Semester I

		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

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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	

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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.

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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			

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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 Rigiditymodulus of a beam and cylinder respectively.

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

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

CO4 Measuringthe 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											

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CO5	2	1													

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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			

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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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Semester II

		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 technology students.
- 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	PO 10	PO 11	PO 12	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

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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		

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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

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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.

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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	

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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	

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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													

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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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Semester III

		L	T	P	C
318MAT01	Engineering Mathematics–III	3	1	0	4

COURSE OBJECTIVES

- To learn various methods to solve the partial differential equations.
- To introduce Fourier series analysis which plays a vital role in many applications in engineering.
- To understand the boundary value problems and to obtain the solution using partial differential equations.
- To acquaint the Fourier transform techniques used in wide variety of situations.
- To develop z-transform techniques which analyze the discrete time signals.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Solutions of first order partial differential equations-Standard types-Singular solutions- Lagrange's Linear equation- Solution of homogeneous and non-homogenous linear equations ofsecond and higher order with constant coefficients.

UNIT II 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 III 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 IV FOURIER TRANSFORM 9+3

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

UNIT V Z – TRANSFORM 9+3

Z-Transform - Elementary properties and applications – Initial and final value theorems (Statement and applications only) - Inverse Z-Transform – Partial fractions method, Residue theorem method and Convolution theorem (statement and applications only) - Solution of difference equations by applying Z-transforms.

TOTAL:45+15 = 60 PERIODS

COURSE OUTCOMES

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

CO1 Know the methods to solve partial differential equations occurring in various physical and engineering problems.

CO2 Describe an oscillating function which appears in a variety of physical problems by Fourier series which helps them to understand its basic nature deeply.

CO3 Acquire the knowledge to construct partial differential equations with initial and boundary conditions for various physical and engineering real time problems and obtaining solution using Fourier series methods.

CO4 Apply the Fourier transform techniques in engineering field.

CO5 Gain the concept of analysis of linear discrete system using Z-transform approach.

TEXT BOOKS

1. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publications, 44th edition, 2017.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition Wiley India, 2016.

REFERENCE BOOKS

1. Andrews L.C and Shivamoggi. B.K., "Integral Transforms for Engineers", SPIE Press Book, 1999
2. Wylie C R and Barrett L C, "Advanced Engineering Mathematics", 6th Edition, McGraw-Hill Co., New Delhi, 1995.
3. T.Veerarajan,"Engineering Mathematics-III", Tata McGraw-Hill Publishing company, New Delhi,2015.
4. P.Kandasamy, K.Thilagavathy, K.Gunavathy, " Engineering Mathematics-III", S.Chand Publishers,2015.
5. V.Prameelakaladharan and G.Balaji ,"Engineering Mathematics-III", Amrutha marketing, Chennai,2016.

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

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318EET02	Electro Magnetic Theory	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

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

UNIT I INTRODUCTION 9

Introduction: Co-ordinate systems and transformation, Cartesian co-ordinates, Circular cylindricalcoordinates, Spherical coordinates and their transformation. Differential length, area and volume indifferent 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 – Capacitance - Boundary conditions: Conductor –dielectric Poisson's and Laplace's equation.Numerical problems.

UNIT III MAGNETO STATIC FIELDS 9

Biot- savart law, Ampere's circuital law, Magnetic flux density, Magneto 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 depth, Power, Poynting vector, Reflection and refraction of a plane wave at normal incidence-Polarization. Numerical problems

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Learnt mathematical operations of three dimensional vectors related to electromagnetic fields

CO2 Gained the acquaintance in applications of Poisson's and Laplace's equations

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

CO4 Gained the indulgent of the Maxwell's equations and its applications.

CO5 Attained the knowledge in principles of propagation of plane waves.

TEXT BOOKS

1. Mathew N.O. Sadiku ,Elements of Electromagnetic, , 4th edition, Oxford university press. 2007

2. William.H. Hayt& J.A. Buck , Engineering Electromagnetic, , 7th Edition, TMH, 2001
3. Joseph A.Edminister, Theory and problems of Electromagnetic, 2nd Edition, TMH, 1993
4. Guru &Hizroglu , Electromagnetic field theory fundamentals, 2nd edition, CambridgeUniversity Press.2000.

REFERENCE BOOKS

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

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

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318EET03	Network Analysis and Synthesis	L	T	P	C
		3	0	0	3

COURSE 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 **9**

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 **9**

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

UNIT III SINGLE PORT AND TWO PORT NETWORKS **9**

Driving point impedance and admittance of single 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 **9**

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

UNIT V ELEMENTS OF NETWORK SYNTHESIS **9**

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

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be

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
CO5 Learnt about apply to synthesis techniques

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 series McGraw Hill Book Company, 5th Edition, 2010.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3	2											1		
CO2	3	3	1		2				2				2	2	1
CO3	3	2											2	2	
CO4	3	2											2	2	1
CO5	3	1												2	

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318EET04	Linear Integrated Circuits and Applications	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Electron Devices and Circuits is required

COURSE OBJECTIVES

- To study the IC fabrication procedures.
- To study characteristics; realize circuits; design for signal analysis using Op-amp ICs.
- To study the applications of Op-amp.
- To study internal functional blocks and the applications of special ICs like Timers, PLL circuits.
- To study the about Application ICs like regulator Circuits.

UNIT I IC FABRICATION 9

Fundamentals of Integrated Circuits, IC classifications, fundamentals of monolithic IC technology, Basic Planar Processes, Realization of monolithic ICs and packaging. Fabrication of diodes,capacitor, resistor, 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, monostable and astable multivibrators, sine and triangular wave generators, first-and second-order active filters, log and antilog amplifier.

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.

UNIT V APPLICATION ICs 9

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

TOTAL:45 PERIODS

COURSE OUTCOMES

The student will be/have

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

CO5 Able to analyze different application ICs.

TEXT BOOKS

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

2003

REFERENCE BOOKS

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.

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	2		2						2				1		
CO2	2		2						2				1		
CO3	2		2						2				2	2	1
CO4	3	2	2						2				2	2	1
CO5			3		2				3				3	1	

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318EET05	Measurements and Instrumentation	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the student have a clear knowledge of Functional elements of an instrument, error, calibration etc.
- Emphasis is laid on analog and digital techniques used to measure voltage, current, energy and power etc.
- To have an adequate knowledge of comparison methods of measurement.
- To have elaborate discussion about storage & display devices
- Exposure to various transducers and data acquisition systems.

UNIT I INTRODUCTION **9**

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

UNIT II ELECTRICAL AND ELECTRONICS INSTRUMENTS **9**

PMMC instruments-MI instruments-Digital voltmeters – 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.

UNIT III COMPARISON METHODS OF MEASUREMENTS **9**

Types of D.C potentiometers: Laboratory type, Duo-range, Vernier and Deflection-Types of A.C potentiometers: Polar, co-ordinate Potentiometers-Types of D.C bridges: Wheatstone Bridge-Kelvin Bridge- Types of A.C bridges: Maxwell, Schering and Anderson Bridge-Transformer ratio bridges– Electromagnetic interference.

UNIT IV STORAGE AND DISPLAY DEVICES **9**

Recorders: Analog and Digital recorders: Magnetic tape Recorders-X-Y recorder- Digital plotters – Printers- CRT display-Digital CRO- LED& LCD - Dot matrix display – Data Loggers.

UNIT V TRANSDUCERS AND DATA ACQUISITION SYSTEMS **9**

Requirements of a transducer- Classification of transducers – Selection of transducers – Resistive, inductive &capacitive transducers – Piezoelectric transducers-– Elements of Data Acquisitions system–Types of A/D converters, Types of D/A converters – Smart sensors.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Be able to analyze the performance characteristics and calibration of aninstrumentation system

CO2 Understand the operation of various types of Potentiometers and bridges.

CO3 Select and apply analog and digital techniques to measure voltage, current, energy,power etc.

CO4 Elaborate knowledge about storage and display devices.

CO5 Explain about various transducers and data acquisition systems.

TEXT BOOKS

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1. E.O. Doebelin, 'Measurement Systems – Application and Design', Tata McGraw Hill publishingcompany, 2003
2. A.K. Sawhney, 'A Course in Electrical & Electronic Measurements & Instrumentation', Dhanpat Rai 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.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3					1									
CO2	3		1											1	
CO3	3				2	1						1	2		
CO4	3					1						1	2		1
CO5	3				2	1						1	2		

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318EET06	Fundamentals of Data structures in'C'	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Familiarize the basic programming concepts in C.
- Solve real time problems using functions, structure and union.
- Impart the basic concepts of linear data structures.
- Solve problem using nonlinear data structures.
- Identity the various Sorting, Searching and hashing algorithms.

UNIT I C PROGRAMMING BASICS 9

Structure of a C program - compilation and linking processes - Constants, Variables – DataTypes- Expressions using operators in C - Managing Input and Output operations - Decision Making and Branching - Looping statements. Arrays - Initialization - Declaration - One dimensional and Two-dimensional arrays. Strings - String operations - String Arrays.

UNIT II FUNCTIONS, POINTERS, STRUCTURES AND UNIONS 9

Functions - Pass by value - Pass by reference - Recursion - Pointers - Initialization - Pointers arithmetic. Structures and unions - Structure within a structure - Union - Files- Operations on Files-Memory Management.

UNIT III LINEAR DATA STRUCTURES 9

Abstract Data Types - Linked list Implementation of List- polynomial addition- Linked List Implementation of Stack- Balancing Symbols - Postfix Expressions - Infix to Postfix Conversion-Linked list Implementation of Queues- Circular Queue.

UNIT IV NON LINEAR DATA STRUCTURES 9

Preliminaries -Binary Trees -Tree Traversals - Binary Search Tree -Operations on Binary Search Tree - Heaps - Binary Heaps - Operations of Heaps - Graph and its representations -Graph Traversals - Shortest Path Algorithm: Dijkstra's Algorithm- Minimum Spanning Tree:Prim's Algorithm – Kruskal's Algorithm.

UNIT V SEARCHING, SORTING AND HASHING 9

Linear Search - Binary Search -Bubble Sort - Insertion Sort - Quick Sort - Merge Sort - Hash Functions - Separate Chaining -Open Addressing.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Summarize the basic concepts of C
CO2 Develop programs for real time application using functions, structures, union
CO3 Gain knowledge on operations of linear data structures
Co4 Develop applications using nonlinear data structures
CO5 Apply appropriate sorting, searching technique for given problem.

TEXT BOOKS

1. Ashok.N.Kamthane,- "Computer Programming" , Pearson Education,Second edition(India), 2012
2. Mark Allen Weiss, "Data Structures And Algorithm Analysis In C", Second Edition, Pearson Education,2002

REFERENCE BOOKS

1. PradipDey and Manas Ghosh, —Programming in C, Second Edition,Oxford University Press, 2011.

2. E.Balagurusamy, - "Computing fundamentals and C Programming", Tata McGraw-Hill Publishing Company Limited, 2008.
3. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, —Fundamentals of Data Structures in C, Second Edition, University Press, 2008

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

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318EEP07 **Linear Integrated Circuits Laboratory**

L	T	P	C
0	0	2	1

COURSE OBJECTIVES

- To understand the basics of linear integrated circuits and available ICs
- To understand characteristics of operational amplifier
- To apply operational amplifiers in linear and nonlinear applications
- To acquire the basic knowledge of special function ICs

LIST OF EXPERIMENTS

1. Inverting and Non inverting amplifiers.
2. Design of Integrator using IC 741.
3. Design of Differentiator using IC 741
4. Astable Multivibrator using Op-amp.
5. Half wave Precision rectifier using Op-amp
6. Schmitt Trigger.
7. RC Phase shift oscillator using Op-amp.
8. Wien bridge oscillator using Op-amp.
9. Astable and Monostable multivibrators using 555 Timer.
10. Regulated DC power supply using LM317.
11. Design of Active low-pass and High-pass filters.
12. Study of Voltage Controlled Oscillator (VCO).

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, the students will have:

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 multivibrator circuits.

CO4 Obtained knowledge to design and construct waveform generators

CO5 Learnt to design filter circuits using op-amps and learnt about VCO

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		3										3		
CO2	3	2										1	2	1	
CO3	2	2	2						2					2	1
CO4	3	2	1						2				2		
CO5	3											3	2	1	

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318EEP08	Measurements and Instrumentation Laboratory	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

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

LIST OF EXPERIMENTS

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

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, the students will have:

CO1 Learnt about the working of AC and DC bridges

CO2 Gained the knowledge to analyze A/D and D/A converters.

CO3 Acquired knowledge to calibration of single-phase energy meter andtransformer

CO4 Obtained knowledge to Measurement of three phase power and powerfactor

CO5 Learnt about Characteristic of pressure transducers and LDR

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															
CO2			3		2				2				2		
CO3			2						2	3	1		2	1	
CO4					1	2			2				3		2
CO5			2		2				2						

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318EEP09	Fundamentals of Data Structures in C Laboratory	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- Understand and implement basic data structures using C
- Apply linear and non-linear data structures in problem solving
- Learn to implement functions and recursive functions by means of data structures
- Implement searching and sorting algorithms.

LIST OF EXERCISES

1. Basic C Programs – Looping, Decision- Making
2. Programming using Arrays and String functions
3. Programming using Functions and Recursion
4. Programs using Structures and Union
5. Program using Pointers
6. Program using Memory Management Functions
7. Linked list implementation of List ,Stacks and Queues
8. Implementation of Tree Traversals
9. Implementation of Binary Search trees
10. Implementation of Graph Traversals
11. Implementation of Shortest Path Algorithm
12. Implementation of Linear search and binary search
13. Implementation of Insertion sort, Quick sort and Merge Sort

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Implement basic and advanced programs in C
CO2 Implement functions and recursive functions in C
CO3 Apply the different Linear Data Structures for Implementing Solutions to PracticalProblems.
CO4 Apply and implement Graph Data Structures for Real Time Applications.
CO5 Implement various Searching, Sorting and hashing Algorithms.

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

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Semester IV

418NMT01	Numerical Methods	L	T	P	C
		3	1	0	4

COURSE 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 9+3

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 9+3

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

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 9+3

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 9+3

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 DIFFERENTIAL EQUATIONS 9+3

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

TOTAL:45+15 = 60 PERIODS

COURSE OUTCOMES

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

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

CO2 Use the concept of interpolation and apply to real life situations.

CO3 Appreciate numerical solutions for differential and integral calculus as a handy tool to solve problems.

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CO4 Implement numerical algorithms to find solutions for intial value problems for ordinary differential equations.

CO5 Demonstrate algorithms using finite differences to obtain solutions to boundary value problems.

TEXT BOOKS

1. Kandasamy.P, Thilagavathy,K. & Gunavathi.K., "Numerical Methods"., S.Chand & Company Ltd., New Delhi, 2014.
2. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2012.

REFERENCE BOOKS

1. Richard L.Burden and J.Dougles Faires, "Numerical Analysis", Ninth Edition, BROOKS/COLE, Visit: www.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.
4. Ward Cheney and David Kincaid, "Numerical Mathematics and Computing", Brooks/Cole Publishing company, Fourth Edition, 1999.
5. Jain M K, Iyengar S R K and Jain R K, "Numerical methods for Scientific and Engineering Computation", 6th edition, New Age International (P) Ltd, 2012.

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	1	1	1							2	2	2	
CO2	3	3	2	2	1							2	2	2	
CO3	3	3	3	2	2							2	2	2	
CO4	3	2	1	1	1							2	2	2	
CO5	3	2	2	2	2							2	2	2	

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418EET02	Control Systems	L	T	P	C
		3	0	0	3

Prerequisite: Electric Circuits, Engineering Mathematics-III

COURSE OBJECTIVES

- To make the student to understand the methods of obtaining the open-loop andclosed–loop systems.
- To make them understand the methods of representation of systems and to derivetheir transfer function.
- To make them gain knowledge in the time-domain and frequency domain response of systems
- To make them analyze the stability of the systems
- To make them analyze the system in state space representation.

UNIT I CONTROL SYSTEM MODELING 9

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

UNIT II TIME RESPONSE ANALYSIS 9

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

UNIT III FREQUENCY RESPONSE ANALYSIS 9

Frequency Response- Frequency Domain specifications -Bode Plot, Polar Plot, Nyquist Plot-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 9

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 9

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

TOTAL:45 PERIODS

COURSE OUTCOMES

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

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 transferfunction 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 designcompensator.

CO5 Ability to analyze the system in state space representation.

TEXT BOOKS

1. Nagrath I J and Gopal M, "Control System Engineering ", New Age InternationalPvt Ltd, Sixth Edition, 2017.
2. Ogata K, "Modern Control Engineering", Prentice-Hall of India Pvt Ltd., NewDelhi,

2010.

REFERENCE BOOKS

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

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

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418EET03	Digital Electronic Circuits	L	T	P	C
		3	0	0	3

Prerequisite: Basic Knowledge in Electron Devices

COURSE OBJECTIVES

- To study various number systems and to simplify the mathematical
- To study the implementation of combinational circuits
- To study the design and analysis of various synchronous sequential circuits.
- To study the design and analysis of various asynchronous sequential circuits.
- 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- Gray, EX-3codes, encoders, decoders,multiplexers and Demultiplexer. 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, Registersand their applications, Synchronous and asynchronous 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 assignment, state reduction.

UNIT IV ASYNCHRONOUS SEQUENCTIAL CIRCUITS 9

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

UNIT V MEMORY DEVICES, PROGRAMMABLE LOGIC DEVICES 9

Memories: Read only memories, PROMs, EPROMs, EEPROMs, and RAMs: Static RAM,Dynamic RAM, Magnetic memories, CD-ROM, Flash memories. Introduction to Programmable Logic Devices: PLA, PAL, CPLD, EPLD, FPGA.

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course, the student will be

CO1 Gained the knowledge of fundamental concept of various number systems
CO2 Able to Implement simple combinational logic circuits using logic gates.
CO3 Able to design of various synchronous sequential circuits.
CO4 Able to design of various asynchronous sequential circuits.
CO5 Understood about semiconductor memories, PLDs.

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. Comer "Digital Logic & State Machine Design, Oxford, 2012.
4. James W. Bignel, Digital Electronics, Cengage learning, 5th Edition, 2007.

REFERENCE BOOKS

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

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2. Thomas L.Floyd, 'Digital Fundamentals', 11th edition, Pearson Education, 2015.
3. Mandal, "Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
4. D.P.Kothari, J.S.Dhillon, 'Digital circuits and Design', Pearson Education, 2016.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3												2		
CO2	1	3	3										3		2
CO3		3	3										3		1
CO4			1										2		
CO5		2	2		2				3				3	1	

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418EET04	Power Generation Systems	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn about the generation of electric power by steam and gas powerstations.
- To understand the generation of electric power by hydro power station.
- To understand the generation of electric power by nuclear and diesel power stations.
- To understand the various types of wind energy conversion systems.
- To study the generation of electric power from solar energy using solarPhotovoltaic systems.

UNIT I STEAM AND GAS POWER PLANT **9**

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.

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 characteristics of diesel engines.

UNIT IV WIND ENERGY **9**

Introduction-Basic principles of wind energy conversion-site selection considerations-basic components of Wind Energy Conversion System-Classification of WECS-Horizontal and vertical axial machines -Advantages and disadvantages of WECS- Grid connection.

UNIT V SOLAR ENERGY **9**

Solar constant-solar radiation measurements-solar radiation Data-Solar energy collectors-Flat-plate collectors and concentrating collector-Solar energy storage-Solar Pond-Solar Electric Power Generation: Solar Photo-Voltaic Systems -Applications of Solar Photovoltaic systems- Solar Pumping-Grid connection. Storage systems-Battery, super capacitor.

TOTAL:45 PERIODS

COURSE OUTCOMES

The student will be/have

CO1 Understanding the layout, construction and working of steam and gas power plants
CO2 Understanding the layout, construction and working of hydro power station and identify the appropriate site for it.
CO3 Understanding the layout, construction and working of Nuclear and Diesel power station.
CO4 Understanding the layout, construction and working of Wind Energy Conversion systemand its applications.
CO5 Analyzing the solar energy system, radiation measurements and applications.

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TEXT BOOKS

1. Renewable Energy Technologies, Solanki, Chetan S. , PHI Learning, New Delhi, 2011
2. Non-Conventional Energy Sources, G.D. Rai , Khanna Publishers, New Delhi, 2011.
3. Solar Energy, S.P.Sukhatme and J.K Nayak, McGraw Hill education, Fourth Edition, 2017.
4. Wind Power Technology, Earnest, Joshua, PHI Learning, New Delhi, 2013.

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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,2007.
3. Wind Power in Power System, Thomas Ackermann, John Willey &Sons, 2005
4. Electric Power Generation: Transmission and Distribution, S. N. Singh, PHI Learning,2008.
5. A Text book of Power System Engineering, A Chakrabarti, M. L Soni, P. V. Gupta, U. S.Bhatnagar, Dhanpat Rai Publication.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	2											2		
CO2	3	2											2		
CO3		3	3	2	2				2		2	2	2	3	2
CO4			3	3	3				3		2	2	2	2	1
CO5	3		2		2						2		2		

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418EET05	Electrical Machines-I	L	T	P	C
		3	0	0	3

Prerequisite: Basic knowledge in Electromagnetic Theory is required

COURSE OBJECTIVES

- To introduce the concept of rotating machines and the principle of electromechanical energy conversion in single and multiple excited systems.
- To understand the working principle of generation of D.C. voltages by usingdifferent types of generators.
- To study the working principles of D.C. motors and their load characteristics,starting and methods of speed control. and study their performance
- To study the testing and methods of speed control of D.C. motors.
- To study the working principles of transformers, autotransformer and thedifferent testing methods to estimate their performance.

UNIT I ENERGY CONVERSIONS AND ROTATING MACHINES 9

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 fieldsin rotating machines- Problems.

UNIT II DC GENERATORS 9

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

UNIT III DC MOTORS 9

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: need for starters, two point, three point and four point. Losses and efficiency - Applications- Problems.

UNIT IV TESTING AND SPEED CONTROL OF DC MACHINES 9

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 disadvantages – Applications - Numerical problems. Speed control: Armature and field control on Shunt motor - Ward- Leonard control system - advantages and disadvantages.

UNIT V TRANSFORMERS 9

Constructional details - Principle of operation - Classification of Transformers-Ideal transformers - EMF equation - Transformation ratio - Equivalent circuit - Voltage regulation - Losses and Efficiency - All day efficiency — Open circuit and short circuit tests - Sumpner's test- Separation of no load losses - Problems. Auto-Transformer - Principle of operation - Applications.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Able to understand the basic concepts of rotating machines.

CO2 Learn the working principles and characteristics of DC Generators and motors.

CO3 Analyze the performance characteristics of Rotating Machines.

CO4 Gain the knowledge in testing and speed control on DC machines.

CO5 Learn the working principles, performance of transformer and autotransformer.

TEXT BOOKS

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

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Company Ltd, Fifth edition , 2017.
2. P.S. Bimbhra, 'Electrical Machinery', Khanna Publishers, 7th Edition, 2011
3. B.L. Theraja, 'A text book of Electrical Technology', Volume II , S. Chand Limited, 2017 .

REFERENCE BOOKS

1. Fitzgerald.A.E. Charles Kingsely Jr, Stephen D.Umans, 'Electric Machinery', 2017.
2. P. C. Sen., 'Principles of Electrical Machines and Power Electronics', JohnWiley&Sons, 2013
3. K. Murugesh Kumar, 'Electric Machines', Vikas publishing house Pvt Ltd, 2010.
4. Cotton H, "Advanced Electrical Technology", A H Wheeler and CompanyPublications, London, 2011.

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

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418EEE07	Neural Networks and Fuzzy Systems	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To conceptualize the working of human brain using ANN.
- To become familiar with neural networks that can learn from available examples and generalizeto form appropriate rules for inference systems.
- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on humanexperience.
- To provide the mathematical background for carrying out the optimization and familiarizingvarious algorithm for seeking global optimum in self-learning situation.
- To provide the ideas of neuro-fuzzy controller systems.

UNIT I INTRODUCTION TO NEURAL NETWORKS 9

Introduction to Neural Networks, Biological Neural Networks, Comparison between Neural networks and Biological Neural Networks-Fundamental concepts, weights, biases and thresholds-Linear capability-Common activation functions, Learning rules and Learning methods of NN- Supervised Learning algorithms, Un-Supervised Learning algorithms, Single Layer, Multilayer Feed forward network- Recurrent network.

UNIT II NEURAL NETWORKS ARCHITECTURES AND ALGORITHMS 9

Mcculloh Pitts neuron-Hebbnet-Perceptron-Adaline-Hopfield net-Maxnet-Mexican Hat-Hamming net-Kohonen self-organizing map-Adaptive resonance theory-Back propagation neural network.

UNIT III FUZZY SETS AND RELATIONS 9

Crisp set-vagueness – uncertainty and imprecision – fuzzy set-fuzzy operators – properties – crisp versus fuzzy sets-representation of fuzzy sets-Membership functions, fuzzy complements, union, interaction combination of operators, crisp and fuzzy relations – compositions of fuzzy relations

UNIT IV CONCEPTS OF FUZZY LOGIC 9

Fuzzy Systems- Fuzzification, Membership value assignment, development of rule base and decision making system, Defuzzification to crisp sets, Defuzzification methods –Fuzzy Structure ofFuzzy logic controllers- Comparison of Fuzzy and Neural Systems.

UNIT V APPLICATIONS OF NEURAL NETWORKS AND FUZZY SYSTEMS 9

Cognitron and Neocognitron Architecture-Training Algorithm and application-Fuzzy associative memories-fuzzy and neural function estimators- Fuzzy associative memories system Architecture--Adaptive neuro, Adaptive Fuzzy, Adaptive Neuro-Fuzzy interface systems-Neuro Controller, Fuzzy logicController.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Ability to understand the difference between biological neuron and neural networks

CO2 Ability to understand the difference between learning and programming and explore practical applications of Neural Networks (NN).

CO3 Ability to appreciate the importance of optimizations and its use incomputer engineering fields and other domains.

CO4 Ability to analyze and appreciate the applications which can use fuzzylogic.

CO5 understood the efficiency of a hybrid system and how NeuralNetwork and fuzzy logic can be hybridized to form a Neuro-fuzzy network and its various applications.

TEXT BOOKS

1. Introduction to Neural Networks using MATLAB 6.0 – S.N.Sivanandam,

S.Sumathi,S.N.Deepa,TMH, 2006.
2. Timothy J.Ross "Fuzzy Logic With Engineering Applications" Wiley, 2011.
3. Laurene Fausett, "Fundamentals of Neural Networks: Architecture, Algorithms andApplications", Pearson Education, 2004.

REFERENCE BOOKS

1. Satish Kumar "Neural Networks A Classroom Approach" Tata McGrawHill,2017.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai "Neural Networks, Fuzzy Logic and GeneticAlgorithms"PHILearning,2003.
3. Zimmermann H.S "Fuzzy Set Theory and its Applications" Kluwer Academic Publishers,2011.

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

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418EEE09	Fundamentals of Nano Science	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To study the basics of nano science
- To study the various methods preparation
- To study the basics about nano materials
- To study the different characterization techniques
- To understand the applications of nano science in different fields

UNIT I INTRODUCTION 9

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering Classifications of nanostructured materials- nano particles- quantum dots, nanowires-ultra-thin films multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

UNIT II GENERAL METHODS OF PREPARATION 9

Bottom-up Synthesis-Top-down Approach: Co-Precipitation, Ultrasonication, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

UNIT III NANOMATERIALS 9

Nanoforms of Carbon - Buckminster fullerene- graphene and carbon nanotube, Single wall carbon Nanotubes (SWCNT) and Multi wall carbon nanotubes (MWCNT)- methods of synthesis(arc-growth, laser ablation, CVD routes, Plasma CVD), structure-property Relationshipsapplications- Nanometal oxides-ZnO, TiO2,MgO, ZrO2, NiO, nanoalumina, CaO, AgTiO2, Ferrites, Nanoclays functionalization and applications-Quantum wires, Quantum dots- preparation, properties and applications.

UNIT IV CHARACTERIZATION TECHNIQUES 9

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysistechniques-AFM, SPM, STM, SNOM, ESCA, SIMS-Nan indentation.

UNIT V APPLICATIONS 9

NanoInfoTech: Information storage- nanocomputer, molecular switch, super chip, nanocrystal, Nanobiotechlogy: nanoprobes in medical diagnostics and biotechnology, Nano medicines, Targetted drug delivery, Bioimaging - Micro Electro Mechanical Systems (MEMS), Nano Electro Mechanical Systems (NEMS)- Nanosensors, nano crystalline silver for bacterial inhibition, Nanoparticles for sunbarrier products - In Photostat, printing, solar cell, battery.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Familiarized about the nanoscience
CO2 Able to demonstrate the preparation of nonmaterial
CO3 Learnt about nano materials
CO4 Having developed knowledge in characteristic nonmaterial
CO5 Learnt the applications of Nano materials

TEXT BOOKS

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties andApplications", Institute of Physics Publishing, Bristol and

Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition,Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCE BOOKS

1. G Timp, "Nanotechnology", AIP press/Springer, 1999.
2. Akhilesh Lakhtakia,"The Hand Book of Nano Technology, Nanometer Structure, Theory, Modeling and Simulations". Prentice-Hall of India (P) Ltd, New Delhi, 2007.

COs	Programme Outcomes												Programme Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO1	PSO2	PSO3
CO1	3		2			2	1							2	
CO2	3	2		2		1									
CO3		3		2										2	1
CO4	2	2		3		2								2	1
CO5	2	2		2		2								3	

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418EEP07	Electrical Machines-I Laboratory	L	T	P	C
		0	0	2	1

COURSE 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 on DC shunt motor.
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

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, the students will have:

CO1 Analyzed the characteristics of DC generators.

CO2 Tested the DC motors.

CO3 Ability to analyze speed and efficiency of DC machines.

CO4 Understood the various tests on transformers.

CO5 Ability to understand the various losses of transformers.

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											1
CO2	3	2	2	2											
CO3	3	2		2										2	
CO4	3	2	2	1											
CO5	3	2			3				1				2		

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418EEP08	Electrical and Electronics Simulation Laboratory	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- Gain knowledge on characteristics of Electrical and Electronics simulation

LIST OF EXPERIMENTS

1. Introduction to MATLAB
2. Diode characteristics
3. MOSFET characteristics
4. SCR characteristics
5. Single phase Half wave rectifier with R load
6. Single phase Half wave rectifier with RL load
7. Single phase full wave rectifier with R load
8. Single phase full wave rectifier with RL load
9. IGBT characteristics.
10. Basic operations of matrices using MATLAB
11. Pspice simulation of DC circuits
12. Pspice simulation of AC circuits

TOTAL:45 PERIODS

COURSE OUTCOMES

Upon successful completion of the course, the students will have:

CO1 Analyzed the characteristics of diode.

CO2 Analyzed and verified different Rectifiers.

CO3 Demonstrated the operation of Single phase half wave and full wave rectifiers

CO4 Understood basic operations of Matrices.

CO5 Analyzed the characteristics of DC and AC circuits using Pspice.

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	1	2											1		
CO2	1		2										2		1
CO3	1	2	2										1		
CO4	2	1	2										1		
CO5	2		3		2				1				2	2	1

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418EEP09	Control Systems Laboratory	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES

- 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 EXERCISES

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. Simulation of first order system using MATLAB.
8. Simulation of 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.

TOTAL:45 PERIODS

COURSE OUTCOMES

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

CO1 Analyze the Transfer function of separately excited DC generators.
CO2 Analyze Transfer function of self-excited DC generators.
CO3 Analyze speed control of DC motor.
CO4 Understand the various position control systems
CO5 Learn about the various controllers and networks.

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

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

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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/

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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 INDUCTION MOTOR** **12**

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 MACHINES** **12**

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.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	ADVANCED	L	T	P	C	CA	EA	Total
515EET03	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

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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.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EET04	PROTECTION 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

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.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
515EET05	TRANSMISSION 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.

UNIT – V SUBSTATION AND DISTRIBUTION SYSTEMS 9

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

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.

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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

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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	

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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

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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		

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

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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		

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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

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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	PSO1	PSO2	PSO3
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			Credits	Maximum Marks		
615EET03	POWER SYSTEM ANALYSIS AND STABILITY	L	T	P	C	CA	EA	TOTAL
		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.

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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	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.

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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.

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

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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		
		L	T	P	C	CA	EA	Total
615EEE05	ELECTRICAL SAFETY,OPERATION REGULATIONS	3	0	0	3	50	50	100

OBJECTIVES

1. To bring general understanding of various electrical systems.
2. To understand practical considerations in their design and various roles of an Electrical Engineer in industry.
3. To learn aboput the safety and protection of various electrical systems.
4. To involve project feasibility, planning. Preparing and reading electrical drawings.

UNIT I CONCEPTS AND STATUTORY REQUIREMENTS 9

Introduction – electrostatics, electro magnetism, stored energy, energy radiation and electromagnetic interference – Working principles of electrical equipment-Indian electricity act and rules-statutory requirements from electrical inspectorate-international standards on electrical safety – first aid-cardio pulmonary resuscitation(CPR).

UNIT II ELECTRICAL HAZARDS 9

Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity. Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges-Safety in handling of war equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect-static electricity –definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization, spark and arc ignition energy-national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS 9

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage – voltage –safe distance from lines-capacity and protection of conductor-joints-and connections, overload and short circuit protection-no load protection-earth fault protection. FRLS insulation-insulation and continuity test-system grounding-equipment grounding-earth leakage circuit breaker (ELCB)-cable wires-maintenance of ground-ground fault circuit interrupter-use of low voltage-electrical guards-Personal protective equipment – safety in handling hand held electrical appliances tools and medical equipments.

UNIT IV SELECTION, INSTALLATION, OPERATION AND MAINTENANCE 9

Role of environment in selection-safety aspects in application - protection and interlock-self diagnostic features and fail safe concepts-lock out and work permit system-discharge rod and earthing devices- safety in the use of portable tools-cabling and cable joints-preventive maintenance-study of various level of authorized certificate for maintenance work.

UNIT V HAZARDOUS ZONES 9

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies.

Lecture:45, TOTAL: 45

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Course Outcomes

CO1 Understand concept and statutory requirements

CO2 Elaborate knowledge about electrical hazards

CO3 Gained the knowledge of protection system

CO4 Understand selection, installation, operation and maintenance, hazardous zones.

	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	2				2	1						2			2
CO3	3	2		2				1			3	2	2	2	
CO4	3		2												

TEXT BOOKS

1. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1998.
2. Accident prevention manual for industrial operations, N.S.C., by Relink books Publishers, New Edition 2017.
3. Indian Electricity Act and Rules, Government of India-2013.

REFERENCES

1. Power Engineers – Handbook of TNEB, Sixth Edition, and Re printed 2011.
2. Martin Glov Electrostatic Hazards in powder handling, Research Studies Pvt.LTd., England, 1988.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615EEE07	ELECTRICAL ENGINEERING MATERIALS	3	0	0	3	50	50	100

Prerequisite: NIL

OBJECTIVES

1. To focus on different types of conducting materials and properties.
2. To study about the semiconductor materials and their prpoerties
3. To understand the knowledge of dielectric insulating materials and applications.
4. To learn about the piezo electric materials and special applications materials.

UNIT I CONDUCTING MATERIALS 9

Review of metallic conduction on the basis of free electron theory Fermi-Dirac distribution – variation of conductivity with temperature and composition, materials for electric resistors- general electric properties; brushes of electrical machines, lamp filaments, fuses and solder.

UNIT II SEMICONDUCTORS 9

Mechanism of conduction in semiconductors, density of carriers in intrinsic semiconductors, the energy gap, types of semiconductors. Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors. Magnetic materials: Classification of magnetic materials- origin of permanent magnetic dipoles, ferromagnetism, hard and soft magnetic materials magneto materials used in electrical machines, instruments and relays.

UNIT III DIELECTRICS INSULATING MATERIALS 9

Dielectrics: Dielectrics polarization under static fields- electronic ionic and dipolar polarizations, behavior of dielectrics in alternating fields, Factors influencing dielectric strength and capacitor materials. Insulating materials, complex dielectric constant, dipolar relaxation and dielectric loss. Insulating materials: Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

UNIT IV INTRODUCTION PROPERTIES AND APPLICATION OF PIEZOELECTRIC MATERIALS 9

Introduction Properties and Application of Piezoelectric materials, Eletrostrictive materials, Ferromagnetic materials, Magnetosrtictive materials, Shape memory alloys, Electro archeological fluids, Magneto archeological fluids, Smart hydrogels.

UNIT V MATERIALS FOR SPECIAL APPLICATIONS 9

Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, sintered alloys for breaker and switch contacts.

Lecture: 45, TOTAL: 45

Course Outcomes

CO1 Students able to understand the types and properties of conducting materials.

CO2 Students able to differentiate the properties of semiconductors and dielectric insulations.

CO3 Students able to explain the application of Piezo electric materials.

CO4 Students able to use the materials for special applications.

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

TEXT BOOKS

1. Ashby, M. F. and Jones, D. R. H., "Engineering Materials: an Introduction to their Properties and Applications", Fourth Edition. Pergamon Press, 2011.

2. Deighton, M., Mead, J. A., "Introduction to Materials Science", Oxford U. P., 1978.

3. Brick, R. M., Pense, A. W., and Gordon, R. B., "Structure and Properties of Engineering Materials", 4th Edn., McGraw-Hill, 1977.

4. Budworth, D. W., "Intorudction to Ceramic Science", revised, Elsevier Publisher, 2016

REFERENCES

1. Van, V. and Lawrence, H., "Materials Science for Engineers", Addison-Wesley, 1970.

2. Van, V. and Lawrence, H., "Elements of Materials Science and Engineering", 6th Edn., Addison-Wesley, 1989.

3. Shackelford, J. F., "Introduction to Materials Science for Engineers", 4th Edn., Prentice-Hall International, 1998. 9. Smith, W. F., "Principles of Materials Science and Engineering", 2nd Edn.,McGraw-Hill, 1990.

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

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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									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

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
615EEP07	POWER 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		
		L	T	P	C	CA	EA	Total
615EEP09	ELECTRONIC SYSTEM DESIGN LABORATORY	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	

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EET02	POWER SYSTEM 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 – FREQUENCY CONTROL **12**

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 – VOLTAGE CONTROL **12**

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

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EET03	ELECTRIC 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

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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.

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		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 SOURCES 9

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.

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UNIT - V POWER QUALITY SOLUTIONS 9

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.

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
715EEE10	SPECIAL ELECTRICAL MACHINES	L	T	P	C	CA	EA	TOTAL
		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	PSO1	PSO2	PSO3
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.

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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

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
715EEP08	POWER SYSTEM 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		

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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 ELECTRICITY **09**

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.

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

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Course code	Course Title	Hours/week			Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815EEE03	Advanced Electric Drives	3	0	0	3	50	50	100

Prerequisite: Power Electronics,Electric Drives and Control

Objectives:

- To understand steady state operation and transient dynamics of a motor load system.
- To study and analyze the operation of the converter / chopper fed dc drive, both qualitatively and quantitatively.
- To study and understand the operation and performance of AC motor drives.
- To analyze and design the current and speed controllers for a closed loop solid state DC motor drive gain knowledge in the sources and effects of lightning, switching and temporary over voltages.

UNIT – I DRIVE CHARACTERISTICS 9

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

UNIT – II CONVERTER / CHOPPER FED DC MOTOR DRIVE 9

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

UNIT - III INDUCTION MOTOR DRIVES 9

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

UNIT - IV SYNCHRONOUS MOTOR DRIVES 9

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

UNIT - V DESIGN OF CONTROLLERS FOR DRIVES 9

Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode – design of controllers; current controller and speed controller-converter selection and characteristics.

Lecture: 45, TOTAL: 45

Course Outcomes:

CO1: Basic requirement of motor selection for different load profiles are studied.

CO2: Stability aspects of drive systems are studied.

CO3: Important features of DC and AC drives are studied.

CO4: Controller design for DC drives is studied.

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

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TEXT BOOKS:

1. G. K. Dubey : Fundamentals of Electrical Drives, 2nd Edition, Alpha Science International, 2001.
2. S. B. Dewan, Gordon R. Slemon and A. Straughen: Power Semiconductor Drives, John Wiley Pub.1996.
3. R. Krishnan: Electric Motor drives - Modeling, Analysis and Control, PHI India Ltd., 2002.

REFERENCES:

1. Mohan, N., Electric Drives: An Integrative Approach, MNPERE ,2001.
2.Krishnan, R., Electric Motor & Drives: Modeling, Analysis& Control, PHI Pvt. Ltd. 2001.
3. Bose B.K., Modern Power Electronics & AC Drives, PHI Pvt. Ltd., 2001
4. W. Shepherd, D. T. W. Liang and L.N. Hulley: Power Electronics and Motor Control, 2nd Edition, Cambridge Univ. Press, 1995

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CourseCode	CourseTitle	Hours/week			Credits	Maximum Marks		
815EEE04	Distributed Generation and Micro Grid	L	T	P	C	CA	EA	TOTAL
		3	0	0	3	50	50	100

Prerequisite: Renewable energy sources

Objectives:

1. To illustrate the concept of distributed generation
2. To analyze the impact of grid integration.
3. To study concept of Microgrid and its configuration.
4. To analyze control and protection of microgrid.

UNIT–I INTRODUCTION **09**

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements:

UNIT-II DISTRIBUTED GENERATIONS **09**

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE1547. DG installation classes, security issues in DG implementations. Energy storage elements:Batteries,ultra-capacitors, flywheels. Captivepower plants

UNIT-III IMPACT OF GRID INTEGRATION **09**

Requirements for grid interconnection, limits on operational parameters,: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with non conventional energy sources on existing power system: reliability, stability and power quality issues.

UNIT-IV BASICS OF A MICROGRID **09**

Concept and definition of micro grid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.

UNIT-V CONTROL AND OPERATION OF MICROGRID **09**

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

Lecture:45,TOTAL: 45HRS

CourseOutcomes:

CO1 Attaining knowledge on the various schemes of conventional and nonconventional power generation.

CO2 Learning about energy sources of distributed generation.

CO3 Learning about the fundamental concept of Microgrid and the requirements for grid interconnection.

CO4 Understanding protection issues and control schemes

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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	2						2			2		1	2	
CO2	2	1	3				2					2		3	2
CO3	2	2			3			3			3		2	3	
CO4	3								3				3		

TEXTBOOKS:

1 John Twidell and Tony Weir, "Renewable Energy Resources" Tyalor and Francis Publications, Second edition 2006

2 DorinNeacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006

3 S. Chowdhury, S.P. Chowdhury and P. Crossley Microgrids and Active Distribution Networks,2009.

REFERENCEBOOKS:

1 Chetan Singh Solanki, "Solar Photo Voltaics", PHI learning Pvt. Ltd., New Delhi,2009

2 J.F. Manwell, J.G. McGowan "Wind Energy Explained, theory design and applications", Wiley publication 2010.

3 D. D. Hall and R. P. Grover, "Biomass Regenerable Energy", John Wiley, New York,1987.

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Course Code	Course Title	Hours/week		Credits	Maximum Marks		
		L	T	P	C	CA	EA	Total
815EEE05	HVDC Transmission Systems	3	0	0	3	50	50	100

Prerequisite: Transmission and Distribution.

Objectives:

1. To study about importance of HVDC transmission,
2. To study about Analysis of HVDC converters, Faults and protections,
3. To study about Harmonics and Filters. I
4. To study about Reactive power control and Power factor improvements of the system

UNIT – I BASIC CONCEPTS **9**

Economics and Terminal equipment of HVDC transmission systems: Types of HVDC Links – Apparatus required for HVDC Systems – Comparison of AC &DC Transmission, Application of DC Transmission System – Planning & Modern trends in D.C. Transmission-Introduction to multi terminal HVDC system.

UNIT – II ANALYSIS OF HVDC CONVERTERS **9**

Choice of Converter configuration – analysis of Graetz – characteristics of 6 Pulse & 12 Pulse converters – Cases of two 3 phase converters in star –star mode – their performance.

UNIT – III CONVERTER & HVDC SYSTEM CONTROL **9**

Principle of DC Link Control – Converters Control Characteristics – Firing angle control – Current and extinction angle control – Effect of source inductance on the system; Starting and stopping of DC link; Power Control.

UNIT-IV REACTIVE POWER CONTROL IN HVDC **9**

Reactive Power Requirements in steady state-Conventional control strategies-Alternate control strategies-sources of reactive power-AC Filters – shunt capacitors-synchronous condensers.

UNIT –V POWER FLOW ANALYSIS IN DC SYSTEMS **9**

Modeling of DC Links-DC Network-DC Converter-Controller Equations-Solution of DC load flow – P.U. System for d.c. quantities-solution of DC Power flow-Simultaneous method-Sequential method.

Lecture: 45, TOTAL: 45

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Krishnagiri

Course outcomes:

CO1: To understand basic concepts of HVDC systems

CO2: To understandPower factor improvements of the system

CO3: Emphasis knowledge in the converter control systems

CO4: Power flow analysis in DC Systems

	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			3	3	2	
CO2	3	3	2		2				2		3		3	2	
CO3	2	3	2					2		1			3	3	1
CO4	1												2	3	

TEXT BOOKS:

1.K.R.Padiyar, HVDC Power Transmission Systems, London: New Academic Science, New
Age International (UK), Third edition, 2017

2.S. Rao ,Ehv-Ac,Hvdc Transmission & Distribution, Khanna Publishers , Third Edition, 2009

REFERENCE BOOKS:

1. J.Arrillaga, High Voltage Direct Current Transmission , The Institution of Electrical Engineers- London, 1998.
2. E.W.Kimbark, Direct Current Transmission, John Wiley & Sons.1999
3. E.Uhlmann, Power Transmission by Direct Current, Springer,2011

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Course Code	Course Title	Hours/week			Credits	Maximum Marks		
	Virtual	L	T	P	C	CA	EA	Total
815EEE07	Instrumentation	3	0	0	3	50	50	100

Prerequisite: Nil

Objectives:

1. To review background information required for studying virtual instrumentation.
2. To study the basic building blocks of virtual instrumentation.
3. To study the various techniques of interfacing of external instruments of PC.
4. To study the various graphical programming environment in virtual instrumentation.

UNIT – I REVIEW OF DIGITAL INSTRUMENTATION **9**

Representation of analog signals in the digital domain – Review of quantization in amplitude and time axes, sample and hold, sampling theorem, ADC and DAC.

UNIT – II GRAPHICAL PROGRAMMING AND LABVIEW **9**

Concepts of graphical programming – LabVIEW software – Concept of VIs and sub VI - Display types – Digital – Analog – Chart and Graphs. Loops -structures - Arrays – Clusters. Local and global variables – String and file I/O. Timers and dialog controls.

UNIT – III INSTRUMENT INTERFACES AND PROTOCOLS **9**

RS232, RS 422, RS 485 and USB standards - IEEE 488 standard – Introduction to bus protocols of MOD bus and CAN bus. Electronic standards for signals – noise and EMI effects. Signal conditioning chassis and extension modules. Image acquisition cards.

UNIT – IV PC BASED DATA ACQUISITION **9**

Concept of PC based data acquisition – Typical on board DAQ card – Resolution and sampling frequency - analog inputs and outputs – Single-ended and differential inputs –DAQ cards terminal boxes - Use of timer-counter and analog outputs on the universal DAQ card.

UNIT – V SIGNAL PROCESSING AND NETWORK BASED AUTOMATION **9**

Mathematical tools for statistical calculation – Signal processing tools- Windowing and filtering tools –Control system tools – PID controller – CRO – function generator – illustration and case study – Web publishing tool –configuring VI server.

Lecture : 45,TOTAL : 45

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Course Outcomes:

CO1 Understood the basics concepts and fundamentals of virtualinstrumentation.
CO2 Able to apply and relate the basic tools and techniques to conductdesign experiments for automation of industrial processes.
CO3 Learnt about create a virtual instrument through graphical userinterface.
CO4 Understood to write simple programs in LabVIEW using variables.

	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	2	2
CO2	2	2	3					2			2		2	3	2
CO3	2	2		3		2				2		3	1	3	
CO4	3									2			3	2	

TEXT BOOKS

1 Sanjeev Gupta, 'Virtual Instrumentation using LabVIEW' TMH, 2004
2 Gary W.Johnson, Richard Jennings, 'Lab-view Graphical Programming', McGraw Hill Professional Publishing, 2001.

REFERENCE BOOKS

1 Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.
2 Kevin James, 'PC Interfacing and Data Acquisition: Techniques or Measurement, Instrumentation and Control', Newness, 2000.

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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 LOGIC 9

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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