineering fields.
CO 3: Describing an oscillating function which appear in a variety of physical problems by Fourier series helps them to understand its basic nature deeply. Acquiring the knowledge to construct partial differential equations for various physical and engineering real time problems and obtaining solution using Fourier series methods.
CO 4: Understanding the effect of Fourier transform techniques and their applications.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2				3		1				2		2		
CO2	2	1			2								2	1	
CO3	2	2			1		1						2	1	1
CO4	2	3			1						2		2		

TEXT BOOK
1.   B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 43rd edition , 2016.

REFERENCES
1. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
2. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.
3. P.Kandasamy, K.Thilagavathy, K.Gunavathy, " Engineering Mathematics-III", S.Chand Publishe

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Course Code	Course Name	Hours/week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
315GET02	ENVIRONMENTAL SCIENCE AND SUSTAINABILITY	3	0	0	3	50	50	100

Objectives
- [ ] To impart knowledge on components of ecosystem.
- To impart knowledge on natural resources on biodiversity.
- To impart knowledge on type of pollution, causes & effect on environment.
- To impart knowledge on social issues & components of sustainability.

UNIT 1 INTRODUCTION TO ENVIRONMENT AND ECOSYSTEM   9

Definition, scope and importance of environment – need for public awareness. Atmosphere – composition of atmosphere (troposphere, stratosphere, mesosphere and thermosphere) Biosphere – Hydrosphere – Lithosphere. Concept of ecosystem – structure and functions of ecosystem- producers, consumers and decomposers - Energy flow –Ecological succession-Food chains-Food webs- Ecological pyramids-Introduction, types, characteristic features -structures and function of forest, grassland and aquatic ecosystems (ponds and rivers) - Case Studies in current scenario.

UNIT 2 NATURAL RESOURCES AND BIODIVERSITY   9

Forest resources-Water resources-Mineral resources-Food resources-Energy resources-Land resources. Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographically 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 3 ENVIRONMENTAL POLLUTION   9

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

UNIT 4 SOCIAL ISSUES, HUMAN POPULATON AND THE ENVIRONMENT   9

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies role of non-governmental organization environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – Wasteland reclamation – consumerism and waste products – environment protection act —environmental legislation-central and state pollution control boards.

UNIT 5 CONCEPT OF SUSTAINABLE DEVELOPMENT   9

Definition of sustainability -Components of sustainability History and emergence of the concept of sustainable development – Our Common Future - Objectives of Sustainable Development - Millennium Development Goals - Environment and Development linkages – Globalization and environment -Sustainability indicators-Hurdles to Sustainability.

Lecture: 45,   TOTAL: 45

COURSE OUTCOMES:

1   To understand & appropriate the structure of ecosystem and its impact on environment.
2   To understand the various natural resources and biodiversity
3   To recognize the environmental problems caused due to pollution.
4   To understand the concept of sustainable development

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2			3									2		
CO2	1			2				2					2	1	
CO3	1	2		3						1			2	1	1
CO4		2						2					2		

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

REFERENCES:

1.   R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2.   Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2011.
3.   Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4.   Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
315EET03	Network Analysis and Synthesis	3	0	0	3	50	50	100

Prerequisite: Basic knowledge in Circuit Theory is required Objectives:

To study about
- Time response of RL,RC and RLC circuits for different sources
- Complex frequency, Pole -Zero concepts and Fourier analysis
- One and Two port network parameters
- Design of various filters
- Synthesis of networks

UNIT – I   DUALITY AND TOPOLOGY   09

Concept of duality, Dual network, Graphs of a network, Trees, Chords and branches, Tie set and cut set of a graph, Application to network analysis.

UNIT - II   S- DOMAIN ANALYSIS AND FOURIER ANALYSIS   09

Concept of complex frequency - Significance of poles and zeros -Necessary conditions for driving point function – Time domain response from pole-zero configurations - Fourier series representation of different waveforms - Trigonometric and complex forms - Fourier integral and Fourier transforms.

UNIT - III   ONE PORT AND TWO PORT NETWORKS   09

Driving point impedance and admittance of one port networks - Two port networks: Z, Y, ABCD and h parameters -Inter relationships of two port network parameters - Image parameters - Interconnection of two port networks - T and π representation- Impedance matching.

UNIT - IV   FILTERS AND ATTENUATORS   09

Filters: Characteristics of ideal filters - Low pass, High pass and Band pass filters– Constant –k and m – derived filters. Attenuators: T-Type, π-Type, Lattice, Bridged-T and L-Type Attenuator.

UNIT - V   ELEMENTS OF NETWORK SYNTHESIS   09

Hurwitz polynomials - PR function - Necessary and sufficient conditions of PR function - Properties of driving point impedance - Synthesis of LC,RL and RC networks by Foster I ,II and Cauer I , II methods.

Lecture: 45, TOTAL: 45 HRS

Course Outcomes:
- CO1 Gained the knowledge of network topology.
- CO2 Learnt about apply fourier transforms to analyze electrical networks.
- CO3 Learnt network functions and two-port parameters.
- CO4 Able to design k and m filters and exposure to synthesis techniques.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2		1		2										
CO2	3		2		2				1					1	
CO3	1						2			2			2		1
CO4		1			2										

TEXT BOOKS

1. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis", TataMcGraw HillPublishers, 4th Edition, 2010.
2. Ravish R Singh, "Network Analysis and Synthesis", Tata McGraw Hill Publishers, 2013.
3. Arumugam .M and Premkumar .N, Electric circuit theory, Khanna Publishers, New Delhi,2006.
4. G.K. Mithal, "Network Anlaysis", Khanna Publishers, New Delhi, 2011.

REFERENCE BOOKS

1. Umesh Sinha, "Network Analysis And Synthesis,"Sathya Prakasan Publishers Limited, NewDelhi, Fifth edition, 1992.
2. Soni M.L and Gupta J.C, "Electrical circuit Analysis", Dhanpat Rai and Sons, Delhi, 1990
3. Edminister, J.A., 'Theory and Problems of Electric Circuits', Schaum's outline seriesMcGraw Hill Book Company, 5thEdition, 2010.
4. Network Analysis- Vanverkimbark.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ELECTRO	L	T	P	C	CA	EA	Total
315EET04	MAGNETIC THEORY	3	0	0	3	50	50	100

Prerequisite: Nil

Objectives: To enable the students to have a fair knowledge about the theory and problems in Electromagnetic Fields.

1. To introduce the basic mathematical concepts related to electromagnetic fields.
2. To understand the concepts of Electrostatics.
3. To understand the concepts of Magneto statics.
4. To understand the concept of Electromagnetic Fields,
5. To understand the concepts of waves and wave propagation.

UNIT – I   INTRODUCTION   9

Introduction: Co-ordinate systems and transformation, Cartesian coordinates, Circul cylindrical coordinates, Spherical coordinates & their transformation. Differential length, are and volume in different coordinate systems. Numerical problems.

Vector calculus: DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Stokes theorem, Classification of vector fields, Numerical problems.

UNIT - II   ELECTROSTATIC FIELD   9

Coulomb's law, field intensity, Gauss's law and applications, Electric potential and Potential gradient, Relation between E and V, Electric dipole and flux lines. Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor –dielectric, Conductor-free space. Poisson's and Laplace's equation. Numerical problems.

UNIT - III   MAGNETO STATIC FIELDS   9

Biot- savart law, Ampere's circuital law, Magnetic flux density, Magnetio static and Vector potential, Forces due to magnetic field, Magnetic torque, Magnetic material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy density. Numerical problems.

UNIT - IV   ELECTROMAGNETIC FIELDS   9

Faraday's law of electromagnetic induction, Transformer and motional emf, Displacement current, Maxwell's equations, Maxwell's equations in differential and integral form. Relation between field theory and circuit theory Numerical problems.

UNIT - V   ELECTROMAGNETIC WAVE PROPAGATION   9

Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power &Poynting vector, Reflection of a plane wave at normal incidence, reflection of a plane wave at oblique incidence, Polarization. Numerical problems

Total Hours: 45

Course Outcomes:

CO1 Learnt mathematical operations related to fields and laws related to electrostatic fields.

CO2 Gained the knowledge of Poisson's and Laplace's equations

CO3 Acquired the knowledge of Biot-Savart's Law and Ampere's Circuital law.

CO4 Gained the understanding of the Maxwell's equations and principles of propagation of uniform plane waves

	Programme Outcomes											Programme Specific Outcomes		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
CO1	2				2										
CO2		3		1				1					2		
CO3													2	1	
CO4	2		2		1		2								1

TEXT BOOKS:

1. Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford university press. 2007
2. Engineering Electromagnetic, William.H. Hayt& J.A. Buck, 7th Edition, TMH, 2001
3. Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH, 1993
4. Electromagnetic field theory fundamentals, Guru &Hizroglu, 2nd edition, Cambridge University Press.2000.

REFERENCES

1. Electromagnetic with application, Krause, 5th Edition, TMH. 1999.
2. Elements of Engineering Electromagnetic, N.N. Rao, 6th Edition, Pearson Education 2000.
3. K. A. Gangadhar and P. M. Ramanathan, 'Electromagnetic Field Theory', Khanna Publishers, Delhi 2009.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315EET05	LINEAR INTEGRATED CIRCUITS AND APPLICATIONS	3	0	0	3	50	50	100

Prerequisite: Basic knowledge in Electron Devices and Circuits is required

Objectives:

    i.   To study the IC fabrication procedures.

    ii.   To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.

    iii.   To study the applications of Op-amp.

    iv.   To study internal functional blocks and the applications of special ICs like Timers, PLL circuits, regulator Circuits.

UNIT – I   IC FABRICATION   9

Fundamentals of Integrated Circuits, IC classifications, fundamentals of monolithic IC technology, Basic Planar Processes, Realisation of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, transistor and FETs.

UNIT - II   CHARACTERISTICS OF OP AMP   9

OP-AMP -block diagram, Ideal OP-AMP characteristics, virtual ground concept, differential amplifiers , DC characteristics, AC characteristics; frequency response of OP-AMP circuits; summer, differentiator and integrator.

UNIT - III   APPLICATIONS OF OP AMP   9

Precision rectifier, half wave and full wave rectifiers, clippers, clampers, peak detectors, Instrumentation amplifier, V/I and I/V converters, S/H circuit, comparators and their applications, monostable&astablemultivibrators, sine and triangular wave generators, first-and second-order active filters,log and antilog amolifier.

UNIT - IV   SPECIAL ICs   9

555 Timer Functional block diagram and description – Monostable and Astable operation, Applications, 566 Voltage Controlled Oscillator, 565 PLL Functional Block diagram – Principle of operation, Building blocks of PLL, Characteristics, Derivations of expressions for Lock and Capture ranges, Applications of PLL: Frequency synthesis, AM and FM detection, FSK demodulator, Motor speed control.

UNIT - V   APPLICATION ICs   9

IC voltage regulators – 78xx, 79xx, LM317, 723 regulators, switching regulator: SMPS, 78S40. LM 380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler IC.

Total Hours: 45

Course Outcomes:

CO1 Obtained the knowledge of ICs and their applications

CO2 Ability to fabricate and design the circuits using ICs.

CO3 Able to analyze and describe the characteristics of Op amps.

CO4 Learnt about Timers, PLL circuits and regulator Circuits

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2														
CO2	2	1						2					2	1	
CO3		1			1					1			1		1
CO4	2			1											

TEXT BOOKS:

1. RamakantA.Gayakward, 'Op-amps and Linear Integrated Circuits', IV edition, Pearson Education, 2003/ PHI. (2000)
2. D.RoyChoudhary, SheilB.Jain, 'Linear Integrated Circuits', II edition, New Age, 2003

REFERENCES

1. Jacob Millman, Christos C.Halkias, 'Integrated Electronics - Analog and Digital circuits system', Tata McGraw Hill, 2003.
2. Robert F.Coughlin, Fredrick F.Driscoll, 'Op-amp and Linear ICs', Pearson Education, 4th edition, 2002 / PHI.
3. David A.Bell, 'Op-amp & Linear ICs', Prentice Hall of India, 2nd edition, 1997.
4. Sedra and Smith, "Microelectronic Circuits", Oxford University Press, Fifth Edition, 2004.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	MEASUREMENTS	L	T	P	C	CA	EA	Total
315EEE06	AND INSTRUMENTATION	3	0	0	3	50	50	100

Prerequisite: Nil

Objectives:
1. To make the student have a clear knowledge of the basic laws governing the operation of the instruments, relevant circuits and their working.
2. Introduction to general instrument system, error, calibration etc.
3. Emphasis is laid on analog and digital techniques used to measure voltage, current and power etc.
4. To have an adequate knowledge of comparison methods of measurement.
5. Elaborate discussion about storage & display devices and exposure to various transducers and data acquisition systems.

UNIT – I INTRODUCTION 9

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

UNIT - II ELECTRICAL AND ELECTRONICS INSTRUMENTS 9

Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeter's and energy meters– Magnetic measurements –Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of frequency and phase.

UNIT - III COMPARISON METHODS OF MEASUREMENTS 9

D.C & A.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening –Electrostatic and electromagnetic interference.

UNIT - IV STORAGE AND DISPLAY DEVICES 9

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

UNIT - V TRANSDUCERS AND DATA ACQUISITION SYSTEMS 9

Classification of transducers – Selection of transducers – Resistive, capacitive & inductive transducers – Piezoelectric, optical and digital transducers – Elements of data acquisition system – A/D, D/A converters – Smart sensors.

Lecture : 45, TOTAL : 45

Course Outcomes:
- CO1 Learnt the concept of instrumentation system.
- CO2 Obtained knowledge of operation of instruments, relevant circuits and working
- CO3 Gained the knowledge of analog and digital techniques to measure voltage, current, energy and power.
- CO4 Understood about storage, display devices and various transducers.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	2												2		
CO2	2			2		2	1						2		1
CO3		1	1		1		3				3		3	2	1
CO4		2												2	

TEXT BOOKS

1   E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishing company, 2003
2   A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', DhanpatRai and Co, 2004

REFERENCE BOOKS

1   A.J. Bouwens, 'Digital Instrumentation', Tata McGraw Hill, 1997
2   D.V.S. Moorthy, 'Transducers and Instrumentation', Prentice Hall of India Pvt Ltd, 2007.
3   H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw Hill, II Edition 2004
4   Martin Reissland, 'Electrical Measurements', New Age International (P) Ltd., Delhi, 2001.
5   J. B. Gupta, 'A Course in Electronic and Electrical Measurements', S. K. Kataria& Sons, Delhi, 2003.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315EEP07	LINEAR INTEGRATED CIRCUITS LABORATORY	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:
1. To understand the basics of linear integrated circuits and available ICs
2. To understand characteristics of operational amplifier
3. To apply operational amplifiers in linear and nonlinear applications
4. To acquire the basic knowledge of special function ICs

LIST OF EXPERIMENTS

1 Inverting and Non inverting amplifiers.
2 Differential amplifiers and precision rectifier(either half wave (or)full wave)
3 Integrator and Differentiator.
4 Active low-pass and High-pass filters.
5 Astable&Monostablemultivibrators using op-amp.
6 Schmitt Trigger and VCO 566.
7 RC Phase shift oscillator using op-amp.
8 Wien bridge oscillators using op-amp.
9 Astable and monostablemultivibrators using 555 Timer.
10 DC power supply using LM317 and LM723.
11 Voltage controlled oscillator (VCO).
12 Measurement of slewrate characteristics of op-amp.

Practical= 45 Total = 45

Course Outcomes:

CO1 Learnt about the characteristics of op-amp
CO2 Gained the knowledge to analyze basic applications using op-amps.
CO3 Acquired knowledge to design power supply and multi-vibrator circuits.
CO4 Obtained knowledge to design and construct waveform generators

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2										3	2		1
CO2	3	2	2				2						2	2	1
CO3	3	2								2			3		
CO4	3												3	2	

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315EEP08	ELECTRICAL AND ELECTRONICS CIRCUITS SIMULATION LAB	0	0	4	2	50	50	100

Prerequisite: Knowledge of Electronic Devices is needed

Objectives:

1. To understand the basics of simulation software.
2. To simulate the characteristics of amplifier circuits.
3. To simulate the filter circuits
4. To simulate and test the various oscillators.

LIST OF EXPERIMENTS

1   Introduction to simulation software
2   Rectifiers
3   BJT Switch
4   BJT Amplifiers I
5   BJT Amplifiers II
6   MOS Amplifiers
7   Operational amplifiers I
8   Operational amplifiers II
9   Instrumentation amplifiers
10 Active low-pass, High-pass and band-pass filters.
11 Astable&Monostablemultivibrators and Schmitt Trigger using op-amp.
12 Phase shift and Wien bridge oscillators using op-amp.
13 Astable and monostablemultivibrators using NE555 Timer.

Practical= 45 Total = 45

Course Outcomes:

CO1   Learnt about the basics of simulation software.
CO2   Gained the knowledge to simulate and to analyze the characteristics of amplifier circuits.
CO3   Acquired knowledge to simulate filter circuits.
CO4   Obtained knowledge to simulate and test the various oscillators.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3							3							
CO2	3	2	2										1		2
CO3	3	2				2						2		3	
CO4	3	2											1		
CO5	3	2										2			1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
315EEP09	MEASUREMENTS AND INSTRUMENTATION LAB	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:

1. To train the students in the measurement of displacement, resistance, inductance and capacitance
2. To give exposure to A/D and D/A converters.
3. To Calibrate single-phase energy meter
4. To measure the three phase power and power factor

LIST OF EXPERIMENTS

1. AC bridges - Measurement of inductance, capacitance – Maxwell Bridge – Schering bridge – Anderson bridge
2. DC bridges - Wheatstone bridge – Kelvin double bridge.
3. Instrumentation amplifiers
4. A/D and D/A converters
5. Characteristics of LVDT
6. Calibration of single-phase energy meter
7. Calibration of current transformer
8. Measurement of three phase power and power factor
9. Measurement of iron loss
10. Characteristic of pressure transducers
11. Characteristic of LDR

Practical= 45 Total = 45

Course Outcomes:

CO1 Gained knowledge to measure displacement, resistance, inductance and capacitance

CO2 Learnt about A/D and D/A converters.

CO3 Acquired knowledge to calibrate single-phase energy meter

CO4 Understood measurement of three phase power and power factor

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2								2			2	2	2
CO2	3	2								2			2	2	1
CO3		2		2						2			2		
CO4	2												2		1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415NMT01	NUMERICAL METHODS	3	1	0	4	50	50	100

Objectives
- To solve equations using direct and iterative methods.
- To introduce interpolation techniques to determine the intermediate values of a function from a given set of values in ordered pairs.
- To study the principle of numerical differentiation and integration using interpolation.
- To learn some of the methods of numerical solutions of ordinary differential equations with initial conditions.
- To determine the solutions of boundary value problems using numerical iterative processes

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 12
Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Eigenvalues of a matrix by Power method.

UNIT II INTERPOLATION AND APPROXIMATION 12
Interpolation with equal intervals - Newton's forward and backward difference formulae - Interpolation with unequal intervals - Lagrange interpolation – Newton's divided difference interpolation.

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 12
Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 12
Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIALEQUATIONS 12
Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank-Nicholson) methods - One dimensional wave equation by explicit method.

Lecture:45, Tutorial:15, TOTAL:60

Course Outcomes

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

CO1   Apply numerical methods such as direct iterative and interpolation to solve algebraic or transcendental equations and system of equations.

CO2   Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems.

CO3   Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations.

CO4   Demonstrate algorithms using finite differences to obtain solutions to boundary value problems.

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2											2		2
CO2	3	2				1		3					2		
CO3	2	2	1									2		2	2
CO4	3		1					2							

TEXT BOOKS

1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2012.

2. Kandasamy.P,Thilagavathy,K.,&Gunavathi.K., "Numerical Methods"., S.Chand & Company Ltd., New Delhi, 2014.

REFERENCES

1. Richard L.Burden and J.Dougles Faires, "Numerical Analysis", Ninth Edition, BROOKS/COLE, Cengage.com.,2012. Visit www.cengage.com/international.
2. S.S.Sastry, "Introductory Methods of Numerical Analysis", 5th Edition, Prentice Hall of India Private Ltd., New Delhi, 2012.
3. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 2nd Edition Prentice Hall of India Private Ltd., New Delhi, 2005.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415EET02	CONTROL SYSTEMS	3	1	0	4	50	50	100

Prerequisite: Electric Circuits, Engineering Mathematics-III

Objectives:

1. To make the student to understand the methods of obtaining the open-loop and closed–loop systems.
2. To make them understand the methods of representation of systems and to derive their transfer function.
3. To make them gain knowledge in the time-domain and frequency domain response of systems
4. To make them analyze the stability of the systems
5. To design the compensators that can be used to stabilize control systems

UNIT I   CONTROL SYSTEM MODELING   12

Basic Elements of Control System - Open loop and Closed loop systems – Differential equation - Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems - Block diagram reduction Techniques - Signal flow graph

UNIT II   TIME RESPONSE ANALYSIS   12

Time response analysis - First Order Systems - Impulse and Step Response analysis of second order systems - Steady state errors - P, PI, PD and PID Compensation, Analysis using MATLAB

UNIT III   FREQUENCY RESPONSE ANALYSIS   12

Frequency Response-Bode Plot, Polar Plot, Nyquist Plot - Frequency Domain specifications from the plots - Constant M and N Circles - Nichol's Chart - Use of Nichol's Chart in Control System Analysis. Lead, Lag, and Lead Lag Compensators, Analysis using MATLAB.

UNIT IV   STABILITY ANALYSIS   12

Stability, Routh-Hurwitz Criterion, Root Locus Technique, Construction of Root Locus, Stability, Dominant Poles, Application of Root Locus Diagram - Nyquist Stability Criterion - Relative Stability, Analysis using MATLAB.

UNIT V   STATE VARIABLE ANALYSIS   12

State space representation of Continuous Time systems - State equations - Transfer function from State Variable Representation - Solutions of the state equations - Concepts of Controllability and Observability, Analysis using MATLAB.

Lecture : 45, Tutorial : 15, TOTAL : 60

Course Outcomes:

CO1　Ability to Understand the basic concepts of open-loop and closed–loop of systems

CO2　Ability to understand the basic concept of systems and to derive their transfer function models.

CO3　Analyzing the time-domain and frequency response of systems and steady state error analysis

CO4　Ability to analyze the concept of stability of control systems and design compensator.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3			2									2		2
CO2	2	2										2	2	2	
CO3	3	2	2					2					2		
CO4	3	3									2	3	1		2

TEXT BOOKS:

1. Nagrath I J and Gopal M, "Control System Engineering ", New Age International Pvt Ltd, Fifth Edition, 2008.
2. Ogata K, "Modern Control Engineering", Prentice-Hall of India Pvt Ltd., New Delhi, 2010.

REFERENCE BOOKS:

1. Norman S. Nise, Control Systems Engineering, 4th Edition, John Wiley, New Delhi, 2007.
2. Samarajit Ghosh, Control systems, Pearson Education, New Delhi, 2004.
3. Benjamin C. Kuo, Automatic Control systems, Pearson Education, New Delhi, 2003.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	DIGITAL	L	T	P	C	CA	EA	Total
415EET03	ELECTRONIC CIRCUITS	3	0	0	3	50	50	100

Prerequisite: Basic Knowledge in Electron Devices

Objectives:

1. To study various number systems and to simplify the mathematical expressions using Boolean functions –simple problems
2. To study the implementation of combinational circuits
3. To study the design and analysis of various synchronous sequential circuits.
4. To study the design and analysis of various asynchronous sequential circuits.
5. To expose the students to various memory devices.

UNIT – I   BOOLEAN ALGEBRA AND LOGIC GATES   9

Review of number systems; types and conversion, Codes- BCD, Gray,EX-3code, Error detection and correction codes, Code conversion, Logic Gates, Boolean algebra – Basic Postulates and theorems, Switching functions, Canonical forms and simplification using K-maps and Quine McCluskey method.

UNIT - II   COMBINATIONAL CIRCUITS   9

Implementing Combinational Logic - Design of half adder and full adder, half and full-subtractor, magnitude comparators, code converters, encoders, decoders, multiplexers and demultiplexers. Function realization using gates and multiplexers.

UNIT - III   SYNCHRONOUS SEQUENTIAL CIRCUITS   9

Basic Concepts, Flip-Flops, Analysis of RS, JK, Master Slaves, T and D Flip-Flop, Controlled Registers, Registers and their applications, Synchronous and asynchronous counters, Controlled Counters, Up/Down counters, Ring counter. Analysis of synchronous sequential circuits; design of synchronous sequential circuits – Completely and incompletely specified sequential circuits - state diagrams, state reduction, state assignment.

UNIT - IV   ASYNCHRONOUS SEQUENCTIAL CIRCUITS   9

Mealy and Moore models, analysis procedure - circuit with latches - design procedure reduction of state and flow tables- race free state assignment- Hazards - Design problems.

**UNIT – V   MEMORY DEVICES, PROGRAMMABLE LOGIC   9
                    DEVICES AND LOGIC FAMILIES**

Memories: Read only memories, PROMs, EPROMs, EEPROMs, RAMs: Static RAM, Dynamic RAM, Magnetic memories, CD-ROM, Flash memories.
Introduction to Programmable Logic Devices: PLA, PAL, Generic array logic, EPLD, FPGA.
Introduction to Various Logic Families: TTL, CMOS, ECL.

TOTAL : 45

Course Outcomes:

CO1   Gained the knowledge of fundamental concept of various number systems

CO2   Ability to Implement simple combinational logic circuits using logic gates, multiplexers and decoders.

CO3   Able to design of various synchronous sequential circuits.

CO4   Able to design of various asynchronous sequential circuits

CO5   Understood about semiconductor memories, PLDs and digital logic families.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1		2											3	2	2
CO2	3	2													
CO3	3	2	2	3								3			2
CO4	3				3				3				2	3	
CO5	3												2	2	2

TEXT BOOKS

1   M. Morris Mano, 'Digital Design', Pearson Education, 2013.

2   Raj Kamal, ' Digital systems-Principles and Design', Pearson education 2nd edition, 2007

3   John M.Yarbrough, 'Digital Logic, Application & Design', Thomson, 2002.

REFERENCE BOOKS

1   Charles H.Roth, 'Fundamentals Logic Design', Jaico Publishing, IV edition, 2002.

2   Floyd and Jain, 'Digital Fundamentals', 8th edition, Pearson Education, 2003.

3   John F.Wakerly, 'Digital Design Principles and Practice', 3rd edition, Pearson Education, 2002.

4   Tocci, "Digital Systems : Principles and applications, 8th Edition" Pearson Education.

Course code	Course name	Hours/week			Credit	Maximum mark		
		L	T	P	C	CA	EA	Total
415EET04	**Power Generation Systems**	3	0	0	3	50	50	100

Course Objective(s)	1. To understand the generation of electric power by steam and gas Power Station.
	2. To understand the generation of electric power by hydro power station.
	3. To understand the generation of electric power by nuclear and diesel power station.
	4. To understand the various types of wind energy conversion system.
	5. To understand the generation of electric power by solar energy

Prerequisites: Nil

UNIT I   STEAM AND GAS POWER PLANT   9

Introduction: Generation of electric power from Conventional and non-conventional sources of energy.
Steam Power Station: Schematic arrangement, advantages and disadvantages, choice of site selection, Types of prime movers, Environmental aspects.
Gas Turbine Power Plant: Schematic arrangement, advantages and disadvantages of Gas turbine power plant. Open cycle and Closed cycle gas turbine power plant, Combined cycle power plant, Comparison of various power plants

UNIT II   HYDRO POWER STATION   9

Schematic arrangement, advantages and disadvantages, choice of site constituents of hydro power plant, Hydro turbine. Types of hydro power station- pumped storage plant-Environmental aspects for selecting the sites and locations of hydro power stations

UNIT III   NUCLEAR AND DIESEL POWER STATION   9

Nuclear power station: Schematic arrangement, advantages and disadvantages, selection of site, types of reactors, Hazards, Environmental aspects for selecting the sites and locations of nuclear power stations.

Diesel power station: Introduction, Schematic arrangement, advantages and disadvantages, Choice and characteristic of diesel engines-auxiliaries.

UNIT IV   WIND ENERGY   9

Introduction-Basic principles of wind energy conversion-site selection considerations-basic components of WECS (wind energy conversion system)-Classification of WECS-Advantages and disadvantages-Energy storage-Applications.

UNIT V   SOLAR ENERGY   9

Photovoltaic Power Conversion systems: Solar radiation spectrum, Radiation measurement-Applications of solar thermal systems- Solar Photovoltaic(SPV) systems- Block diagram of general SPV system -Applications of Solar Photovoltaic systems

Course Outcomes:

CO1 Understanding the working of steam and gas power plant thermal power station (TPS) using single line diagram and state the functions of the major equipment and auxiliaries of a Steam power plant.

CO2 Understanding the working of hydro energy conversion process with block diagrams and identify the appropriate site for it.

CO3 Understanding the working of Nuclear and Diesel power station

CO4 Understanding the various components of Wind Energy Conversion system

CO5 Understanding the performance analysis of Solar cell

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3											1	1		2
CO2		2											2	2	
CO3	3	2	2					1					1	2	
CO4	3		2	2							1		2	2	2
CO5	2												2		

TEXT BOOKS:
1. Renewable Energy Technologies, Solanki, Chetan S. , PHI Learning, New Delhi, 2011
2. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, Dhanpat Rai Publication
3. Wind Power Technology, Earnest, Joshua, PHI Learning, New Delhi, 2013
4. Electric Power Generation: Transmission and Distribution, S. N. Singh, PHI Learning,

REFERENCE BOOKS:

1. Electrical Power, Dr. S.L. Uppal, Khanna Publishers, 13th Edition 2009
2. Renewable Energy Sources for Sustainable Development, N.S. Rathore and N. L. Panwar, New India Publishing Agency, New Delhi
3. Wind Power in Power System, Thomas Ackermann, John Willey &Sons, 2005

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415EET05	ELECTRICAL MACHINES –I	3	0	0	3	50	50	100

Prerequisite: Basic knowledge in Electromagnetic Theory is required

Objectives:

1. To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.

2. To understand the working principle generation of D.C. voltages by using different types of generators.

3. To study the working principles of D.C. motors and their load characteristics, starting and methods of speed control. and study their performance

4. To study the starting and methods of speed control of D.C. motors.

5. To study the working principles of transformers, autotransformer and the different testing methods to estimate their performance.

UNIT – I   BASIC CONCEPTS IN ENERGY CONVERSION AND ROTATING MACHINES   **12**

Principle of energy conversion-Energy in magnetic systems-singly excited system: Electrical input energy, magnetic field energy stored and co-energy. multiply excited system, Generated EMF - MMF of distributed windings: MMF space wave of single coil– magnetic fields in rotating machines.

UNIT- II DC GENERATORS   **12**

Principle of operation, Constructional details, Armature Windings, EMF equation, Methods of Excitation –Types of DC Generators: Separate, shunt, series and compound. Armature reaction, Commutation, Interpoles, Compensating windings- losses -Numerical problems-Applications.

UNIT- III DC MOTORS   **12**

Principle of operation – Torque equation- Lenz's law-Back EMF- Types of DC Motors: shunt, series and compound-Electrical and Mechanical characteristics of DC shunt series and compound motors. Starters: 2 point, 3 point and 4 point. Losses and efficiency- Numerical problems –Applications.

UNIT- IV TESTING AND SPEED CONTROL OF DC MACHINES   **12**

Testing: O.C.C. and load test on separately and self-excited DC Generators - Brake test – Swinburne's test –Hopkinson's test on motor - advantages and dis advantages.

Speed control: Armature and field control on Shunt motor - Ward-Leonard control system - advantages and dis advantages - Applications.

UNIT – V   TRANSFORMER   **12**

Principle of operation – Constructional details, Classification of Transformers, EMF equation, Transformation ratio, Transformer on no-load and load. Equivalent circuit - Voltage regulation, Losses, Efficiency, All day efficiency-Ideal transformers – Open circuit and short circuit tests, Sumpner's test. Separation of no load losses – condition of Parallel operation-Numerical problems -Applications.

Auto-Transformer – Principle of operation – Saving of copper –Three phase Transformer connections – Applications.

Lecture : 45, Tutorial : 15, TOTAL : 60

Course Outcomes:

CO1   Learning the basic concepts of rotating machines and electromechanical energy conversion systems .

CO2   Learning the working principles, performance, as well as to identify, formulate and solve machine related problems on DC Generators.

CO3   Learning the working principles, performance, as well as to identify, formulate and solve machine related problems on DC Motors.

CO4   Gained knowledge in testing and speed control on DC machines.

CO5   Understood the functions of transformer and autotransformer.

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3												2	2	2
CO2	3			3		3						2			
CO3	2	2		3		3							2	2	
CO4	2	2		3								2			2
CO5	2													1	

TEXT BOOKS

1   Nagrath I. J and Kothari D. P. 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 1990.

2   P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

3   B.L. Theraja, 'A text book of Electrical Technology', Volume II , S. Chand Limited. 2008.

REFERENCE BOOKS

1   Fitzgerald.A.E. Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', McGraw Hill Books Company, 1992.

2   P. C. Sen., 'Principles of Electrical Machines and Power Electronics', John Wiley&Sons, 1997

3   K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2002.

4   Cotton H, "Advanced Electrical Technology", A H Wheeler and Company Publications, London, 1990.

		L	T	P	C	CA	EA	TOTAL
415EOE06	**OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES**	3	0	0	3	50	50	100

(Common to EIE and EEE)

COURSE OBJECTIVE:

- To comprehend the fundamentals of object oriented programming in C++.

- To implement the linear and non-linear data structures.

- To introduce sorting and searching techniques.

- To familiarize with the applications of various data structures.

Prerequisite: Fundamentals of Computing and C Programming

UNIT-I   DATA ABSTRACTION & OVERLOADING   9

Introduction to C++ programming – Class Scope and Accessing Class Members – Constructors – Destructors – Object and Member Functions – Friend Function –this pointer - Dynamic Memory Management with operators new and delete – Static Class Members – Data abstraction and Information binding - Container Classes and Iterators – Proxy Classes.

UNIT-II   INHERITANCE & POLYMORPHISM   9

Base Classes and Derived Classes – Protected Members – Protected members – Constructors and Destructors in derived Classes – Public, Protected and Private inheritance - Polymorphism Examples - Function Overloading and Operator Overloading – Abstract Classes and Pure Virtual functions – Dynamic Binding – Virtual Destructors.

UNIT-III   LINEAR DATA STRUCTURES   9

Abstract Data Types - Arrays and its representations – Stacks and Queues – Linked lists – Linked list based implementation of Stacks and Queues – Evaluation of Expressions – Linked list based polynomial addition – Applications of stacks & queues.

UNIT-IV   NON-LINEAR DATA STRUCTURES   9

Trees – Binary Trees – Binary tree representation and traversals – Threaded binary trees – Binary Search tree – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Connected components.

UNIT-V   SORTING & SEARCHING   9

Insertion sort – Merge sort – Quick sort – Heap sort – Hashing - Hash function - Static hashing - Dynamic hashing - Linear Search – Binary Search.

TOTAL: 45

COURSE OUTCOMES

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

CO1: Understand the fundamentals of object oriented programming concepts,

particularlyin C++.

CO2: Design applications using inheritance and polymorphism.

CO3: Apply object oriented programming concepts to implement Linear Data Structures.

CO4: Implement Non-linear Data Structures using C++.

CO5: Design applications using sorting and searching techniques.

	Programme Outcomes											**Programme Specific Outcomes**		
	a	**b**	**c**	**d**	**e**	**f**	**g**	**h**	**i**	**j**	**k**	**l**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2								2			3	2	
CO2	3	2											2	2	2
CO3	3	2						2					2	2	
CO4	3	2	2										1		2
CO5	3		2									2	1		

TEXT BOOk

1. Deitel and Deitel, - "C++, How To Program", Sixth Edition, Prentice Hall of India Pvt. Ltd, 2008.
2. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", Universities Press (India) Pvt. Ltd., 2008.

REFERENCE BOOKS:

1. Mark Allen Weiss, - "Data Structures and Algorithm Analysis in C++", Third Edition, Addison-Wesley, 2007.

2. Bhushan Trivedi, - "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press, 2010.

3. Goodrich, Michael T., Roberto Tamassia, -"David Mount. Data Structures and Algorithms in C++ ", 7th Edition, Wiley. 2004.

4. Yedidyah, Augestein, Tannenbaum, "Data Structures Using C and C++ "Pearson Education India; Second Edition, 2015.

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E-REFERENCE(S):

1. http://nptel.ac.in/courses/106105085/

2. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-01sc-introduction-to-electrical-engineering-and-computer-science-i-spring-2011/unit-1-software-engineering/object-oriented-programming/

3. http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-006-introduction-to-algorithms-fall-2011/lecture-videos/.

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Krishnagiri (Dt), Tamil Nadu.

415EEP07

L	T	P	C	M
0	0	3	2	100

AIM

To provide a platform for understanding the basic concepts of linear control theory and its application to practical systems.

OBJECTIVE

To impart knowledge on transfer function of various machines, stability analysis, digital simulation of first order and second order systems and stepper motor control.

LIST OF EXPERIMENTS

1   Transfer function of separately excited DC Generator.
2   Transfer function of self-excited DC Generator
3   Transfer function of Armature controlled DC Motor.
4   Transfer function of Field controlled DC Motor.
5   Transfer function of AC Servomotor.
6   DC and AC position control systems.
7   Stepper motor control system.
8   Digital simulation of first order and second order system using MATLAB.
9   P, PI and PID Controllers (First Order).
10 Design of Lag network.
11 Design of Lead network.
12 Design of Lag-Lead network.

Practical Total = 60

Course Outcomes:

CO1   Analyzing the Transfer function of separately excited DC generators.
CO2   Analyzing and Transfer function of self-excited DC generators.
CO3   Able to analyzing speed of DC motor.
CO4   Understanding the various position control systems.
CO5   Learning the various controllers and networks.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3										2		2		
CO2	3				1									2	2
CO3	3	3							3				2	1	
CO4	3	2			1						2	2		1	2
CO5		1											2		1

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
415EEP08	ELECTRICAL MACHINES LABORATORY – I	0	0	3	2	50	50	100

Objectives:

To study the various characteristics of DC machines and transformer experimentally

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of a separately excited DC Generator
2. Open circuit and load characteristics of self-excited DC shunt generator.
3. Load characteristics of DC compound generator with differential and cumulative connection.
4. Load characteristics of DC shunt motor
5. Load characteristics of DC series motor.
6. Load characteristics of DC compound motor
7. Speed control of DC shunt motor.
8. Swinburne's test.
9. Hopkinson's test on DC motor – generator set.
10. Load test on single-phase transformer.
11. Open circuit and short circuit tests on single phase transformer
12. Separation of no-load losses in single phase transformer

Practical Total = 60

Course Outcomes:

CO1 Analyzing the characteristics of DC generators.
CO2 Analyzing and test of different DC motors.
CO3 Able to analyzing speed and efficiency of DC machines.
CO4 Understanding the various tests on transformers.
CO5 Learning the various connections of transformers

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1		2		1					2				3		
CO2	3		2	1					2			3	2	2	
CO3	3	2	2						1				2	3	2
CO4	3											3			
CO5	3	2												2	

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	L	T	P	C		CA	EA	TOTAL
415EOP09 DATA STRUCTURES LABORATORY	0	0	3	2		50	50	100

(Common to EIE and EEE)

OBJECTIVE(S):

- To learn object oriented programming concepts.
- To implement various data structures using C++.
- To illustrate the concepts of infix, prefix and postfix.
- To implement the sorting techniques.

Prerequisite: Fundamentals of Computing and C Programming.

LIST OF EXPERIMENTS:

Implement the following programs using C++.

1. Basic Programs using C++.

i. Constructors & Destructors,

ii. Function overloading,

iii. Operator Overloading

iv. Types of Inheritance

2. Array Implementation of List Abstract Data Type (ADT).

3. Linked List Implementation of List Abstract Data Type (ADT).

4. Stack ADT – Array and Linked list Implementations.

5. Implementation of Stack to convert Infix Expressions to Postfix Expressions.

6. Queue ADT - Array and Linked list Implementations.

7. Binary Search Tree Implementations.

8. Implementation of Graph Traversals and Finding shortest path using Graph.

9. Hash Table –Separate chaining.

10. Implementation of Searching

   i. Linear Search.

   ii. Binary Search.

11. Implementation of Sorting – Quick sort   **Total: 60**

COURSE OUTCOMES

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

CO1: Develop programs using oops concept.

CO2: Design and implement C++ programs for manipulating stacks, queues, linked lists.

CO3: Apply the different data structures for implementing solutions to practical problems

CO4: Demonstrate the Infix. Prefix and Postfix notations using C++ programs.

CO5: Implement sorting techniques using C++ programs.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3		2							2			3		3
CO2	3	2						2				2	2		
CO3	2	2								2			2	2	2
CO4	3	3	2										2	3	
CO5	3		2							2					2

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C	CA	EA	Total
515EET01		3	0	0	3	50	50	100

Pre – Requisite: Knowledge of Linear Integrated Circuits and Applications is required

COURSE OBJECTIVES:
- To get familiarized with architecture, addressing modes and instruction of 8085 & 8086 microprocessor
- To get exposed to high Performance and advanced architectures
- To gain knowledge on essential peripherals and the associated interfacing ICs
- To get acquainted with 8-bit microcontroller and be able to program in assembly language
- To design microcontroller based system/application

UNIT I   ARCHITECTURE OF 8085 AND 8086 PROCESSOR   9

Evolution of Microprocessors – Introduction to 8085 – Architecture – Addressing Modes – Timing diagrams – Introduction to 8086 – Architecture –Maximum mode – Minimum mode – Addressing Modes and Programming

UNIT II   ADVANCED ARCHITECTURES   9

Pipeline concepts and Performance – Superscalar Processing – Hardware Accelerators – Multiprocessor – RISC and CISC Processors – Nano Programming – Case.

UNIT III   PERIPHERALS AND THEIR INTERFACING   9

Programmable Peripheral Interface (8255) - keyboard display controller (8279) – ADC – DAC Interface – Programmable Timer Controller (8254) – Programmable interrupt controller (8259)– Serial Communication Interface (8251) – DMA Controller(8257).

UNIT IV   MICROCONTROLLER ARCHITECTURE & PROGRAMMING 9

8051 Microcontroller- Architecture - Instruction Set –Addressing modes –Interrupts – Assembly Language Programming - Programming 8051 Timers- Serial Port Programming – Interrupts Programming - 8051 Programming.

UNIT V   8051: INTERFACING AND SYSTEM DESIGN   9

LCD and Keyboard Interfacing- ADC, DAC interfacing - External Memory interfacing – Sensor Interfacing - Motor Control- Relay – PWM - DC motor and Stepper Motor - Design of traffic light control and Washing machine control.

Lecture: 45, TOTAL: 45

Course Outcomes:

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

CO1 Ability to understand the architecture of any advanced Processor to be in pace with technological challenges.

CO2 Apply the acquired Programming skills and relate to any Processor/microcontroller in a multidisciplinary. project.

CO3 Able to utilize the IT tools like TASM, MASM and Proteus to develop electronic prototyping and thereby establishing real time control.

CO4 Ability to develop/design microcontroller based system paving way for automation and continuous Development.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3											2		2	2
CO2	3	2						2				2	2	2	
CO3	3	2			2							2			1
CO4	3	3	2									2	2		

TEXT BOOKS:

1. Ramesh S. Gaonkar, Microprocessor Architecture Programming and Applications with 8085. Sixth edition, Penram International Publishing, 2013.

2. Douglas V.Hall, Microprocessor and Interfacing, Programming and Hardware. Revised second Edition, Indian edition 2007, Eleventh Reprint 2010, Tata McGraw Hill.

REFERENCE BOOKS:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D.MCKinlay, The 8051 Microcontroller and Embedded Systems, Second Edition 2008, Fifth Reprint 2010, Pearson Education.
2. Krishna Kant, Microprocessor and Microcontroller Architecture, programming and system design using 8085, 8086, 8051, 8096, PHI, Seventh Reprint 2011.
3. A.K. Ray, K.M .Bhurchandi, Advanced Microprocessor and Peripherals, second Edition, Tata McGrawHill, 2007.
4. Kenneth J.Ayala, The 8051 Microcontroller, 3rd Edition, Thompson Delmar Learning,2007, New Delhi.
5. Dogan Ibrahim, Microcontroller Based Applied Digital Control, John Wiley & Sons Ltd, 2006.

E-REFERENCE(S):

1. http://nptel.ac.in/courses/108107029/

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EET02	ELECTRICAL MACHINES – II	3	1	0	4	50	50	100

Prerequisite: Electrical Machines – I

Objectives:

To impart knowledge on
  i. Construction and performance of salient and non – salient type synchronous generators.
  ii. Principle of operation and performance of synchronous motor.
  iii. Construction, principle of operation and performance of induction machines.
  iv. Starting and speed control of three-phase induction motors.
  v. Construction, principle of operation and performance of single phase induction motors and special machines.

UNIT – I   **ALTERNATOR**

Constructional details – Types of rotors – EMF equation – Synchronous reactance –Armature reaction – Voltage regulation – EMF, MMF– Synchronizing and condition of parallel operation – Synchronizing power - Change of excitation and mechanical input – Blondel's theory – Determination of Xd and Xq using slip test.

UNIT - II   **SYNCHRONOUS MOTOR**   **12**

Principle of operation – Torque equation – Starting methods -Operation on infinite bus bars – V and inverted V curves – Power input and power developed equations – Power/power angle relations – Hunting - synchronous condenser - Applications.

UNIT – III   **THREE PHASE INDUCTION MOTOR**   **12**

Constructional details – Types of rotors – Principle of operation – Slip – Equivalent circuit – Torque equations -Slip-torque characteristics – Losses and efficiency – Load test - No load and blocked rotor tests - Circle diagram – Separation of no load losses   –Crawling and cogging –Induction generator.

UNIT - IV   **STARTING AND SPEED CONTROL OF THREE PHASE**   **12**
                          INDUCTION MOTOR

Starters – Types of starters – Direct On Line, Stator resistance, rotor resistance, autotransformer and star-delta starters Applications. Speed control: changes of voltage, frequency, poles and rotor resistance – Cascaded connection. Applications.

UNIT - V   **SINGLE PHASE INDUCTION MOTORS AND SPECIAL**   **12**
                          MACHINES

Constructional details – Double revolving field theory – Starting methods and applications – Working principles of shaded pole induction motor, Linear Induction motors, repulsion motor, Hysteresis motor, Working principles of stepper motor , universal motor. Applications.

                                        Lecture: 45, Tutorial: 15, TOTAL: 60

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Course outcomes

CO1   Constructional details, principles of operation, performance of Alternators

CO2   Ability to calculate torque, starting methods of AC motor

CO3   Employ different starting and speed control methods to three phase induction motors.

CO4   Emphasis knowledge in basic concepts and principles of special machines.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3								3			1		2	
CO2	3	2			3						1		3	2	2
CO3	3	2					3		2		1		2	2	
CO4	2	2											2		

TEXT BOOK

1   D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002

2   Theraja B L., Theraja A K., "A Text Book of Electrical Technology Vol.II AC & DC Machines"
S Chand and Company Limited, 2007.

3   J.B. Gupta, 'Theory and Performance of Electrical Machines', S.K.Kataria and Sons, 2002.

4   K.Murugesh Kumar, 'Induction & Synchronous Machines', Vikas Publishing House Pvt. Ltd, 2000.

REFERENCE BOOK

1   A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, 'Electric Machinery', Tata McGraw Hill Publishing Company Ltd, 2003.

2   P.S. Bhimbhra, 'Electrical Machinery', Khanna Publishers, 2003.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EET03	ADVANCED CONTROL THEORY	3	0	0	3	50	50	100

AIM

To gain knowledge in analysis of non-linear system and digital control of linear system

OBJECTIVE

i.   To study the description and stability of non-linear system.

ii.   To study the conventional technique of non-linear system analysis.

iii. To study the analysis discrete time systems using conventional techniques.

iv.   To analyze the stability of the systems using different techniques.

v.   To study the design of optimal controller.

UNIT - I   STATE VARIABLE DESIGN   9

Introduction to state variable -Design by state feedback – output feedback – Pole placement technique – Design of state and output feedback controllers – Design of reduced and full order observers – PI feedback – Dynamic state feedback.

UNIT – II   SAMPLED DATA CONTROL SYSTEM   9

Introduction to Sample data control systems –Sampling process, signal reconstruction, difference equation, Z-transform, Z-transfer function – Inverse Z transform, Z-transform analysis of sampled data control system, Z and S-domain Relationship.

UNIT - III   NON-LINEAR SYSTEMS   9

Typesof non-linearity – Typical examples – Equivalent linearization - Phase plane analysis – Limit cycles – Describing functions- Analysis using Describing functions.

UNIT –IV   STABILITY ANALYSIS   9

Introduction – Equilibrium points – BIBO and asymptotic stability – Direct method of Liapunov – Application to non-linear problems – Frequency domain stability criteria – Popov's method and its extensions.

UNIT – V   OPTIMAL CONTROL   9

Introduction -Decoupling - Time varying optimal control – LQR steady state optimal control– Optimal estimation – Multivariable control design.

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1	Identify state variables and poles to find the stability of non-
CO2	Ability to formulate differential equation, Z-transform, Z-transfer function
CO3	Identify the analysis of discrete time systems using
CO4	Analyze optimal control theory and design.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3		2				2				2		3		
CO2	3	2						2				1	2	2	2
CO3	3	2	3	2					2			1	2		
CO4	3													2	

TEXT BOOKS

1. Benjamin C. Kuo, 'Digital Control Systems', Oxford University Press, 1992.
2. M. Gopal, " Modern Control System Theory", New Age International
3. B.C. Kuo, "Automatic Control systems", Pearson Education, 1995.

REFERENCE BOOKS

1. J. Nagrath and M. Gopal, 'Control Systems Engineering', New Age International Publishers, 2003.
2. K. Ogata - Digital control systems - Prentice Hall of India Pvt. Ltd,1997.
3. George J. Thaler, 'Automatic Control Systems', Jaico Publishers, 1993.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	PROTECTION	L	T	P	C	CA	EA	Total
515EET04	AND SWITCHGEAR	3	0	0	3	50	50	100

Prerequisite: Basic knowledge in Transmission and Distribution and Electrical Machines are required

Objectives:
- Study of Relays and Study of protection schemes and solid state relays.
- To understand instrument transformer and accuracy.
- To understand the methods of circuit breaking, various arc theories and Arcing phenomena – capacitive and inductive breaking, Types of circuit breakers, Protection against over voltages.

UNIT – I   PROTECTIVE RELAYS   9

Need for power system protection schemes – nature and causes of faults – types of faults –Power system earthing - Zones of protection and essential qualities of protection – Protection scheme – construction and characteristics of relays – over current relays – directional, distance and differential relays – under frequency relays – negative sequence relays – static relays – microprocessor based relays.

UNIT - II   APPARATUS PROTECTION   9

Apparatus protection – generator and transformer protection – protection of bus bars, transmission lines, CT's , PT's and their application in protective schemes.

UNIT - III   THEORY OF CIRCUIT INTERRUPTION   9

Physics of arc phenomena and arc interruption. restriking voltage and Recovery voltage, rate of rise of recovery voltage, current chopping, interruption of capacitive current, resistance switching – DC circuit breaking.

UNIT - IV   CIRCUIT BREAKERS   9

Switch gear – fault clearing process – interruption of current – Types of Circuit Breakers – Air blast, oil, SF6 and Vacuum circuit breakers – comparative merits of different circuit breakers – Testing of circuit breakers – Circuit breaker ratings.

UNIT – V   PROTECTION AGAINST OVER VOLTAGES   9

Causes of over voltages – methods of protection against over voltages – ground wires, Peterson coil, surge absorbers, surge diverters – relay co-ordination – selection of protective system – Insulation co-ordination.

Lecture: 45, TOTAL: 45

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Course Outcomes:

CO1   Knowledgeable in the field of power system protection and switchgear.

CO2   Ability to demonstrate and design the relevant protection systems for the elements in power systems.

CO3   Emphasis knowledge in the field of over voltages.

CO4   Implement the theory of circuit breakers in power system network.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3												2	3	1
CO2	3	3				2			3				2	2	
CO3	3	3	2			2			3				3	3	3
CO4	3	2									3			1	

TEXT BOOKS

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

2   Y.G.Paithankar and S.R.Bhide, Fundamentals of power system protection, Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi , 2010.

3   Badri ram and Vishwakarma D N , "Power System Protection and Switchgear" Tata McGraw Hill Publishing Company Ltd. New Delhi , 2001.

REFERENCE BOOKS

1   B. Ravindranath, and N. Chander, 'Power System Protection & Switchgear', New Age Publishers, 1977.

2   M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co., 2008.

3   RavindraP.Singh, " Switchgear and Power System Protection " PHI Learning Private Ltd., New Delhi 2009.

4   C.L. Wadhwa, 'Electrical Power Systems', New Age International (P) Ltd., 2005.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	TRANSMISSION	L	T	P	C	CA	EA	Total
515EET05	AND DISTRIBUTION	3	0	0	3	50	50	100

Prerequisite   **Nil**

OBJECTIVE

- To study the description and structure of power systems.
- To study the conventional technique transmission line parameters.
- To study the performance of transmission lines.
- To study the different types of cables and insulators
- To study the mechanical design of transmission line and distribution system

UNIT – I   INTRODUCTION   9

Structure of electric power systems – Types of transmission systems: AC systems - DC systems-Advantages and disadvantages of AC and DC System-EHV AC transmission systems: Necessity for EHV Transmission-Merits and Demerits of EHV Transmission system-HVDC Transmission: Principle-Types of HVDC System- Merits and Demerits of HVDC Transmission system-comparison of HVDC and HVAC systems – Terminal equipment of HVDC Transmission line-FACTS (qualitative treatment only): TCSC, SVC, STATCOM, UPFC.

UNIT - II   TRANSMISSION LINE PARAMETERS   9

Parameters of single and three phase transmission lines with single and double circuits: Resistance, inductance and capacitance– stranded and bundled conductors – symmetrical and unsymmetrical spacing – Transposition of conductors – self and mutual GMD – Skin and Proximity effect –Inductive interference with neighboring circuits.

UNIT – III   PERFORMANCE OF TRANSMISSION LINES   9

Classification of lines: Short line, medium line and long line; equivalent circuits, Attenuation constant, phase constant, surge impedance; Transmission Efficiency and Voltage Regulation-Active and Reactive power flow in lines: Power-angle diagram; surge impedance loading, Ferranti effect - Factors Affecting corona loss -Advantages and Disadvantages of Corona-Methods of reducing corona effect.

UNIT - IV   CABLES AND INSULATORS   9

Underground cables: General Construction of cable – Types of cables- Advantages of Underground cables- Insulation resistance of a cable – Capacitance of a single core and three core cables- Grading of cables– Capacitance and inter sheath grading
Insulators: Properties of insulators-Types of insulators for overhead lines – Voltage distribution in insulator string and grading -String Efficiency – Calculating string efficiency-Methods of improving string efficiency.

Calculations of Sag and Tension — Supports at different levels – Factor of Safety-Effect of wind and ice –Requirements of a Tower-Type of Towers.

Distribution system: Requirements of distribution system-Types of DC distribution system – Radial and Ring main system-Types of distributors with concentrated and distributed loads-- Classification of Substations- selection of site and location for a substation- Equipment's for substations-Comparison between indoor and outdoor substation.

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1   Understood the difference between the higher capacity AC and DC Lines

CO2   Ability to compare the different types of conductors and characteristics

CO3   Identify the transmission line systems for various ranges.

CO4   Gained the knowledge of the cables, the insulators and study of distribution system.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3		2										1		2
CO2	3	2							2		1		3	2	
CO3	3				2		3						3	2	2
CO4	3	2											3		

TEXT BOOKS

1   Wadwa. C.L., "Electric Power Systems, Wiley Eastern Ltd", New Delhi 2001.

2   Metha.V.K, and RohitMetha, "Principles of Power System", S.Chand, 2005.

REFERENCE BOOKS

1   Luces M. Fualkenberry, Walter Coffer,"Electrical Power Distribution and Transmission",Pearson Education, 1996.

2   Despande.M.V, "Electrical Power Systems Design" , Tata McGraw Hill PublishingCompany, New Delhi, 1990

3   Stevenson.W.L., "Elements of Power System Analysis", McGraw Hill, New Delhi, 1999

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Course Code	Course Name	Hours/Week			Credit	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EOE01	COMMUNICATION THEORY	3	0	0	3	50	50	100

Prerequisite Nil

Course Objectives

- Understand working of various Amplitude modulation and demodulation systems.
- Explain about various Angle modulation and demodulation systems.
- Discuss transmitters and receivers of AM and FM
- Understand the mathematical representation of noise.
- Understand the effect of noise on the performance of AM and FM receivers.

UNIT I   AMPLITUDE MODULATION   9

Analysis of an AM Signal Spectrum –Generation and Detection of DSB-FC waves- Square law Modulator, Square law detector, Envelope Detector- Generation and Detection of DSB-SC waves- Balanced Modulator, Ring Modulator, Coherent detection, Costas loop, Generation and Detection of SSB-SCwaves– Phase discrimination method, coherent detection, Generation and Detection of VSB Signals, Comparison of Amplitude modulation systems.

UNIT II   ANGLE MODULATION   9

Phase modulation, Frequency modulation, Analysis of FM Signal Spectrum–Narrowband and wideband FM, Transmission Bandwidth of FM signals- Generation of FM signal – Direct FM ,Indirect FM, Demodulation of FM signals-Balanced slope Detector, Foster-Seeley Discriminator, PLL –Linear and non-linear model of PLL,FM stereo multiplexing .

UNIT III   TRANSMITTERS AND RECEIVERS   9

Classification of Transmitters- Block diagram of AM broadcasting transmitters- Low level and high level transmitters- FM transmitters.
Classification of Receivers- Receiver Characteristics- Tuned Radio frequency receiver- Super heterodyne receiver- Block diagram of FM receiver- Automatic frequency control- Automatic gain control.

UNIT IV   NOISE THEORY   9

Gaussian Process. Noise – Shot noise, Thermal noise and white noise; Noise temperature; Noise Figure- Noise Bandwidth –mathematical representation of noise-Frequency Domain Representation of Noise, Power Spectral Density -Effect of a Filter on the Power spectral density of noise- Narrow band representation of noise and its PSD.

UNIT V   NOISE PERFORMANCE IN AM AND FM RECEIVERS   9

Noise in AM Systems: Calculation of Signal Power and Noise Power in SSB-SC, DSB-SC and DSB-C. Figure of Merit of Square law and Envelope Detection. Noise in FM system: Mathematical Representation of the operation of the Limiter, Discriminator, Calculation of SNR- Threshold in FM– Pre-emphasis and De-emphasis.

Lecture: 45, TOTAL: 45

	Course	CO 1 : Understand the modulation and its significance

Course Outcomes

CO 1 : Understand the modulation and its significance

CO 2: Analyze the different modulation systems

CO 3: Understand the working principle of AM and FM transmitters and receivers.

CO 4: Understand the frequency characteristics of noise and Calculate and analyze noise performance in various receivers.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2						1		2			3		
CO2	3	2											3	3	2
CO3	3	3				3		1		2			3	3	2
CO4		2		2									3	2	
CO5	3					3		2				2			

Text Books

1. Herbert Taub& Donald L Schilling – Principles of Communication Systems (3rd Edition) Tata McGraw Hill, 2008.

2. Simon Haykin, "Communication systems", Willey Publication, New Delhi, 2011.

3. Kennedy G, "Electronic communication systems" Tata McGraw Hill, New Delhi, 2009.

Reference Books

1. John G. Proakis, MasoudSalehi, Fundamentals of Communication Systems, Pearson Education, 2006.

2. B.P.Lathi, Modern Digital and Analog Communication Systems, Third Edition, Oxford Press,2007.

3. P.Ramakrishnarao, "Communication Systems", Published by McGraw Hill Education, 2013

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EEP07	ELECTRICAL MACHINES LABORATORY – II	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:

To study the various characteristics of AC machines experimentally.

LIST OF EXPERIMENTS

1 Regulation of three-phase alternator by EMF and MMF methods.

2 Load test on three-phase alternator.

3 Regulation of three-phase salient pole alternator by slip test.

4 V and Inverted V curves of Three Phase Synchronous Motor.

5 Load test on three-phase squirrel cage induction motor.

6 Load test on three-phase slip ring induction motor.

7 No load and blocked rotor test on three-phase induction motor.

8 Separation of No-load losses of three-phase induction motor.

9 Load test on single-phase induction motor

10 Determination of Equivalent circuit of single-phase induction motor

Practical= 60 Total = 60

Course Outcomes

CO1	Ability to interpret and connect circuits of synchronous generators and motors.
CO2	Develops a knowledge and ability to analyze and specify motors for use in varying applications.
CO3	Gaining practical experience in starting, speed control and testing of three-phase induction motors.
CO4	Interpret the performance of single phase induction motor.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	3											1	1	
CO2	2	3			3	3					1		3	2	2
CO3	2	3	3		3					1			2	2	1
CO4		3									1		2	1	

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EEP08	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	4	2	50	50	100

Pre – Requisite: Knowledge of Microprocessor and Microcontrollers is required

COURSE OBJECTIVE:
- To study the 8085 microprocessor, 8051 microcontroller kit
- To perform the arithmetic operation, code conversion of 8085 using microprocessor kit .
- To acquire the knowledge about Interfacing Experiments
- To acquire the knowledge about Programming with control instructions.
- To explore the Programming in 8051.

LIST OF EXPERIMENTS
1. Programming for 8/16 bit Arithmetic operations Using 8085 Addition / subtraction / multiplication / division.

2. Programming with control instructions Using 8085 Increment / Decrement,Ascending / Descending.

3. Programming with control instructions Using Maximum / Minimum of numbers.

4. Code conversions using 8085: Hex. / ASCII / BCD code conversions.

5. Interface Experiments: - A/D Interfacing.

6. Interface Experiments: - D/A Interfacing.

7. Key board interfacing using 8279 with 8085.

8. Programming for 8/16 bit Arithmetic operations Using 8051 Addition / subtraction / multiplication / division.

9. Programming- Arithmetic operations Using 8086 Addition / subtraction / multiplication / division.

10. Programming with control instructions Using 8086 Increment / Decrement, Ascending / Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex. / ASCII / BCD code conversions.

11. Interfacing and Programming of Traffic light controller using 8085.

12. Interfacing and Programming of Stepper Motor control using 8085.

Practical= 60 Total = 60

COURSE OUTCOMES:

CO1 Develop the code for simple arithmetic circuits in assembly language.

CO2 Implement the developed code using 8085 processors and 8051 controllers.

CO3 Interface the peripherals with microprocessor and micro controller.

CO4 Acquire the knowledge about direct addressing, Bit addressing and Implement the Programming in 8051.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2	1						2				2		
CO2	2								2				2	3	1
CO3	2	1							2			2	2	2	
CO4	2	1										2	2		

Course Code	Course Title	Hours/week				Credits	Maximum Marks		
515EEP09	DIGITAL ELECTRONICS LABORATORY	L	T	P		C	CA	EA	Total
		0	0	4		2	50	50	100

Objectives:

1. To design an experiment, to produce various logical outputs
2. To study the output of code converters, shift registers, counters
3. To study the output of multiplexers and De-multiplexers
4. To study the output of synchronous sequential circuits

LIST OF EXPERIMENTS

1. (a).Verification of truth table for logic gates AND, OR, EXOR, NOT, NOR, NAND

   (b).Verification of Characteristic table for Flip-flops JK FF, RS FF, T FF

2. Design and Implementation of Half/Full Adder and Subtractor using basic logic gates.
3. Design and Implementation of 4 bit binary adder / Subtractor and BCD Adder.
4. Design and Implementation of 16 bit even parity generator and checker.
5. Design and Implementation of 2 bit magnitude comparator using logic gates.
6. Design and Implementation of Code converters using logic gates
   (a).BCD to Excess – 3 Code and vice-versa
   (b).Binary to Gray codes and vice-versa
7. Design and Implementation of Encoders and Decoders using logic gates and study of IC7445 and IC74147.
8. Design and implementation of BCD to 7 segment display using decoder IC.
9. Design and Implementation of Multiplexers and Demultiplexers using logic gates and study of IC7474150 and IC74154.
10. Construction and Verification of 4 bit 4-bit modulo synchronous Counters.
11. Design and Implementation of 3-bit synchronous up-counter, down-counter using MSI circuits.
12. Shift Registers: Design and implementation of 4-bit shift registers in SISO, SIPO, PISO, PIPO modes using suitable IC's.

Practical= 60 Total = 60

Course Outcomes:

CO1: Verification of digital logic circuits using digital IC's

CO2: Simplification of Boolean function and implementing those circuits practically.

CO3: Implementation of different combinational logic circuits using logic gates.

CO4: Implementation of synchronous and asynchronous sequential logic circuits using digital IC's

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2					3					1	3		2
CO2	3	2			2					1			2	2	
CO3	3	2							1			1	2		2
CO4	3					1									

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615EET01	ELECTRICAL MACHINE DESIGN	3	1	0	4	50	50	100

Prerequisite: Electrical Machines – I, & Electrical Machines – II

Objectives:

- To provide sound knowledge about Reluctance and MMF calculations.
- To study the design calculations of armature and field systems for D.C. machines.
- To design core, yoke, windings and cooling systems of transformers.
- To design stator and rotor of induction machines and synchronous machines.

UNIT – I   INTRODUCTION   12

Major considerations in Electrical Machine Design – Limitations in design- Choice of Specific Electrical and Magnetic loadings – Fundamentals of magnetic circuit – Reluctance and MMF calculation for air gap and tooth – real and apparent flux density of rotating machines-Standard specifications.

UNIT - II   DESIGN OF D.C. MACHINES   12

Review of Constructional details - Output Equation – Main Dimensions – Selection of number of poles – Design of Armature – Design of commutator and brushes – design of field pole and coils – Design problems.

UNIT-III   DESIGN OF TRANSFORMERS   12

Review of Constructional details – Main Dimensions - KVA output equation for single and three phase transformers – Overall dimensions – design of yoke, core and winding for core and shell type transformers – Optimum designs - Temperature rise in Transformers – Design of Tank and cooling tubes of Transformers- Design problems.

UNIT-IV   DESIGN OF THREE PHASE INDUCTION MOTORS   12

Review of Constructional details - Output equation of Induction motor – Main dimensions – choice of specific loadings – Design of Length of air gap – Design of stator - Design of squirrel cage rotor and wound rotor – Depth of stator and rotor core- Design problems.

UNIT – V   DESIGN OF SYNCHRONOUS MACHINES   12

Review of Constructional details -Output equation – Main Dimensions -choice of specific loadings – Design of salient pole machines – Short circuit ratio – shape of pole face – Armature design – Slot dimensions – Estimation of air gap length – Design of rotor –Design of damper winding – Design of field winding – Design of turbo alternators- Design problems.

Lecture: 45, Tutorial: 15, TOTAL: 60

Course Outcomes:

CO1	Gain knowledge in the design procedures of various electrical machines.
CO2	Apply the concept of specific electric and magnetic loadings for the armature design of rotating machine.
CO3	Gain knowledge in design of various parameters of DC motors and transformers.
CO4	Gain knowledge in design of various parameter of AC machines

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3									3		1	2		
CO2	3	2								3			2	2	
CO3	3	2	3		2				1			1	3		
CO4		2					2						3		

TEXT BOOKS

1. Sawhney, A.K., 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, New Delhi, Sixth Edition, 2009.

2. Sen, S.K., 'Principles of Electrical Machine Designs with Computer Programmes', Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Second Edition, 2011.

3. R.K. Agarwal, 'Principles of Electrical Machine Design', S.K.Kataria and Sons, Delhi, Fourth Edition, 2005.

REFERENCE BOOKS

1. V.N. Mittle and A. Mittle, 'Design of Electrical Machines', Standard Publications Distributors, Delhi, Fifth Edition, 2012.

2. Shanmugasundaram, A., Gangadharan G. and Palani R., "Electrical Machine Design Data Book", Wiley Eastern Ltd., New Delhi, 1979.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
615EET02	POWER ELECTRONICS	3	0	0	3	50	50	100

Prerequisite: Electron Devices and circuits

Objectives:

1. To get an overview of different types of power semi-conductor devices and theirswitching characteristics.
2. To understand the operation, characteristics and performance parameters ofcontrolled rectifiers.
3. To study the operation, switching techniques and basic topologics of DC-DCswitching regulators.
4. To learn the different modulation techniques of pulse width modulated invertersand to understand the harmonic reduction methods.

UNIT – I   POWER SEMI-CONDUCTOR DEVICES   09

Construction, Principle of operation - Static and dynamic characteristics of Power diodes, SCR,TRIAC, GTO, power BJT, power MOSFET and IGBT – Types of power diodes – Two Transistor model of a thyristor – Turn on methods of thyristor-series and parallel operation of thyristor-Applications.

UNIT - II   PHASE CONTROLLED CONVERTERS   09

AC to DC converters: single phase and three phase converter with R, RL and RLE load – Estimation of RMS load voltage, RMS load current and input power factor – Dual converters –Effect of source impedance on the performance of converter: single phase and three phase converter-Applications.

UNIT - III   DC TO DC CONVERTER   09

DC to DC converters: Principle of Chopper operation – Time ratio control -step up choppers–classification of chopper configuration: Type A, B, C, D, E - Voltage, Current and load- commutated chopper- Forced Commutation and load Commutation-Applications.

UNIT - IV   INVERTERS   09

DC to AC converters: Inverters– Types: voltage source and current source inverters – singlephase bridge inverters – three phase bridge inverters :120 and 180 mode of operation-current source inverters : single phase capacitor commutated CSI - single phase Auto Sequentialcommutated CSI —PWM Inverter- Harmonic reduction – Applications.

UNIT - V   CYCLOCONVERTER AND AC VOLTAGE REGULATOR   09

Single phase to single phase cycloconverter - Step up and step down cycloconverter - three phase to single phase and three phase to three phase cycloconverter-AC voltage controller:Single phase voltage controller with R,RL Load-Three phase voltage controller- Applications: UPS – HVDC systems.

Lecture: 45, TOTAL: 45 HRS

Course Outcomes:

CO1 Gain knowledge on principles of operation on power semiconductordevices.

CO2 Understand the function of single phase and three phase converters.

CO3 Recognize the operation of choppers and inverters and.

CO4 Gain knowledge on principles of operation on cyclo converters and AC voltage regulators

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PS O1	PS O2	PS O3
CO1	3								2				3	2	
CO2	3	2										2	1		3
CO3	3	2			2				2			2	2	2	
CO4	3	2										2	1		

TEXT BOOKS:

1 Rashid, M.H., 'Power Electronics - Circuits Devices and Applications', Prentice Hall ofIndia, 2001.

2 Singh.M.D and Kanchandani-'Power Electronics'-Tata McGraw-Hill & Hillpublication Company Ltd New Delhi-2002.

3 Vedam Subrahmanyam, "Power Electronics", New Age International (P) Limited, NewDelhi, 1996.

REFERENCE BOOKS:

1 Joseph Vithayathil, "Power Electronics", Mc Graw Hill series in electrical andComputer Engineering , USA., 1995

2 Dubey, G.K., Doradia, S.R., Joshi, A. and Sinha, R.M., 'Thyristorised PowerControllers', Wiley Eastern Limited, 1986.

3 Dr.P.S.Bimbhra, "Power Electronics", khanna Publishers.2010.

4 Philip T Krein, "Elements of Power Electronics", Oxford University Press, Inc., New York,2003

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Course Code	Course Title	Hours/week			Cred its	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
615EET03	POWER SYSTEM ANALYSIS AND STABILITY	3	1	0	4	50	50	100

Prerequisite: Numerical Methods &Transmission and Distribution

Objectives:
- To model the power system under steady state operating condition.
- To apply numerical methods to solve the power flow problem.
- To model and analyze the system under faulted conditions.
- To model and analyze the transient behavior of power system when it is subjected to afault.

UNIT – I   INTRODUCTION   **09**

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

UNIT - II   POWER FLOW ANALYSIS   **09**

Importance of power flow analysis in planning and operation of power systems - statement of power flow problem - classification of buses - development of power flow model in complex variables form and polar form - iterative solution using Gauss-Seidel method-Newton- Raphson method and Decoupled method –comparisons of three methods

UNIT - III   FAULT ANALYSIS – BALANCED FAULTS   **09**

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

UNIT - IV   FAULT ANALYSIS – UNBALANCED FAULTS   **09**

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

UNIT - V   STABILITY ANALYSIS   **09**

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

                                                                    Lecture: 45, TOTAL: 45 HRS

Course Outcomes:
CO1 Develop the knowledge about power System under steady state operating condition.
CO2 To apply efficient numerical methods to solve the power flow problem.
CO3 Understand the analysis of power systems under abnormal (or) fault conditions.
CO4 Analyze the transient behavior of power system when it is subjected to a fault.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	I	j	k	l	PSO1	PSO2	PSO3
CO1	3	2											1		
CO2	3	2					2			3		1	2	3	2
CO3	3	2		2		2							1	3	
CO4	3									3			3		

TEXT BOOKS:

1 John   J. Grainger   and Stevenson Jr. W.D.,   'Power System Analysis', Tata McGraw Hill, 1st Edition, 2003.

2 Nagrath. I.J, Kothari. D.P, "Modern Power system Analysis", Tata McGraw Hill Pub. Co. Ltd., 4th Edition, 2011.

3 Hadi Saadat, 'Power System Analysis', Tata McGraw Hill Education Pvt. Ltd., Ne Delhi, 21st reprint 2010.

REFERENCE BOOKS:

1 Kundur P., 'Power System Stability and Control, Tata McGraw Hill Education Pvt. Ltd.,New Delhi, 10th reprint 2010.

2 Pai M A, 'Computer Techniques in Power System Analysis', Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.

3 C.L. Wadhwa-Electrical Powersystems, Second edition, Wiley Eastern Limited, 1993.

4 Stagg, G.W. and El-Abaid, A. H. 'Computer Methods in Power System Analysis', McGraw-Hill International Book Company 1993.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615EET04	HIGH VOLTAGE ENGINEERING	3	0	0	3	50	50	100

Prerequisite: Transmission and Distribution &Power Electronics

Objectives:

1. To understand the various types of over voltages in power system and protection methods.
2. Generation of over voltages in laboratories, Measurement of over voltages.
3. Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
4. Discussion on commercial insulations and Testing of power apparatus and insulation coordination, testing of impulse, insulator, circuit breakers and productive devices.

UNIT – I   TRANSIENT OVERVOLATGES IN ELECTRIC POWER SYSTEMS   9

Natural causes of over voltages - Lightning phenomena - Over voltages due to switching surges –Characteristics of switching surges- control of over voltage due to switching- System faults and other abnormal conditions – Traveling waves on transmission lines.

UNIT - II   ELECTRICAL BREAKDOWN IN GASES, SOLIDS AND LIQUIDS   9

Ionization processes – Townsend's Criterion -   Paschen's law - Streamer theory - Breakdown in non-uniform fields and corona discharges – Practical considerations in using gases for insulation purposes - Vacuum insulation. Conduction and breakdown in pure and commercial liquids. Intrinsic breakdown in solids - Electromechanical breakdown - Thermal breakdown - Breakdown in composite dielectrics.

UNIT – III   GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS   9

Generation of high DC voltage, alternating voltages, impulse voltages and impulse currents – Tripping and control of Impulse Generators

UNIT - IV   MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS   9

Measurement of high DC voltages, high AC voltages and impulse voltages - Measurement of high DC currents, high AC currents and impulse currents - CRO for impulse voltage and current measurement - Digital techniques in high voltage measurement.

UNIT – V   HIGH VOLTAGE TESTING OF ELECTRICAL POWER APPARATUS   9

Testing of Insulator, Bushings, Isolators, Circuit breakers, Cables, Transformers, Surge Arresters – Partial Discharge measurement – Radio interference measurement – International and Indian Standards.

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1   Gain knowledge in the fundamental concept of electric breakdown in liquids, solids and gases.

CO2   Extrapolate the production of various types of high voltages.

CO3   Familiar in non-destructive test techniques in high voltage engineering.

CO4   Outline the Indian and international standards for high voltage equipment testing.

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	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	3	3	3	2		2					1	3	3	2
CO2	3	3	2	3	2							1	3	3	2
CO3	3	3	2	3	2							1	3	3	2
CO4	2	3	3	3	3							1	3	3	2

TEXT BOOKS

1. M.S. Naidu andV.Kamaraju, 'High Voltage Engineering', McGraw Hill, 5th Edition, 2013.
2. Kuffel, E , Zaengl, W.S and Kuffel.J, 'High Voltage Engineering Fundamentals', Pergamon Press, Oxford, London, 2nd Edition ,2000.

REFERENCE BOOKS

1. Kuffel, E and Abdullah, M., 'High Voltage Engineering', Pergamon Press, Oxford, 1970.
2. C.L. Wadhwa, "High voltage Engineering" New Age Publishers, 2010.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615EEE01	INDUSTRIAL AUTOMATION	3	0	0	3	50	50	100

OBJECTIVES

* To introduce different types of sensors used extensively in vehicle automation
* To understand the basic scheme for interfacing sensing and actuating component
* To focus on scope for embedded based secured environment for industrial and home Automation.

UNIT I   INTRODUCTION TO SENSORS AND ACTUATORS   9

Sensor electronics and techniques – Overview of sensor measurements – Sensor linearization and characterization – Sensor classification - – sensors and actuators for automotive systems - .Air flow rate sensor – angular position sensor – engine speed sensor – torque, light, distance and level –Hall Effect position sensor – optical crank shaft sensor – throttle angle sensor – sensor for feedback control – automotive engine control actuators–sensor data acquisition.

UNIT II   AUTOMOTIVE SYSTEM AND CONTROL   9

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

UNIT III   AUTOMOTIVE INSTRUMENTATION   9

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

UNIT IV   BUILDING AUTOMATION   9

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

UNIT V   ADVANCES IN AUTOMOTIVE ELECTRONIC SYSTEMS   9

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

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1	Understand the concept of sensors and actuators
CO2	Emphasis knowledge in basic concepts and principles of automotive system and control
CO3	Understand the concept of automotive instrumentation
CO4	Understand the concept of the building automation and advances in automotive electronic systems

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3						2					2	2		2
CO2	3	2								2			1	2	
CO3	3	2		2		2			2			2	2	3	1
CO4	3	3											3		

TEXT BOOKS

1. William B. Ribbens, Understanding Automotive Electronics, 6th edition, YES DEE Publishing Private Limited, 2011.

2. Ronald k. Jurgen, Automotive Electronics Handbook, 2nd edition, McGraw-Hill, 2007.

REFERENCES

1. Al Santini, ' Automotive Technology', Cengage Learning edition 2004.

2. Ali Emadi, 'Vehicular Electric Power Systems', Marcel Dekkeredition 2004

3. MehrdadEhsani, 'Modern Electric, Hybrid Electric and Fuel cell vehicles', CRC Press Second edition 2011.

4. BarneyCapehart,'WebBasedEnterpriseEnergyandBuildingAutomationSystems',C.E.M, Editor,2003.

5. E Q Doebelin, Measurement Systems, Application and Design, 4th edition, McGraw-Hill, 2011.

6. Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; First edition, 2000.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	EMBEDDED SYSTEM	L	T	P	C	CA	EA	Total
615EEE08		3	0	0	3	50	50	100

Pre – Requisite: Knowledge of Microprocessors and Microcontrollers is required

OBJECTIVES
- Learn the basic concepts and architecture of the embedded systems.
- Understand the various concepts of the RTOS and OS.
- Obtain the knowledge on programming for embedded system
- Analyze various networking protocols.
- Apply the various designs in real time applications.

UNIT I   EMBEDDED ARCHITECTURE   9

Embedded Computers, Characteristics of Embedded Computing Applications, Challenges in Embedded System Design, Embedded System Design Process - Requirements, Specification, Architectural Design, Designing Hardware and Software Components, System Integration.

UNIT II   REAL-TIME OPERATING SYSTEM CONCEPTS   9

Desk Top OS versus RTOS - Architecture of the Kernel-task and task scheduler-Interrupt Service Routines- Semaphores-Mutex-Mailboxes-Message Queues-Event Registers-Pipes-Signals- Timers-Memory Management – Priority Inversion Problem

UNIT III   PROGRAMMING FOR EMBEDDED SYSTEMS   9

Embedded Program – Role of Infinite loop – Compiling, Linking and locating – downloading and debugging – Emulators and simulators processor - Overview of Embedded C - Programming and Assembly – Register usage conventions - procedure call and return - parameter passing – retrieving parameters - temporary variables

UNIT IV   NETWORKS   9

Distributed Embedded Architecture - Hardware and Software Architectures, Networks for embedded systems- I2C, CAN Bus, SHARC link ports, Ethernet, Internet. Design Example: Elevator Controller.

UNIT V   CASE STUDY   9

Data Compressor-Alarm clock-Cell phones-Audio player-Software Modem-Digital still camera-Telephone answering machine-Engine control unit.

Lecture: 45, TOTAL: 45

Course Outcomes:
1. Identify the basic concepts and architecture of the embedded systems.
2. Summarize the various concepts of the RTOS and OS.
3. Write program for embedded system
4. Gain knowledge on various communication protocols.
5. Perform the design in various concepts for real time application models

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3									2			3		
CO2	3	2											3	2	
CO3	3	3		2						2		2	3	2	1
CO4	2	3						2						2	
CO5	1	2								2			2		

TEXTBOOKS:
1. Wayne Wolf, "Computers as Components - Principles of Embedded Computing System Design",Morgan Kaufman Publishers, First Indian Reprint, 2001.
2. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design",
3. Morgan Kaufman Publishers, Third edition, 2012.
4. K.V.K.K. Prasad ,"Embedded /Real-Time Systems: Concepts, Design and programming" Dreamtech, Wiley, 2003.

REFERENCE BOOKS:
1. Raj Kamal "Embedded Systems Architecture Programming and Design" 2nd Editio TMH,2008.
2. David E Simon "An Embedded Software Primer" Pearson Education 2003
3. Daniel.W. Lewis, "Fundamentals of Embedded Software" Pearson Education-2001Ethem Alpydin

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
	POWER							
615EEP07	ELECTRONICS LABORATORY	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:

To study the characteristics and applications of power switching devices through experimentally

LIST OF EXPERIMENTS

1. VI and Switching characteristics of SCR and TRIAC.
2. VI and Switching characteristics of MOSFET and IGBT.
3. Single phase and Three phase half controlled Rectifiers.
4. Single phase and Three phase fully controlled Rectifiers
5. Step up and step down chopper.
6. Single phase IGBT inverter.
7. Three phase IGBT inverter.
8. Voltage and current commutated chopper.
9. Single phase AC voltage controllers.
10. Single-phase cycloconverter.
11. Simulation of Single phase and Three phases fully controlled Rectifiers.
12. Simulation of Single phase and Three phase half controlled Rectifiers

Practical= 60 Total = 60

Course Outcomes:

CO1   Ability to describe about modern power semiconductors and their control.

CO2   Measure and experimentally quantify steady state and transient characteristics of power converters.

CO3   Design and build complete converters, choppers and inverters.

CO4   Obtain the variable output voltage using AC voltage controller.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3				3								1	2	
CO2	3	2						2			2		3	2	
CO3	3	2	2		2		2					2	2		3
CO4	3	2			2					2			2		

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Course Code	Course Name	L	T	P	C	CA	EA	Total
615EEP08	EMPLOYABILITY SKILLS LABORATORY	0	0	4	2	50	50	100

Pre – Requisite: Technical English - I&Technical English - II

COURSE OBJECTIVE:
- To enhance the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
- To help them improve their soft skills, including report writing, necessary for the workplace situations

LIST OF EXPERIMENTS
1. Making presentations – introducing oneself – introducing a topic – answering questions – individual presentation practice
2. Creating effective PPTs – presenting the visuals effectively
3. Using appropriate body language in professional contexts – gestures, facial expressions, etc.
4. Preparing job applications - writing covering letter and résumé
5. Applying for jobs online - email etiquette
6. Participating in group discussions – understanding group dynamics – brainstorming the topic
7. Training in soft skills - persuasive skills – People skills - questioning and clarifying skills – mock GD
8. Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report
9. Attending job interviews – answering questions confidently
10. Interview etiquette – dress code – body language – mock interview

TOTAL:60

COURSE OUTCOMES:
1. Enhancing the employability skills of students with a special focus on Presentation skills, Group discussion skills and Interview skills
2. Improving their soft skills, including report writing, necessary for the workplace situations
3. Creating effective PPTs and presenting the visuals effectively
4. Writing Project proposals – collecting, analyzing and interpreting data / drafting the final report

REQUIREMENTS FOR A CLASS OF STUDENTS
1. A PC or a lap top with one or two speakers
2. A Collar mike and a speaker
3. An LCD projector and a screen
4. CD's and DVD's on relevant topic

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ELECTRONIC SYSTEM DESIGN LABORATORY	L	T	P	C	CA	EA	Total
615EEP09		0	0	4	2	50	50	100

AIM

To design & fabricate electrical and electronics circuits

OBJECTIVE

To make the students to learn the design procedures and fabrication techniques of small electrical & electronics circuits.

LIST OF EXPERIMENTS

1. Design and Fabrication of 5V Constant Voltage Power supply
2. Design and Fabrication of 0-12 V, 1A Variable Power Supply
3. Design and Fabrication of Driver Circuit to drive an Electromagnetic relay using Microprocessor with required Protection.
4. Design and Fabrication of an isolation circuit using opto coupler which is required for Microcontroller interfacing
5. Design and Fabrication of Domestic UPS
6. Sound operated timer circuit
7. Motion Detector Using NE555 Timer
8. Smart Cellphone Guard
9. Optical smoke alarm
10. Automatic Anchor Light
11. Generating PWM Using 555 Timer IC

PRACTICAL: 60 TOTAL : 60

Course Outcomes:

CO1	Able to design power supply units.
CO2	Able to design driver circuit for relay.
CO3	Able to design and fabricate opto-coupler and timer IC based circuits.
CO4	Capable of designing domestic Kits for different applications.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3												2		2
CO2	3	2							2				3	1	2
CO3	3		2			3		2			2		3	1	2
CO4	3	2											2	1	

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	POWER SYSTEM	L	T	P	C	CA	EA	Total
715EET02	OPERATION AND CONTROL	3	2	0	4	50	50	100

Prerequisite: Transmission and Distribution &Power System Analysis and Stability

Objectives:
1. To get an overview of system operation and control.
2. To understand & model power-frequency dynamics and to design power-frequency controller.
3. To understand & model reactive power-voltage interaction and different methods of control for maintaining voltage profile against varying system load.

UNIT – I   INTRODUCTION   12

System load variation: System load characteristics, load curves ,tariff - Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation: Load forecasting, unit commitment, load dispatching. Overview of system control: Governor control, LFC, EDC, AVR, system voltage control, security control.

UNIT – II   SYSTEM OPERATION

System load forecasting – components of system load – classification of base load - forecasting the base load – forecasting procedure Economic dispatch – Incremental cost curve, co-ordination equations without loss and with loss, solution by direct method and λ-iteration method. (No derivation of loss coefficients.) Base point and participation factors. Economic dispatch controller added to LFC.

UNIT – III   SYSTEM CONTROL – REAL POWER –   12
FREQUENCY CONTROL

MW – frequency interaction – load-frequency mechanism – load frequency control – Q- IVI control – interaction between P – f and Q - IVI channels – Basic control loops Fundamentals of speed governing – Transfer function model – speed governing system – Turbo generator - Static response – Feedback control – static and dynamic response of ALFC – secondary ALFC loop AGC in isolated power systems - AGC in interconnected power systems – Two area system – modeling of tie line – representation of two area system – static and dynamic response – tie line bias control - Frequency bias tie line control.

UNIT – IV   SYSTEM CONTROL – REACTIVE POWER –   12
VOLTAGE CONTROL

Reactive power and voltage control - Production and absorption of reactive power - Methods of voltage control - Shunt reactors, Shunt capacitors, Series capacitors, synchronous condensers - Static VAR Systems - Types of SVC - Application of Static VAR compensators Excitation systems requirements - Elements of an excitation system - Types of excitation systems - DC, AC, Static and recent developments and future trends – Modeling of exciter, generator – static performance – dynamic performance.

UNIT – V   COMPUTER CONTROL OF POWER SYSTEMS   12

Energy control center: Functions – Monitoring, data acquisition and control. System hardware configuration – SCADA and EMS functions: Network topology determination, state estimation, security analysis and control. Various operating states: Normal, alert, emergency, in-extremis and restorative.

Lecture : 45, Tutorial : 15, TOTAL : 60

Course Outcomes:

CO1   Gained knowledge about Outline of planning and control of power system.

CO2   Develop the mathematical model of single area and two area load frequency control for static and dynamic analysis.

CO3   Determine the economic dispatch of the generating units with loss and without loss case.

CO4   Got Used to SCADA and EMS for monitor and controlling the power system.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2											2		
CO2	2	2				2							2	2	1
CO3	2	2	2				2		2		2		1	2	
CO4		1											3	1	

TEXT BOOK

1   O.I.Elgerd - Electrical Energy System Theory : An introduction - Tata McGraw Hill Publication, 2003 second Edition.

2   PrabhaKundur - Power System stability and control - EPRI Series - McGraw Hill Inc., 2004

REFERENCE BOOKS

1   PSR Moorthy - Power System Operation & Control, Tata McGraw Hill publication,1992

2   Dr S Mukhopadhyaya - Modern power system control and operation, Roorkee Publishing House, Roorkee, 1983Edition

3   HadiSaadat, Power system analysis, WCB, McGraw Hill International Edition, 2002

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ELECTRIC	L	T	P	C	CA	EA	Total
715EET03	DRIVES AND CONTROL	3	0	0	3	50	50	100

Prerequisite: Electrical Machines and Power Electronics

Objectives:
1. To understand the stable steady-state operation and transient dynamics of a motor-load system and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
2. To study and understand the operation of both classical and modern induction motor drives and synchronous motor drive
3. To learn the basics of permanent magnet synchronous motor drives and to analyze digital control for a drive and various applications.

UNIT – I   CHARACTERISTICS OF ELECTRIC DRIVES   9

Electric drives: introduction, types, advantage, choice. Speed - Torque characteristics of various types of drive motors- dynamics of electric drives. Selection of power rating for drive motors with regard to thermal overloading and load variation factors – Classes of duty and selection of motor-load equalization – Starting, braking, and reversing operations.

UNIT - II   DC DRIVES   9

Speed control of DC motors - Ward - Leonard scheme - drawbacks - Thyristor converter fed dc drives: - Single, two and four quadrant operations - Chopper fed DC drives : - Time ratio control and current limit control - Single, two and four quadrant operations - Effect of ripples on the motor performance.

UNIT – III   THREE PHASE INDUCTION MOTOR DRIVES   9

Speed control of three phase Induction Motors - Stator control: Stator voltage and frequency control - AC chopper, Inverter and cycloconverter fed Induction Motor drives, rotor control - Rotor resistance control and slip power recovery schemes - Static control of rotor resistance using DC chopper - Static Kramer and Scherbius drives – Introduction to Vector Controlled Induction Motor Drives

UNIT - IV   THREE PHASE SYNCHRONOUS MOTOR DRIVES   9

Speed control of three phase Synchronous Motors - True synchronous and self-controlled modes of operation - Inverter fed Synchronous Motors – Commutator-less DC motors - cycloconverter fed Synchronous Motor - Effect of harmonics on the performance of AC motors

UNIT – V   DIGITAL CONTROL AND DRIVE APPLICATIONS   9

Digital techniques in speed control - Advantages and limitations – Microprocessor/ Microcontroller based separately excited dc motor drive and field oriented control of a CSI fed induction motor and PLC based control of drives - Selection of drives and control schemes for Steel rolling mills, Paper mills, Lifts and Cranes.

Lecture : 45, TOTAL : 45

Course Outcomes:

CO1 Understood the steady-state operation and transient dynamics of a motor-load system.

CO2 Learnt about steady state behavior of converter fed DC drive.

CO3 Gained knowledge in speed control of AC motor drives.

CO4 Gained knowledge regarding relevant drive system for a given application with given specifications.

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2										3	3		
CO2	2	2		2			1		2		2		2	2	2
CO3	2	2		2				2					1	2	
CO4	1						1			2			3		

TEXT BOOKS

1 VedamSubramanyam, "Electric Drives: Concepts and Applications", Tata McGraw hill Pvt. Ltd, New Delhi, 2011.

2 Dubey G.K., "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2017.

REFERENCE BOOKS

1 Bose, B.K., "Power Electronics and Variable frequency Drives – Technology and Applications", IEEE, Press, Inc. New York, 1997.

2 Bose, B.K., "Modern Power Electronics and AC Drives", Pearson Education (Singapore) Pvt.. Ltd, New Delhi, 2003

3 Ion Boldea and S. A. Nasar", Electric Drives", CRC Press LLC, New York, 2005.

4 Krishnan R, "Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall of India, Pvt. Ltd, New Delhi, 2002.

	L	T	P	C	CA	EA	Total
715EET04 **RENEWABLE ENERGY SOURCES**	3	0	0	3	50	50	100

Prerequisite: Power Generation Systems
Objectives:

1. To understand the principle of working and the components of different non-conventional sources of energy and their utilization.
2. To get an exposure on the power plants working with non-conventional energy.
3. To study the comparison of different non-conventional sources of energy and their performance

UNIT – I   INTRODUCTION   9

Energy Conservation and Energy Efficiency – Needs and Advantages, Different types of Renewable Energy Sources - Energy Resources Availability in World –Environmental aspects of energy utilization – - Statistical Report on Renewable energy scenario in India - Applications.

UNIT - II   SOLAR ENERGY   9

Introduction to solar energy: solar radiation, availability, measurement and estimation – Solar thermal conversion devices and storage – solar cells and photovoltaic conversion – PV systems – MPPT. Applications of PV Systems – solar energy collectors and storages-Estimate & Design

UNIT - III   WIND ENERGY   9

Introduction – Basic principles of wind energy conversion – wind data and energy estimation – site selection consideration – basic components of wind energy conversion system –Types of wind machines -Schemes for electric generations – generator control, energy storage – applications of wind energy – Inter connected systems- Estimate & Design

UNIT - IV   BIOMASS ENERGY AND OTHER ENERGY   9
                         SOURCES

Biomass: Introduction, Biomass conversion technologies, photosynthesis, classification of biogas plants. Biomass direct combustion – Biomass gasifier Biogas plant – Ethanol production – Bio diesel. Cogeneration: , Biomass applications. Tidal energy : Basic principles of tidal power, component of tidal power plants, operation methods of utilization of tidal energy – Wave energy and its energy conversion devices ,Open and Closed OTEC cycle. Geothermal energy and Fuel cells.

UNIT -V   GRID INTEGRATION   9
Introduction to renewable energy grid integration, concept and need of mini/micro grids, and smart grids. Regulations regarding grid interconnections of renewable energy systems.

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1   Create awareness about the scenario of energy consumption and energy availability in India and world.

CO2   Understand the necessity and potential advantages of renewable energy resources like solar thermal and PV system over fossil fuels.

CO3 Understand the process of power generation using bio gas, wind energy and biomass.

CO4 Analyze the functioning of Geo thermal, ocean and small hydro plants and grid integration.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3					2						1	2	2	
CO2	3	3						2				3	3	3	
CO3	3	2			3					1		3	3	2	2
CO4	2	1						2						3	

TEXT BOOKS

1. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 2011.

2. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2008.

REFERENCE BOOKS

1. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
2. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press,U.K., 2012.

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Course code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EEE06	Power Quality Management	3	0	0	3	50	50	100

Objectives:

1. To understand the various power quality issues.
2. To understand the concept of power and power factor in single phase and three phase systems supplying non linear loads
3. To understand the conventional compensation techniques used for power factor correction and load voltage regulation.
4. To understand the active compensation techniques used for power factor correction.
5. To understand the active compensation techniques used for load voltage regulation.

UNIT – I INTRODUCTION 9

Definitions – Power quality, Voltage quality – Power quality issues : Short duration voltage variations, Long duration voltage variations, Transients, Waveform distortion, Voltage imbalance, Voltage fluctuation, Power frequency variations, low power factor – Sources and Effects of power quality problems – Power quality terms – Power quality and Electro Magnetic Compatibility (EMC) Standards.

UNIT – II SHORT INTERRUPTIONS & LONG INTERRUPTIONS 9

Introduction – Origin of short interruptions : Voltage magnitude events due to re-closing, Voltage during the interruption – Monitoring of short interruptions –Influence on induction motors, Synchronous motors, Adjustable speed drives, Electronic equipments – Single phase tripping : Voltage during fault and post fault period, Current during fault period – Prediction of short Interruptions. Definition – Failure, Outage, Interruption – Origin of interruptions – Causes of long interruptions – Principles of regulating the voltage – Voltage regulating devices, Applications : Utility side, End-User side –Reliability evaluation – Cost of interruptions.

UNIT - III VOLTAGE SAG AND TRANSIENTS 9

Introduction – Definition – Magnitude, Duration – Causes of Voltage Sag – Three Phase Unbalance – Phase angle jumps – Load influence on voltage sags on Adjustable speed drives, Power electronics loads, Sensitive loads - Stochastic assessment of voltage sags - Overview of mitigation methods. Definition – Power system transient model – Principles of over voltage protection - Types and causes of transients – Devices for over voltage protection - Capacitor switching transients –Lightning transients – Transients from load switching.

UNIT - IV WAVEFORM DISTORTION, WIRING AND GROUNDING 9

Introduction – Definition and terms – Harmonics, Harmonics indices, Inter harmonics, Notching – Voltage Vs Current distortion – Harmonics Vs Transients – Sources and effects of harmonic distortion – System response characteristics – Principles of controlling harmonics – Standards and limitation - Definitions and terms – Reasons for grounding –National Electrical Code (NEC) grounding requirements – Utility Power system grounding –End-User power system grounding – Wiring and grounding problems.

Introduction – Power quality monitoring : Need for power quality monitoring, Evolution of power quality monitoring, Deregulation effect on power quality monitoring – Power factor improvement – Brief introduction to power quality measurement equipments and power conditioning equipments – Planning, Conducting and Analyzing power quality survey – Mitigation and control techniques - Active Filters for Harmonic Reduction

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1 To study various methods of power quality monitoring and the production of voltages sags.
CO2 To Study the interruptions types and its influence in various components.
CO3 To Study the Effects of harmonics on various equipment's.
CO4 Understand power quality monitoring and classification techniques.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	1									2		2	3	
CO2	3	2					3						3	3	
CO3	3	2			1						2		2	3	2
CO4	3								2				1		

Text Book

1   Roger C.Dugan, Mark F. McGranaghan andH.WayneBeaty, "Electrical Power Systems Quality", McGraw-Hill, New York, 2nd Edition, 2002.
2   Barry W.Kennedy, "Power Quality Primer", McGraw-Hill, New York, 2000.

REFERENCE BOOKS :

1   Sankaran.C, "Power Quality", CRC Press, Washington, D.C., 2002

2   Math H.J.Bollen, "Understanding Power Quality Problems: Voltage Sags and Interruptions", IEEE Press, New York, 2000.

3   Arrillaga.J, Watson.N.R and Chen.S, "Power System Quality Assessment", John Wiley & Sons Ltd., England, 2000

4   Short.T.A., "Distribution Reliability and Power Quality", CRC Press Taylor and Francis Group, 2006.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
715EEE10	SPECIAL ELECTRICAL MACHINES	3	0	0	3	50	50	100

Prerequisite: Electrical Machines – I & II

Objectives:

To impart knowledge on
- Construction, principle of operation and performance of permanent magnet synchronous motors.
- Construction, principle of operation and performance of permanent magnet brushless D.C. motors and synchronous reluctance motors
- Construction, principle of operation and performance of switched reluctance motors and stepping motors.

UNIT – I   PERMANENT MAGNET SYNCHRONOUS MOTORS   09

Permanent Magnet Motors – Classifications – PMSM - Principle of operation – EMF and Torque equations – Reactance – Power controllers - Converter - Volt- ampere requirements – circle diagram and torque / speed characteristics - Microprocessor based control- Slotless motors.

UNIT - II   PERMANENT MAGNET BRUSHLESS D.C. MOTORS   09

Necessity for brushless DC. Principle of operation – Types. Three phase unipolar and bipolar driven motors. Rotor position detection. Elimination of dead points– EMF and Torque equations – Power controllers – torque /speed characteristics and control.

UNIT - III   SYNCHRONOUS RELUCTANCE MOTORS   09

Constructional features – Types –rotor design. Operating principle – Reluctance – Phasor diagram - torque /speed characteristics. Vernier motor- constructional features, working principle and characteristics- design of vernier motor- Applications.

UNIT - IV   SWITCHED RELUCTANCE MOTORS   09

Constructional features – Principle of operation – poles, phases and winding- static torque production – Analysis - converter circuits. Control: current regulation, commutation.
Torque / speed characteristics-Microprocessor based control-Applications.

UNIT - V   STEPPING MOTORS   09

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Theory of torque production – Linear and non-linear analysis – static and dynamic characteristics – Drive circuits – Microprocessor based control- Applications..

Lecture: 45, TOTAL: 45 HRS

Course Outcomes:

CO1   Classify and explain the working of PMSM.

CO2   Apply control techniques to permanent magnet brushless DC motors.

CO3   Analyze the performance of switched reluctance motor andsynchronous reluctance motor.

CO4   Categorize the stepping motors and analyze their performance

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PS O1	PS O2	PS O3
CO1	3												2	3	
CO2	3	1		2			2		2			2	2	2	
CO3	3	3	3			2	2				1		3	2	1
CO4	3	2											2	1	

TEXT BOOKS:

1. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.

2. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.

REFERENCE BOOKS:

1. P.P. Aearnley, Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus, London, 1982.

2. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EEP07	MINI PROJECT	0	0	4	2	50	50	100

Objectives:

To enable the students to do a project involving some design and fabrication work.

Every project work shall have a Guide who is a member of the faculty. Four periods per week shall be allotted in the time table for this important activity and this time shall be utilized by the students to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present in periodical seminars or viva to review the progress made in the mini project.

Each student shall finally produce a comprehensive report covering background information, literature – survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation is to be carried out as specified in the guidelines to be issued from time to time.

Course Outcomes:

CO1   Identification of real time problems

CO2   Awareness of design methodologies & its implementation.

CO3   Implementing advanced simulation software techniques.

CO4   Able to produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

	Programme Outcomses												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	1						2					3		3
CO2	2	3	2		3				2		2		2	3	2
CO3	2	2		2	3			2					2	3	
CO4	3								2				3		2

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	POWER SYSTEM	L	T	P	C	CA	EA	Total
715EEP08	SIMULATION LABORATORY	0	0	4	2	50	50	100

Prerequisite: Power System Operation and Control

Objectives:

1. To be familiar with the simulation power system analysis.

LIST OF EXPERIMENTS

1	Computation of parameters and modelling of transmission lines.
2	Formation of Bus admittance and impedance matrices
3	Load flow analysis by Gauss-siedel method
4	Power flow analysis by Newton Raphson method
5	Fault analysis
6	Transient stability analysis of single machine infinite bus system
7	Transient stability analysis of multi machine infinite bus system
8	Load frequency dynamics of single area power system
9	Load frequency dynamics of two area power system
10	Economic dispatch in power system

Practical= 60 Total = 60

Course Outcomes:

CO1 Acquire experience in the usage of standard packages for the following analysis / simulation / control functions.

CO2 Ability to develop computer programs to perform load flow analysis on the power system.

CO3 Compute and model the transmission lines and analyze the generation control on power system using simulation tools.

CO4 Solve the transient stability problem in single machine infinite bus system.

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	2										2	3	3	
CO2	3	2		2			3		2		2		2	2	1
CO3	3		2		2							1	1	3	
CO4	2									1			3		

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EEP09	ELECTRIC DRIVES LABORATORY	0	0	4	2	50	50	100

Prerequisite: Nil

Objectives:
1. To be familiar with the simulation of DC & AC drives,
2. To get the speed control and closed loop control of different machines using DSP processor.

LIST OF EXPERIMENTS

Simulation of

1	Closed loop control of converter fed DC motor
2	Closed loop control of chopper fed DC motor
3	Single phase full controlled bridge rectifier fed separately excited DC motor
4	Single phase semi controlled bridge rectifier fed separately excited DC motor
5	Three phase rectifier fed DC motor.
6	VSI fed 3ϕ induction motor
7	Closed Loop PWM Inverter Fed IM Drive
8	Closed Loop Control Of PMSM By V/F/ Method
9	Speed control of BLDC motor
10	Switched reluctance motor drive
11	Stepper motor drive
12	3ϕ synchronous motor drive

Practical= 60 Total = 60

Course Outcomes:

CO1 Demonstrate the software tools used for simulation of drives.
CO2 Design and apply the speed control for converter/chopper fed DC motor.
CO3 Design and apply the speed control for stepper motor.
CO4 Demonstrate the software tools used for simulation of drives.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	1							2				3	1	
CO2	3	2	2				2		2				2	2	
CO3	2	3			2			2	3			3	2	3	3
CO4	3												3		

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	TOTAL
815EET015	Electric Power Utilization and Energy Auditing	3	0	0	3	50	50	100

Prerequisite: : power system
Objectives:
To impart knowledge on
- Principle and design of illumination systems and methods of heating and welding.
- Electric traction systems and their performance.
- Electrolytic process and storage of electricity.
- Electrical energy conservation, energy auditing and power quality

UNIT – I   ILLUMINATION   09

Nature-of radiation –definition – laws of photometry – polar curves – lighting calculations-design of illumination systems (for residential, industrial, commercial and street lightings) - types of lamps-energy efficiency lamps – comparison with CFL and LED.

UNIT - II   ELECTRIC HEATING AND WELDING   09

Advantages of electric heating – Types of Heating - Resistance heating – Temperaturecontrol, Induction heating – induction furnace - Dielectric heating - Choice of voltage and frequencies for Dielectric heating –Welding - Equipment's for Welding - Resistance welding- Arc welding - Laser welding – Ultrasonic Welding-Introduction to TIG, MIG Welding

UNIT - III   ELECTRIC TRACTION   09

Introduction – requirements of an ideal traction system – supply systems – mechanics of train movement – tractive effort – Specific energy consumption – traction motors and control – multiple units – braking methods - current   collection systems-recent trends in electric traction-Introduction to EMU and metro railways.

UNIT - IV   ELECTROLYTIC PROCESS AND STORAGE OF   09
**   ELECTRICITY**

Electrolysis – Polarization factor – Preparation of work for electroplating – tanks and other equipment – Method of charging and maintenance – Nickel iron, Nickel-cadmium and lithium ion batteries – components and materials – capacity rating of batteries – battery chargers: charging and discharging..

UNIT - V   ENERGY CONSERVATION   09

Economics of generation – definitions – load curves – number and size of units – cost of electrical energy – tariff – need for electrical energy   conservation-methods – energy efficient equipment – energy management – energy auditing – case study. Economics of power factor improvement – design for improvement of power factor using power capacitors – power quality – effect on conservation.

**   Lecture: 45, TOTAL: 45 HRS**

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Course Outcomes:

CO1 Impart knowledge on Generation of electrical power by conventional,non–conventional methods.

CO2 Understand the principle and design of illumination systems and methodsof heating and welding.

CO3 Attain the knowledge about Electric traction systems and theirperformance.

CO4 Determine the needs of energy conservation and implement conservation techniques.

	Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	1		2								1	3	3	
CO2	3	3			3		2		2			2		2	
CO3	3	2	3					1					2		1
CO4	3				2							3	1	2	

TEXT BOOKS:

1,S.L. Uppal, "Electrical Power", Khanna Publishers, 1988

2.E. Openshaw Taylor, "Utilization of Electrical Energy in SI Units" Orient Longman Private Limited, 2003.

REFERENCE BOOKS:

1.M.L. Soni, P.V. Gupta, V.S. Bhatnagar, A. Chakrabarti, 'A Text Book on Power System Engineering', DhanpatRai& Co., 1998.

2.Utilization of Electrical Energy by JB Gupta, Kataria Publications, Ludhiana. Albert Thumann, William J. Younger, "Hand Book of Energy Audits", The Fairmont Press, Inc., 2003.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	EHVAC POWER TRANSMISSION	L	T	P	C	CA	EA	Total
815EEE01		3	0	0	3	50	50	100

Objectives:

- To illustrate concepts of reactive parameters.
- To describe about the voltage gradient.
- To illustrate the corona effects.
- To describe about the voltage control in AC transmission.

UNIT – I   INTRODUCTION   09

Standard Transmission Voltages – Average Values of Line Parameters – Power Handling Capacity and Line Loss – Costs of Transmission Lines and Equipment – Mechanical Considerations in Line Performance.

UNIT - II   CALCULATION OF LINE PARAMETERS   09

Calculation of Resistance, Inductance and Capacitance – Calculation of sequence inductances and capacitances – Line parameters for Modes of propagation.

UNIT - III   VOLTAGE GRADIENTS OF CONDUCTORS   09

Charge-Potential Relations for Multi-conductor lines – Surface Voltage Gradient on Conductors – Gradient Factors and their use – Distribution of Voltage Gradient on Sub conductors of Bundle - Voltage Gradients on Conductors in the Presence of Ground Wires on Towers.

UNIT - IV   CORONA EFFECTS   09

Power losses and audible losses : I^2R Loss and Corona Loss -Attenuation of Traveling Waves Due to Corona Loss - Audible Noise Generation and Characteristics - Limits for Audible Noise - Day-Night Equivalent Noise Level. Radio Interference : corona pulse generation and properties - Limits for Radio Interference Fields - The CIGRE Formula - The RI Excitation Function -Measurement of RI, RIV and Excitation Function - Design of Filter.

UNIT - V   ELECTROSTATIC FIELD OF EHV LINES   09

Capacitance of Long Object - Calculation of Electrostatic Field of AC Lines Effect of High Field on Humans, Animals, and Plants - Meters and Measurement of Electrostatic Fields - Electrostatic Induction in Unenergised Circuit of a D/C Line - Induced Voltages in Insulated Ground Wires - Electromagnetic Interference.

Lecture: 45, TOTAL: 45 HRS

Course Outcomes:

CO1 Understand the concepts of line parameters and its design.

CO2 Ability to understand the line parameters for modes of propagation,

CO3 Ability to understand about the voltage gradients

CO4 Become very conversant and knowledgeable in Corona effects and in Electrostatic field

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		Programme Outcomes											Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	3						2			2		3	3	
CO2	3	2	3	2							2	2	3		
CO3	3	2		2			2		3		1		2	2	1
CO4	2												2		

TEXT BOOKS :

1. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Academic Science, Fourth Edition, 2011.
2. TuranGonen: Electric Power Transmission System Engineering Analysis and Design, CRC press, Third edition, 2014.

REFERENCES:

1. A Chakraborti, D.P. Kothari and A.K. Mukhopadyay: Performance, Operation and Control of EHV Power Transmission Systems, T.M.H, 1999.
2. S. Rao , Ehv-Ac,Hvdc Transmission & Distribution, Khanna Publishers , Third Edition, 2009

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815EEE08	VLSI Design	3	0	0	3	50	50	100

Prerequisite: Digital Logic circuits

Objectives:
1. To introduce the basis of MOS theory and Manufacturing Technology
2. To analyse the switching characteristics of MOS transistor /stick diagram and design rules.
3. To study about the construction of NMOS, CMOS and BiCMOS based logic gates.
4. To introduce FPGA architecture and Programming of programmable devices.

UNIT – I   BASIC MOS TRANSISTOR THEORY   9

Basic MOS Transistor- MOSFET Threshold Voltage-Enhancement and Depletion mode operation- Saturation and linear mode operation-CMOS Fabrication: P well, N Well and Twin Tub process – Sub micron technology

UNIT – II   NMOS AND CMOS CIRCUIT DESIGN   9

MOS Layers- Stick Diagrams- Design rules and layout –Sheet resistance –Area capacitance of layers –NMOS Inverter –CMOS inverter - Determination of pull up / pull down ratios - Switching characteristics. Rise time. Fall time –Latch-up problem in CMOS Circuits.

UNIT – III   SUB SYSTEM AND LOGIC DESIGN   9

Pass Transistor and Transmission gates- NMOS and CMOS Logic gates- CMOS Combinational Logic Design-Clocked Sequential Logic Circuits -super buffers – BiCMOS

**UNIT – IV   DESIGN OF COMBINATIONAL ELEMENTS AND ARRAY   9
                 LOGIC**

Read Only Memory (ROM)- PLA, PAL, GAL - Complex Programmable Logic Devices (CPLD)- Field Programmable Logic Devices(FPGA)- Xilinx 4000 Series FPGA:CLB,I/O Blocks – FPGA Design Flow

UNIT – V   CIRCUIT DESIGN USING VHDL   9

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

                                              Lecture : 45, TOTAL : 45

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Course Outcomes:

CO1 Understood the fundamentals of MOS transistor and fabrication techniques.

CO2 Ability to Understand the characteristics of MOS and CMOS circuits.

CO3 Able to design the NMOS, CMOS and BiCMOS based logic circuits.

CO4 Emphasis knowledge in the PLDs and CPLDs and design using FPGA and Expose to HDL language and ability to design simple devices

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	I	j	k	l	PSO1	PSO2	PSO3
CO1	3	2							3			3	2	2	
CO2	3	3					2		2		2	2	3	2	3
CO3	3	2	1	2									2	2	
CO4	3		3							2			2	2	

TEXT BOOKS

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

REFERENCE BOOKS

1 N.H.Weste, 'Principles of CMOS VLSI Design', Pearson Education, India, 2002.
2 Charles H Roth,"Digital System Design Using VHDL", PWS Publishing company.
3 ZainalatsedinNavabi, 'VHDL Analysis and Modelling of Digital Systems', 2n Edition,   Tata McGraw Hill, 1998.
4 Parag K.Lala, 'Digitl System Design using PLD', BS Publications, 2003
5 Amar Murkherjee, "Introduction to NMOS and CMOS VLSI system design", Prentice Hall, 1986.
6 Douglas Perry, 'VHDL Programming By Example', Tata McGraw Hill, 3rdEdition.2007.

Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815EEP04	PROJECT WORK	0	0	14	7	50	50	100

Objectives:

To enable the students to do a project involving some design and fabrication work.

Every project work shall have a Guide who is a member of the faculty. Fourteen periods per week shall be allotted in the time table for this important activity and this time shall be utilized by the students to receive directions from the Guide, on library reading, laboratory work, computer analysis, or field work as assigned by the Guide and also to present in periodical seminars or viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature – survey, problem statement, project work details, estimation of cost and conclusions. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation is to be carried out as specified in the guidelines to be issued from time to time.

Course Outcomes:

CO1   Identification of real time problems.
CO2   Awareness of design methodologies and its implementation.
CO3   Implementing advanced simulation software techniques.
CO4   Able to produce a comprehensive report covering background information, literature survey, problem statement, project work details and conclusion.

	Programme Outcomes												Programme Specific Outcomes		
	a	b	c	d	e	f	g	h	i	j	k	l	PSO1	PSO2	PSO3
CO1	3	1					3			3		1	3	2	
CO2		2	2			3						2	3	2	1
CO3	3				2			2		2			3	2	
CO4	3	2													

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