EE16201 **CIRCUIT THEORY** **3 2 0 4**

(COMMON TO EEE / CHEMICAL)

COURSE OBJECTIVES

- To understand the basics of circuit theory and analysis of electric circuits.
- To apply the network elements and theorems for the analysis of complex circuits.
- To analyse the coupled circuits using the series & parallel resonance circuit terminologies.
- To compute the transient responses of RLC circuits.
- To understand the concepts of power measurements.

UNITI BASICS OF CIRCUIT ELEMENTS AND ANALYSIS 15

Basics of circuit elements - Network reduction – voltage division – current division – Star – delta transformation - Ohm's Law – Kirchhoff's laws – DC and AC Circuits -Mesh current and node voltage method of analysis.

UNITII NETWORK THEOREMS 15

Thevenin's Theorem- Norton's Theorem- Superposition theorem- Maximum power transfer theorem, Reciprocity theorem, Substitution theorem, Compensation theorem, Millman's theorem, Tellegan's theorem– Statement, illustration. Application to DC and AC circuits.

UNITIII RESONANCE AND COUPLED CIRCUITS 15

Series resonance, parallel resonance – Q factor – Bandwidth.Self-Inductance – Mutual Inductance – Coefficient of coupling – dot rule – ideal transformer effective inductance of coupled coils in series & in parallel – Analysis of magnetic circuits.

UNITIV TRANSIENT CIRCUITS 15

Transient response of RL, RC and RLC circuits using Laplace transform for DC input and AC with sinusoidal input. Introduction to PSpice-Application to electrical circuits.

UNITV POWER MEASUREMENTS 15

Power, Power Factor and Energy, Power measurement by 3 volt meter and 3 ammeter method - Solution of three phase balanced circuits & unbalanced circuits – Three phase power measurement using 2 wattmeter method

TOTAL: 75 PERIODS

COURSE OUTCOMES

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

- understand the basic elements, laws and circuit solving methods.
- analyse the complex circuits using the network theorems.
- design the resonance circuit and calculate the inductance under coupled conditions.
- perform transient analysis of electrical circuits
- understand the concepts of power measurements.

COURSE OUTCOMES

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

- know the concepts of water hardness and analysevarious types of water.
- familiar on instrumental analysis method for the presence of metals.

Mapping of Course Outcomes with Programme Outcomes (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak														
COs	**Programmes Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	3	-	-	-	2	-	-	-	-	-	-	-
CO2	2	-	2	2	-	-	-	-	-	-	-	-	-	-
CO3	-	3	3	1	-	-	2	-	-	-	-	-	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	-	-

EE16301 ELECTRON DEVICES AND CIRCUITS 3 0 0 3

COURSE OBJECTIVES

- To acquire the knowledge of PN junction diode, its VI characteristics and special diodes.
- To analyze the construction, theory and characteristics of BJT, FET and MOSFET.
- To impart knowledge on amplifier circuits and their performance and to familiarise the students with the concepts of biasing transistors and obtain the frequency response.
- To study the concepts on different classes of power amplifiers.
- To learn the basics of negative feedback amplifiers and their characteristics and oscillators

UNIT I PN JUNCTION DEVICES 9

PN junction diode –structure, operation and V-I characteristics, Diffusion and Transient Capacitance-Varactor Diode – Tunnel Diode.Rectifiers – Half Wave and Full Wave Rectifier,– Display devices- LED, Laser diodes-Zener diode, characteristics-Zener Reverse characteristics – Zener as regulator.

UNIT II TRANSISTORS 9

BJT, JFET, MOSFET- structure, operation, characteristics and Biasing UJT, Thyristor and IGBT -Structure and characteristics-Transistor as a switch-Use of a heat sink.

UNIT III AMPLIFIERS 9

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

UNIT IV MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER 9

Differential amplifier – Common mode and Difference mode analysis –Single tuned amplifiers Transformer coupled class A, B, C and AB power amplifiers, complementary symmetry amplifiers, push pull amplifiers.

UNIT V FEEDBACK AMPLIFIERS AND OSCILLATORS 9

Advantages of negative feedback – voltage / current, series, Shunt feedback –positive feedback –Condition for oscillations, phase shift – Wien bridge, Hartley, Colpitts, Crystal and UJT relaxation oscillator.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the VI characteristics of PN junction diode and special diodes.
- construct the characteristics of BJT, FET and MOSFET and analyze their VI characteristics.
- perform analysis of amplifiers and their frequency response
- give details about the operation of multistage power amplifiers.
- design feedback amplifiers and oscillators.

TEXT BOOKS

1. David.A.Bell, " Electronic Devices and Circuits ",Oxford University Press
2. Millman and C.Halkias, Electronic Devices and Circuits, Tata McGraw Hill., 2001

REFERENCES

1. Donald A. Neaman, "Electronic Circuits" Tata McGraw Hill
2. Mathur.S.P.,KulshreshthaD.C. &Chanda.P.R.,Electronic Devices – Applications and Integrated circuits– Umesh Publications.,1999.
3. Allen Mottershed, "Electronic Devices & Circuits, An Introduction", Prentice Hall Of India (P) Ltd,1999.
4. S.Salivahanan, "Electronic Devices and Circuits", Tata McGraw Hill, 2008, Second Edtion
5. Rashid, "Microelectronic circuits" Thomson Publication, 1999.
6. P.RameshBabu , "Electronic Devices and Circuits", SciTech Publications Pvt Ltd, 2005

WEB LINKS

1. http://ecee.colorado.edu/~bart/book/book/chapter4/ch4_6.htm
2. http://www.electronics-tutorials.ws/
3. http://hyperphysics.phy-astr.gsu.edu/hbase/electronic/feedn.html
4. http://onlinevideolecture.com/?course_id=821

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	3	-	-	-	-	-	-	-	2	-	3	3
CO2	3	-	3	1	2	-	-	-	-	-	2	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	2	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	2	-	3	3

EE16302 MEASUREMENTS AND INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

- To acquire the basic functional elements of instrument and bridges
- To learn the use of different types of meters for measuring electrical quantities such as current, voltage, power, energy, power factor and frequency
- To understand the working principle and applications of CRO and other electronic measuring devices
- To familiarize the instrumentational equipments such as signal generators and analyzer.
- To illustrate various types of transducers.

UNIT I BASIC MEASUREMENT CONCEPTS AND BRIDGES 9

Functional elements of an instrument – Static and dynamic characteristics – Standards and Calibration of measurements - Errors in measurement – Statistical evaluation of measurement data –Wheatstone bridge, Kelvin double bridge , Maxwell‟s bridge, Anderson bridge, Schering bridge, Wien bridge and Hay‟s Bridge.

UNIT II ELECTRICAL INSTRUMENTS 9

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

UNIT III ELECTRONIC MEASUREMENTS 9

Cathode ray oscilloscopes – block schematic – applications – Analog and digital storage oscilloscope, sampling oscilloscope –Digital plotters and printers- Q Meters-Vector Meters – RF Voltage and Power Measurements – True RMS Meters.

UNIT IV SIGNAL GENERATORS AND ANALYZERS 9

Function generators – pulse and square wave generators, RF signal generators – Sweep generators – Frequency synthesizer – wave analyzer – Harmonic distortion analyzer – spectrum analyzer - digital spectrum analyzer – Digital L,C,R Measurements and Digital RLC Meters.

UNIT V TRANSDUCERS 9

Introduction of transducers – Classifications Selection of transducers – Resistive transducer – Potentiometer - Strain gauge –Inductive transducer - LVDT – Capacitive transducer - Piezo-electric transducers – Optical transducer - Encoders –Measurement of pressure and flow –Smart sensors.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the basic quantities in measurements using bridges.
- analyze various measuring techniques for both electrical and non-electrical quantities.
- evaluate the various types of oscilloscope.

- elaborate the basic fundamentals of signal generators and analyzer.
- compare & differentiate the types of transducers.

TEXT BOOKS

1. Albert D.Helfrick and William D.Cooper – Modern Electronic Instrumentation and Measurement Techniques, Pearson / Prentice Hall of India, 2007.
2. Ernest O. Doebelin, Measurement Systems- Application and Design, TMH, 2007.
3. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", DhanpatRai& Sons, New Delhi, 18th Edition, 2012

REFERENCES

1. S.Ramabhadran, Electronic Measurements and Instruments, Second edition, Khanna Publishers, Delhi, 2003.
2. Kalsi H.S, "Electronic Instrumentation", McGraw Hill Education India, 3rd Edition, 2010.
3. D. V. S. Moorthy, Transducers and Instrumentation, Prentice Hall of India Pvt Ltd, 2003.
4. J.B.Gupta,"A Course in Electronics and Electrical Measurement,"S.k.kataria& Sons,Delhi,2003.
5. Martin Reissland," Electrical Mesaurements," New Age International (P)Ltd,Delhi,2001

WEB LINKS

1. www.virtins.com
2. www.digital-instruments.com

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	-	-	-	-	-	-	-	-	-	-	2	-
CO2	-	-	2	-	-	-	-	-	-	-	1	-	2	-
CO3	3	-	2	-	-	-	-	-	-	-	1	-	2	-
CO4	3	-	2	-	-	-	-	-	-	-	-	-	2	2
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-

EE16303 ELECTROMAGNETIC THEORY 3 0 0 3

COURSE OBJECTIVES

- To study the electric force on stationary charged particles.
- To impart knowledge on the concepts of conductors, dielectrics and capacitance.
- To examine the magnetic force on steadily moving charged particles.
- To know the concepts of force between various elements and inductance.
- To acquire knowledge on the concepts of field equations and electromagnetic waves.

UNIT I STATIC ELECTRIC FIELDS 9

Coulomb‟s law – Electric field intensity – electric field due to infinite conductors and circular disc – Field due to different types of charges - Electric flux density – Gauss law – Concept of divergence and curl – Electric potential – Potential field due to different types of charges – Potential gradient – dipole – potential due to dipole.

UNIT II CONDUCTORS, DIELECTRICS AND CAPACITANCE 9

Current density – continuity of current – conductor properties– the nature of dielectric materials – boundary conditions– capacitance – capacitance in different dielectric medium – capacitance of a two wire line - Energy density in electrostatic field – Poisson‟s and Laplace‟s equations.

UNIT III STEADY MAGNETIC FIELDS 9

Biot- Savart Law – applications – Ampere‟s circuital law – applications – curl of magnetic field intensity - Magnetic flux and magnetic flux density –magnetic field intensity due to straight conductors and circular disc - scalar and vector magnetic potentials – Magnetic boundary conditions.

UNIT IV FORCE TORQUE AND INDUCTANCE 9

Lorentz force equation – force between differential current elements – force and torque on a closed circuit – the nature of magnetic materials – magnetization and permeability –inductance and mutual inductance – inductance of solenoid and toroid – Energy density in magnetic field.

UNIT V MAXWELLS EQUATIONS AND ELECTROMAGNETIC WAVES 9

Concept of displacement and conduction current – Modified Ampere‟s Circuital law – Maxwell‟s equations in point and integral forms – Comparison between Field Theory & Circuit Theory - Wave equations – Plane waves in free space – Poynting Theorem and Poynting Vector and its significance.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply concepts and theories of electrostatics in field calculations for real world systems.
- analyze the concepts of electrostatic fields with capacitance
- determine the field due to moving charges.
- develop the boundary condition for different medium
- formulate the Maxwell‟s equations and analyze the propagation of electromagnetic waves and their parameters in different media.

TEXT BOOKS

1. William H.Hayt, Jr., Engineering Electromagnetics, Tata McGraw-Hill Publishing Ltd, New Delhi,7th Edition, 2011.
2. GangadharK.A ,Field theory, Khanna Publication Limited, New Delhi, 15th Edition, Third reprint 2004.

REFERENCES

1. Muthusubramanian R and Senthilkumar N, Electromagnetic field theory, Anuradha publications,1999.
2. Joseph A. Edminister ,Theory and Problems of electromagnetics Schaum"s outline series, 3rd Edition, 1999.
3. David J.Griffite, Introduction to electrodynamics, Prentice Hall of India Private Limited, 3rd Edition 1999.

WEB LINKS

1. http://nptel.ac.in/downloads/115101005/
2. http://nptel.ac.in/syllabus/syllabus_pdf/115101005.pdf

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO2	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO3	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	-	-	-	-	-	-	-	-	2	2	2

IT16304 OBJECT ORIENTED PROGRAMMING WITH C++ 3 0 0 3

COURSE OBJECTIVES

- To learn the basic concepts of object oriented programming.
- To understand the basics of C++ language.
- To classify C++ data types, access modifiers, classes and objects.
- To examine the relationship between classes.
- To construct object oriented programming using C++.

UNIT I INTRODUCTION TO C++ 9

Object oriented programming concepts - Introduction to C++ - Tokens – Keywords – Identifiers and constants – Basic data types– User defined data types – Derived data types – Symbolic constants – Declaration of variables – Dynamic initialization of variables – Reference variables – Operators in C++ – Scope resolution operator – Manipulators – Expressions and their types – Control structures - The main function – Function prototyping – Call by reference – Return by reference – Inline functions – Default arguments –Function overloading.

UNIT II CLASSES AND OBJECTS 9

Specifying a class – Defining member functions – Private member functions –Arrays within a class – Memory allocation for objects – Static data members – Static member functions – Arrays of objects – Objects as function arguments –Friendly functions – Returning objects. Constructors: Parameterized constructors – Multiple constructors in a class – Constructors with default arguments – Dynamic initialization of objects – Copy constructor – Dynamic constructors – Destructors.

UNIT III OPERATOR OVERLOADING AND INHERITANCE 9

Defining operator overloading: Overloading unary, binary operators. Manipulation of strings using operators – Rules for overloading operators – Type Conversions - Defining derived classes – Single inheritance – Multilevel Inheritance – Multiple inheritance –Hierarchical inheritance – Hybrid inheritance – Virtual base classes – Abstract classes.

UNIT IV POLYMORPHISM AND TEMPLATES 9

Introduction to pointers to objects: This pointer – Pointers to derived classes – Virtual functions – Pure virtual functions. Function templates, user defined template arguments, class templates.

UNIT V EXCEPTION HANDING AND GENERIC PROGRAMMING 9

Exception Handling: Exception handling mechanism, multiple catch, nested try, rethrowing the exception – Namespaces – std namespace- Standard Template Library.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- identify and apply object oriented concepts like abstraction, encapsulation, modularity, hierarchy, typing, concurrency and persistence.
- relate the real world object into entity.
- create reusable system components.
- estimate the various metrics specific to object oriented development.
- predict the runtime error using exception handling technology.

TEXT BOOKS

1. E.Balagurusamy, "Object Oriented Programming with C++", Tata McGraw Hill, Sixth Edition, 2013.

REFERENCES

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, JoseeLajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.
3. B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004.

WEB LINKS

1. http://nptel.ac.in/courses/106105151/
2. https://www.tutorialspoint.com/cplusplus/cpp_object_oriented.htm
3. http://www.studytonight.com/cpp/cpp-and-oops-concepts.php

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	1	2	2	1	-	2	-	-	-	1	1	1	3
CO2	-	1	3	-	1	-	2	-	-	-	-	-	1	3
CO3	-	1	3	2	-	-	-	-	-	-	-	-	1	3
CO4	-	2	2	-	1	-	-	-	-	-	-	1	1	3
CO5	1	2	2	1	-	-	1	-	-	-	-	-	1	3

EE16304 ELECTRONICS AND INSTRUMENTATION LABORATORY 0 0 3 2

COURSE OBJECTIVES

- To conduct relevant experiments for determining the characteristics of various electronic devices.
- To design and test amplifiers and oscillators
- To design and test power supplies
- To caliber current transformer

LIST OF EXPERIMENTS

1. Characteristics of PN Junction diode and Zener diode
2. Half wave and Full wave rectifiers with and without filter
3. Characteristics of Bipolar Junction transistor - CE, CB, CC Configurations
4. Characteristics of JFET
5. Characteristics of UJT
6. Characteristics of Photo Diode & Photo Transistor
7. Design of RC phase shift oscillator.
8. AC bridges.
9. DC bridges.
10. Instrumentation amplifiers.
11. Frequency response of RC coupled amplifier
12. A/D and D/A converters.
13. Calibration of current transformer.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- design and construct a power supply and analyze the ripple factor with filters.
- compare the characteristics of electronic devices by conducting suitable experiments.
- analyze the response characteristics of diode clippers and clampers by constructing them.
- caliber current transformer

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	2	2	-	-	-	-	-	3	-	3	3
CO2	3	3	3	2	2	-	-	-	-	-	3	-	3	3
CO3	3	3	3	2	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	2	2	-	-	-	-	-	3	-	3	3

IT16307 OBJECT ORIENTED PROGRAMMING WITH C++ LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To implement fundamental knowledge of object oriented programming.
- To demonstrate C++ syntax and semantics
- To solve simple engineering problems.
- To develop a solution for complex problems in the real world.

LIST OF EXPERIMENTS

1. Write C++ Programs using Classes and Objects.
2. Design C++ Classes with static members, methods with default arguments, friend functions.
3. Develop C++ Programs using Operator Overloading.
4. Develop C++ Programs using constructor, destructor, and copy constructor.
5. Develop C++ Programs Overload the new and delete operators.
6. Develop C++ Programs using Inheritance, Polymorphism and its types.
7. Develop C++ Programs using Arrays and Pointers.
8. Develop C++ Programs using Dynamic memory allocation.
9. Develop C++ Programs using Function Templates.
10. Develop C++ Programs using Exceptions Handling.

TOTAL PERIODS 60

COURSE OUTCOMES

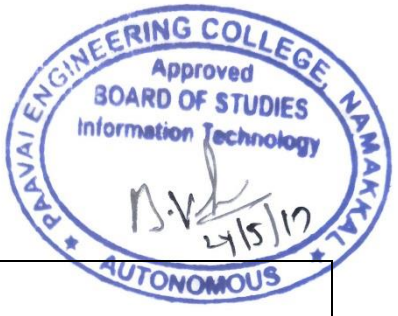
At the end of this course, students will be able to

- design object-oriented concepts and how they are supported by C++
- analyze, use, and create functions, classes, to overload operators.
- create and initialize real world entities using constructors.
- describe exception handling and file handling mechanism.
- apply the concepts of data encapsulation, inheritance, and polymorphism to develop large scale software.

RECOMMENDED SYSTEM/SOFTWARE REQUIREMENTS

Software: Turbo C++.

Hardware: Flavor of any WINDOWS or LINUX and Standalone desktops 30 Nos.



CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	1	-	3	-	2	-	1	-	2	-	1	-	-	3
CO2	-	2	-	2	-	3	-	-	-	2	-	-	-	3
CO3	-	-	-	-	1	-	2	-	-	-	-	-	-	3
CO4	1	2	3	2	1.5	3	1.5	-	2	2	1	2	-	3

EE16401 **ELECTRICAL MACHINES I** **3 2 0 4**

COURSE OBJECTIVES

- To understand the principles of electromechanical energy conversion in singly and doubly excited systems.
- To comprehend the working principles, types and characteristics and applications of DC generators.
- To identify the Characteristics, starting and methods of speed control of DC motors.
- To impart the knowledge of principle of operation and performance and three phase transformer connections.
- To categorize various losses in DC machines by conducting different tests

UNIT I BASIC CONCEPTS OFROTATINGMACHINES 15

Introduction to magnetic circuits – Magnetically induced e.m.f and force – AC operation of magnetic circuits – Hysteresis and Eddy current losses. Energy in magnetic systems – Principles of electromechanical energy conversion – Single and multiple excited systems – m.m.f of distributed A.C. windings – Rotating magnetic field – Generated voltage – Torque in round rotor machine.

UNIT II DCGENERATORS 15

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

UNIT III DCMOTORS 15

Principle of operation – Back emf and torque equation – Characteristics of series, shunt and compound motors – Starting of DC motors – Types of starters – Speed control of DC series and shunt motors.

UNIT IV TRANSFORMERS 15

Constructional details of core and shell type transformers – Types of windings – Principle of operation – emf equation – Transformation ratio – Transformer on no-load – Parameters referred to HV / LV windings – Equivalent circuit – Transformer on load – Regulation – Parallel operation of single phase transformers – Auto transformer – Three phase transformers – Vector group.

UNIT V TESTING OF DC MACHINESANDTRANSFORMERS 15

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

TOTAL PERIODS 75

COURSE OUTCOMES

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

- describe the concepts of electromechanical energy conversion.
- deliberate the characteristics and applications of DC generators.
- identify the characteristics and speed control of DC motors.
- examine the performance of transformers.
- evaluate the efficiency of DC machines and transformers by conducting suitable tests

TEXT BOOKS

1. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill,2002.
2. P.S. Bimbhra, "Electrical Machinery", Khanna Publishers,2003.
3. Theraja A.K &Theraja B.L, " A Text book of Electrical Technology (Vol II)", S Chand & Co- ., 2008.

REFERENCES

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill, 2003
2. SmarajitGhosh, "Electrical Machines", Pearson Education,2012.
3. Parkar Smith, N.N., "Problems in Electrical Engineering" CBS Publishers and Distributers,1984.
4. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria and Sons,2002.
5. K. Murugesh Kumar, "Electric Machines", Vikas publishing,2002.

WEB LINKS

1. http://www.newagepublishers.com/samplechapter/001374.pdf
2. http://nptel.iitk.ac.in/courses/Webcourse-contents/IIT- MADRAS/Elec_Mach1/Transformers1.pdf

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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CO2	3	3	3	1	-	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	-	-	-	-	-	-	3	-	3	3
CO4	3	3	3	2	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	-	-	-	-	-	-	3	-	3	3

EE16402 ELECTRICAL POWER GENERATION 3 0 0 3

COURSE OBJECTIVES

- To understand basic concepts of thermal and hydro power plants.
- To distinguish the basic structure and operation of nuclear and diesel power plants.
- To study basic concepts and applications of solar photovoltaic power conversion systems.
- To comprehend the basic concepts of wind power conversion system and types of power generators.
- To acquire the knowledge of tariff and economic aspects in power generation.

UNIT I THERMAL AND HYDRO POWER STATION 9

Thermal power station: Schematic arrangement, choice of site, efficiency of steam power station, Types of prime movers - Environmental aspects for selecting the sites and locations of thermal power stations. Hydro power station: Schematic arrangement, choice of site constituents of hydro power plant, Hydro turbine. Environmental aspects for selecting the sites and locations of hydro power stations

UNIT II NUCLEAR AND DIESEL POWER STATION 9

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

Diesel power station: Schematic arrangement, Choice and characteristic of diesel engines.

UNIT III SOLAR PHOTOVOLTAIC POWER CONVERSION SYSTEMS 9

Solar Photovoltaic (SPV) systems: Operating principle, Photovoltaic cell concepts, Types of solar cells, fabrication of SPV cells, Cell, module, array (Series and parallel connections),SPV system components and their characteristics. Applications of solar thermal systems: Heating, Cooling, Drying, Distillation, Power generation. Applications of Solar Photovoltaic systems: Battery charging, Pumping, Lighting.

UNIT IV WIND POWER CONVERSION SYSTEM 9

Introduction to wind energy : basic principles of wind energy conversion - Basic components of wind energy conversion systems - classifications of WECS-HAWT, VAWT, Geared wind power plants (WPPs) - Schemes of electric generation: Squirrel Cage Induction Generators (SCIG), wound rotor (WRIG), doubly-fed (DFIG), wound rotor synchronous generator (WRSG), Permanent magnet synchronous generator (PMSG) - Site selection considerations.

UNIT V TARIFF AND ECONOMIC ASPECTS IN POWER GENERATION 9

Terms commonly used in system operation, various factors affecting cost of generation: Load curves, load duration curves, Connected load, maximum load, Peak load, base load and peak load power plants, load factor, Plant capacity factor, Plant use factor, Demand factor, diversity factor, Cost of power plant, Tariffs.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the functioning of basic energy conversion devices, the traditional & alternative energy sources.
- explain concept of thermal and hydro electric power plants.
- clarify the operation of nuclear and diesel power plants.
- discriminate the advantages of non –conventional power generator.

- obtain knowledge on tariff and economic.

TEXT BOOKS

1. Arora and Domkundwar, "A Course in Power Plant Engineering" DhanpatRai and Co.Pvt.Ltd., New Delhi 2014.
2. P.K. Nag, "Power Plant Engineering" Tata McGraw Hill, Second Edition , Fourth reprint 2014.
3. G.D. Rai, "An introduction to power plant technology" Khanna Publishers 2016.

REFERENCES

1. Bernhardt G.A.Skrotzki and William A. Vopat, "Power station Engineering and Economy", Tata McGraw Hill, 20th reprint 2002.
2. L.Monition ,MleNir, J.Roux, " Hydroelectric Power Stations" John Wiley & Sons Publishers 2014..
3. M.M. El-Wakil, "Power Plant Technology" Tata McGraw Hill, 2013.
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, 2010.
5. Sh. H.Cohen, G.F.C. Rogers. H.I.H.Saravanamuttoo, "Power Plant Engineering" CBS Published 2014.

WEB LINKS

1. electrical4u.com/power-plants-types-of-power-plant
2. castlelab.princeton.edu/EnergyResources/GenerElectPower_Shalaan.pdf
3. www.indiacore.com/.../kssidhu-non-conventional-energy-resources.pdf
4. www.academia.edu/.../Non_Conventional_Methods_of_Power_Generati...

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	-	-	-	-	-	-	3	-	3	3
CO2	3	2	2	-	-	-	1	-	-	-	3	-	3	3
CO3	3	2	-	3	2	3	-	-	-	-	3	-	3	3
CO4	3	2	-	3	2	3	1	-	-	-	3	-	3	3
CO5	3	3	-	-	-	3	-	-	-	-	3	-	3	3

EE16403 LINEAR INTEGRATED CIRCUITS AND ITS APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

- To generalize the IC fabrication procedure.
- To infer the characteristics and application of Op - amp ICs.
- To understand concepts of waveform generation and converters.
- To impart the knowledge on basic applications of special IC‟s.
- To interpret the internal functional blocks of applications ICs.

UNIT I FABRICATION OF ICS 9

Integrated Circuit Technology, Steps in fabrication of IC-wafer preparation-epitaxial growth-lithography-diffusion. Fabrication of resistors, capacitors, diodes, BJT and FET.

UNIT II OP - AMP CHARACTERISTICS AND APPLICATIONS 9

Op-amp configurations, Ideal op-amp circuit analysis-DC and AC characteristics of ideal op-amp, - Inverting and Non-inverting amplifiers – summing amplifier - difference amplifier - voltage follower - Differentiator - Integrator –Nonlinear applications: clamper - clipper – sample and hold circuit.

UNIT III WAVEFORM GENERATORS AND CONVERTERS 9

Sine wave generator: Weinbridge and phase shift oscillator- square wave, triangular wave, saw tooth wave generation, Schmitt trigger. Digital to analog converters- basic concepts, types-weighted, R-2R ladder DAC. Analog to Digital converter- basic concepts, types-Flash, successive approximation and dual slope.

UNIT IV SPECIAL ICS 9

IC555 Timer-Timer functional diagram, monostable and astable operation and their applications. Phase Locked Loop: Operation of 565 PLL - PLL applications, Voltage Controlled Oscillator. Multiplier and their applications.

UNIT V APPLICATION ICS 9

Regulator IC‟s- LM78XX,79XX Fixed voltage regulators ,IC 723 General purpose register, LM 317, LM380 power amplifier, ICL 8038 function generator IC, isolation amplifiers, opto coupler, opto electronic ICs

TOTAL PERIODS 45

COURSE OUTCOMES

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

- illustrate the IC fabrication procedure.
- describe the characteristics and application of op-amp.
- design waveform generators and Filters
- design circuits using special ICs.
- interpret the internal functional blocks and the applications of special ICs

TEXT BOOKS

1. Roy Choudry and Shail Jain, “Linear Integrated Circuits”, New Age, 2003
2. Gayakwad, R.A., 'Op-amps & Linear Integrated Circuits', Prentice Hall of India, New Delhi ,3rd Edition, 2003.

REFERENCES

1. Sergio Franco,‟ Design with operational amplifiers and Analog Integrated circuits‟‟, Tata McGraw Hill 3rd Edition 2002
2. Millman, J. and Halkias, C.C., 'Integrated Electronics-Analog and Digital Systems', Tata McGraw Hill, 9th Reprint, 1995.
3. Floyd ,Buchla,”Fundamentals of Analog Circuits, Pearson, 2013
4. Jacob Millman, Christos C.Halkias, „Integrated Electronics - Analog 4.Salivahanan S &KanchanaBhaskaran V.S, “Linear Integrated Circuits”, TMH, 2008.
5. Robert F.Coughlin, Fredrick F.Driscoll, “Op-amp and Linear ICs”, 6th Edition, Pearson Education, 2012

WEB LINKS

1. en.wikipedia.org/wiki/Category:Linear_integrated_circuits
2. www.gobookee.org/linear-integrated-circuits-notes

CO-PO MAPPING:

Mapping of Course Outcome (CO’s) with Programme Outcomes (PO’s) and Programme Specific Outcomes PSO’s (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO’s	Programme Outcomes PO’s												PSO’s	
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CO2	3	-	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	-	3	-	-	-	-	-	-	-	-	-	3	3
CO5	3	-	3	-	-	-	-	-	-	-	2	-	3	3

EE16404 **DIGITAL LOGIC CIRCUITS** **3 2 0 4**

COURSE OBJECTIVES

- To analyze various number systems and to simplify the mathematical expressions using Boolean functions – simple problems.
- To develop the implementation concepts of combinational circuits.
- To discuss the design of various synchronous and asynchronous circuits.
- To identify various memory devices.
- To understand the basics of VHDL programmes.

UNIT I NUMBER SYSTEM AND BOOLEAN ALGEBRA 15

Review of number system; types and conversion, codes. Boolean algebra: De-Morgan's theorem, switching functions and simplification using K-maps &QuineMcCluskey method.

UNIT II COMBINATIONAL CIRCUITS 15

Design of Logic gates, NAND and NOR Implementations, Design of adder, subtractor, comparators, code converters, encoders, decoders, multiplexers and demultiplexers- Function realization using gates, multiplexers and demultiplexers

UNIT III SYNCHRONOUS SEQUENTIAL CIRCUITS 15

Flip flops - SR, D, JK and T; Analysis of synchronous sequential circuits; design of synchronous sequential circuits – Synchronouscounters– Modulus counters, Up/Down counters, state diagram, state reduction, state assignment.

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 15

Analysis of asynchronous sequential machines, Races & Hazards, state assignment techniques, asynchronous design problems,Asynchronous counters, Up/Down counters, Modulus counters.

UNIT V MEMORIES AND LOGIC FAMILIES 15

Memories: ROM, PROM, EPROM, EEPROM, PLA, PAL, FPGA - Digital logic families: RTL,TTL, ECL, CMOS.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- compile number systems and simplify Boolean functions
- illustrate the various combinational circuits.
- design the synchronous and asynchronous circuits.
- develop VHDL coding for simple circuits.

TEXT BOOKS

1. M. Morris Mano, “Digital Logic and Computer Design”, Prentice Hall of India, 2002.
2. J.Bhaskar ,“A VHDL primer”,3rd edition 2004, Prentice Hall of India Limited.

REFERENCES

1. Charles H.Roth, “Fundamentals Logic Design”, Jaico Publishing, IV edition, 2002.
2. Floyd, “Digital Fundamentals”, 8th edition, Pearson Education, 2003.

3. John F.Wakerly, “Digital Design Principles and Practice”, 3rd edition, Pearson Education,2002.
4. Charles H,Roth ,“Digital system design using VHDL” , 2nd Edition 2005, PWS Publishing Company.
5. John M.Yarbrough, “Digital Logic, Application & Design”, Thomson, 2002.

WEB LINKS

1. en.wikipedia.org/wiki/Digital_electronics
2. http://freevideolectures.com/Course/2319/Digital-Systems-Design/3

CO-PO MAPPING:

Mapping of Course Outcome (CO’s) with Programme Outcomes (PO’s) and Programme Specific Outcomes PSO’s (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO’s	Programme Outcomes PO’s												PSO’s	
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CO2	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	3	-	3	3

EE16405 COMMUNICATION ENGINEERING 3 0 0 3

COURSE OBJECTIVES

- To understand the fundamentals of analog communication and different type of modulation.
- To know about the pulse modulation and On off keying (OOK) Systems.
- To gain knowledge on the different coding techniques.
- To familiar with the spread spectrum and multiple access techniques in communication systems.
- To educate the basics of telecommunication, satellite and optical communication services.

UNIT I ANALOG COMMUNICATION 9

Introduction to Modulation Techniques: Types –Amplitude Modulation – Generation of AM waves – Double Side Band (DSB) - Suppressed Carrier Systems (DSB/SC) – Single Side Band Modulation (SSB) – Vestigial Side Band Modulation (VSB) - comparison of various AM Systems -AM Receivers – TRF Receiver, Super Heterodyne Receiver. Definitions for FM & PM – Narrow band FM – Wide band FM.

UNIT II DIGITAL COMMUNICATION 9

Pulse Modulations: Concepts of Sampling and Sampling Theorems, PAM, PWM, PPM, PTM.Quantization Technique: Delta Modulation, Slope Overload Error - ADM - Pulse Code Modulation, DPCM.OOK Systems: ASK, FSK, PSK, Applications of Data Communication.

UNIT III CODING TECHNIQUES 9

Primary Communication: Entropy, Properties, BSC, BEC. Source Coding: Shannon Fanon &Huffman Coding Theorem - Efficiency of Transmissions, Error Control Codes and Applications: Convolutional & Block Codes.

UNIT IV SPREAD SPECTRUM AND MA TECHNIQUES 9

Introduction to SS Techniques: Direct Sequence Spread Spectrum (DSSS) – Frequency Hopping Spread Spectrum (FHSS) –Time Hopping Spread Spectrum (THSS). MA Techniques: FDMA – TDMA – CDMA – SDMA – OFDM.

UNIT V COMMUNICATION SERVICES 9

Tele Communication: GSM Architecture – Frequency Reuse – GPRS – EDGE. Satellite Communication: Read – orbit – Satellite altitude – Transmission Path – Satellite System. Fiber Optical Communication: Need – Principles of Light Transmission– Optical Fiber Communication System –Light Sources – Types &Configuration of Optical Fiber.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- characterize and determine different methods of analog communication schemes.
- describe the pulse modulation of digital communication techniques.
- characterize the different type of coding techniques.
- analyze different spread spectrum and multiple access techniques.
- describe the operation of telecommunication, satellite and optical communication systems.

TEXT BOOKS

1. Taub & Schiling "Principles of communication systems" Tata McGraw hill 2007.
2. J.Das "Principles of digital communication" New Age International, 1986.
3. Thedore.S.Rappaport, "Wireless Communication", Pearson Education, 2010.

REFERENCES

1. Kennedy, Electronics of Communication Systems – McGraw Hill – 5th reprint – 2000.
2. Simon Haykin, "Digital Communications", John Wiley, 2006.
3. Lathi B.P. "Modern digital and analog communication systems" Oxford University Press, 2009.

WEB LINKS

1. www.wikipedia.org/wiki/Category:modulation
2. www.web.ee.ccu.edu.tw/.../class%20ppt/Multiple%20Access%20Techniques
3. http://www.tech-faq.com/geostationary-satellite.html
4. www.nptel.ac.in/courses/117102062 & 117101051

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	2	3	-	-	-	-	-	-	-	-	3	3	3
CO2	3	-	3	-	-	-	-	-	-	-	-	3	3	3
CO3	3	2	3	-	-	-	-	-	-	-	-	3	3	3
CO4	3	-	3	2	-	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	2	-	-	-	-	-	2	3	3	3

EE16406 ELECTRICAL MACHINES I LABORATORY 0 0 4 2

COURSE OBJECTIVES

- understand the performance of DC generators.
- Know the characteristics of DC motors under loaded and unloaded conditions.
- Analyze the performance of DC motors.
- Understand the speed control in DC shunt motor
- Know the Equivalent Circuit parameters and performance of Transformers

LIST OF EXPERIMENTS

1. Load test on DC shunt motor and compound motor.
2. Load test on DC Series motor.
3. Speed Control of DC Shunt Motor and Swinburne‟s test.
4. Load test on DC shunt generator, DC compound generator.
5. Load test on single phase transformer.
6. Open circuit & Short circuit test on single phase transformer.
7. Open circuit characteristics of DC generator (Self and Separately Excited)
8. Hopkinson‟s test
9. Sumpner‟s test on 1-phase transformers
10. 3-phase transformer connections
11. Seperation of no load losses in single phase transformer

TOTAL PERIODS 60

COURSE OUTCOMES

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

- estimate the performance of DC generators.
- summarize the characteristics of DC motors under loaded and unloaded conditions.
- predetermine the performance of DC motors.
- implement the speed control in DC shunt motor.
- calculate the Equivalent Circuit parameters and performance of Transformers

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO2	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EE16407 LINEAR INTEGRATED AND DIGITAL CIRCUITS LABORATORY 0 0 4 2

COURSE OBJECTIVES

- To familiarize with the operation of analog circuits using Op-amp
- To design of waveform generators.
- To understand the basic operations of digital ICs
- To commence the functions of counter, shift register and MUX-DEMUX circuits.

LIST OF EXPERIMENTS

LINEAR INTEGRATEDCIRCUITS

1. Inverting and non inverting amplifier
2. Summing amplifier and Difference amplifier
3. Integrator and Differentiator
4. Astable and monostablemultivibrator using IC555
5. Waveform generators using IC741

DIGITAL CIRCUITS

1. Verification of logic gates
2. Boolean function implementation
3. Adder and Subtractor
4. Code Converters
5. Multiplexer and de-multiplexer
6. Encoder and Decoder
7. Synchronous counter

TOTAL PERIODS 60

COURSE OUTCOMES

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

- describe the operation of amplifiers using BJT.
- design different waveforms of variable frequency.
- design multiplexers, data converters and counters.
- design MUX-DEMUX circuits.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
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CO1	3	-	3	-	-	-	-	-	-	-	2	-	3	3
CO2	3	-	3	-	-	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	2	-	3	3

SEMESTER V

EE16501 ELECTRICAL MACHINES II 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on operation of AC generators and methods for determining regulation of AC generator
- understand the operation of AC motors and starting methods
- learn the concepts of operating principle and predetermination of parameters of induction motor.
- study the starters and speed control methods of various motors.
- understand the operation of single phase induction motors and special machines.

UNIT I SYNCHRONOUS GENERATOR 9

Constructional details - Types of rotors - emf equation - Synchronous reactance - Armature reaction - Voltage regulation - E.M.F, M.M.F, Z.P.F and A.S.A methods - Synchronizing and parallel operation - Synchronizing torque - Change of excitation and mechanical input - Two reaction theory - Determination of direct and quadrature axis synchronous reactance using slip test - Operating characteristics.

UNIT II SYNCHRONOUS MOTOR 8

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

UNIT III THREE PHASE INDUCTION MOTOR 12

Constructional details - Types of rotors - Principle of operation - Slip - Equivalent circuit - Slip torque characteristics - Condition for maximum torque - Losses and efficiency - Load test - No load and blocked rotor tests - Circle diagram - Separation of no load losses - Double cage rotors - Induction generator - Synchronous Induction motor.

UNIT IV STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR 7

Need for starting - Types of starters - Stator resistance and reactance, rotor resistance, autotransformer and star-Delta starters - Speed control - Change of voltage, torque, number of poles and slip - Cascaded connection - Slip Power recovery scheme.

UNIT V SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES 9

Constructional details of single phase induction motor - Double revolving field theory and operation - Equivalent circuit - No load and blocked rotor test - Performance analysis - Starting methods of single - phase induction motors - Special machines - Shaded pole induction motor, reluctance motor, repulsion motor, hysteresis motor, stepper motor and AC series motor.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- determine the regulation of synchronous generator.
- analyze the performance of synchronous motor.
- describe the performance of three phase induction motor.
- explain the concept of starting and speed control of induction motors.
- enumerate the operation of single phase induction motor and special machines.

TEXT BOOKS

1. B.L.Theraja, A.K.Theraja, "Electrical Technology", Volume 2, S.Chand Publishers, 2015.
2. D.P. Kothari and I.J. Nagrath, "Electric Machines", Tata McGraw Hill Publishing Company Ltd, 2010.

REFERENCES

1. A.E. Fitzgerald, Charles Kingsley, Stephen.D.Umans, "Electric Machinery", Tata McGraw Hill publishing Company Ltd, 2008.
2. J.B. Gupta, "Theory and Performance of Electrical Machines", S.K.Kataria and Sons, 2015, International Publishers, 2012.
3. K. Murugesh Kumar, "Electric Machines", Vikas publishing house Pvt Ltd, 2002.\
4. Mehta. V.K and Rohit Mehta, "Principle of Electrical Machines", S.Chand Publishers, 2009.
5. Rajput. R.K, "A Text Book of Electrical Machines", Firewall Media, 2008.

CO-PO MAPPING:

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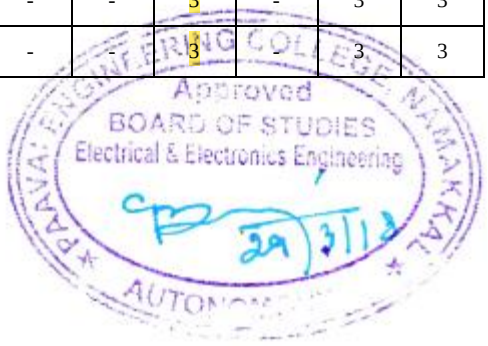
CO4	3	3	-	-	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	3	-	-	-	-	-	3	-	3	3



EE16502 **CONTROL SYSTEMS** **3 2 0 4**

COURSE OBJECTIVES

To enable the students to

- understand the methods of representation of systems and to obtain system transfer function models.
- provide knowledge on time response of systems and steady state error analysis.
- acquaint basic knowledge in obtaining the open loop and closed–loop frequency responses of systems.
- impart the concept of stability of control system and methods of stability analysis.
- study the design of compensators for a control system.

UNIT I SYSTEMS AND THEIR REPRESENTATION 9+6

Basic elements in control systems - Open and closed loop systems - Electrical analogy of mechanical and thermal systems - Transfer function - Synchros - AC and DC servomotors - Block diagram reduction techniques - Signal flow graphs.

UNIT II TIME RESPONSE 9+6

Time response - Time domain specifications - Types of test input - I and II order system response - Error coefficients - Generalized error series - Steady state error - P, PI, PID modes of feedbackcontrol.

UNIT III FREQUENCY RESPONSE 9+6

Frequency response - Bode plot - Polar plot - Constant M and N circles - Nichol‟s chart - Determination of closed loop response from open loop response - Correlation between frequency domain and time domain specifications.

UNIT IV STABILITY OF CONTROL SYSTEM 9+6

Characteristics equation - Location of roots in S plane for stability -Routh Hurwitz criterion - Root locus construction - Effect of pole, zero addition - Gain margin and phase margin -Nyquist stability criterion.

UNIT V COMPENSATOR DESIGN 9+6

Performance criteria - Lag, lead and lag-lead networks - Compensator design using bode plots and root locus. Introduction to MATLAB Simulink.

TOTAL PERIODS 75

COURSE OUTCOMES

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

- model a control system using differential equations and transfer functions.
- analyze the transient response of control systems in using time domain.
- evaluate and analyze control systems using frequency domain methods.
- check the stability of systems and the effect of pole zero addition.

- design compensators for control systems.

TEXT BOOKS

1. I.J. Nagrath& M. Gopal, "Control Systems Engineering", New Age International Publishers, 2017.
2. A.Nagoorkani "Control Systems", RBA Publications,2012.

REFERENCES

1. B.C. Kuo, "Automatic Control Systems", Prentice Hall of India Ltd., 2014.
2. M. Gopal, "Control Systems, Principles & Design", Tata McGraw Hill, 2015.
3. K. Ogata, "Modern Control Engineering", Pearson Education, 2015.
4. S.K.Bhattacharya, "Control System Engineering", Pearson, 2013.
5. Arthur, G.O.Mutambara, "Design and Analysis of Control; Systems", CRC Press, 2017.

CO-PO MAPPING:

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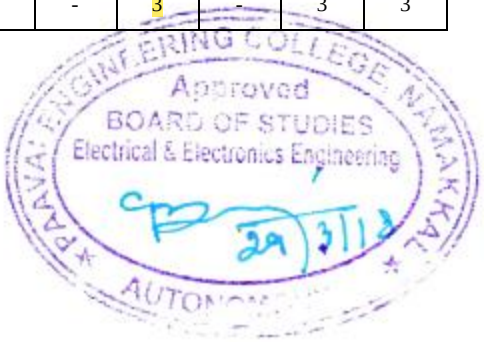
CO4	3	3	3	-	3	-	-	-	-	-	3	-	3	3
CO5	3	3	3	-	3	-	-	-	-	-	3	-	3	3



EE16503 **POWER ELECTRONICS** **3 0 0 3**

(Common to EEE & MCT)

COURSE OBJECTIVES

To enable the students to

- impart knowledge on different types of power semi-conductor devices and their switching characteristics
- understand the operation of converter and their firing circuits and different commutation techniques of power converters.
- know the operation of various chopper conversion techniques and basics of resonance converter.
- study the mode of inverters and different modulation techniques.
- learn the types of AC voltage controllers and basics of matrix converters.

UNIT I POWER SEMICONDUCTOR DEVICES 9

Study of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT- Static and Dynamic Characteristics - Commutation: Natural Commutation, Forced commutation, snubber circuit.

UNIT II PHASE - CONTROLLED CONVERTERS 9

2- pulse, 3-pulse and 6-pulseconverters - performance parameters - Effect of source inductance – gate circuit schemes for phase control - Dual converters.

UNIT III CHOPPER 9

Step-down and step-up chopper - control strategy -Forced commutated chopper: Voltage commutated, Current Commutated, Switched mode regulators - Buck, boost, buck-boost converter. Introduction to Resonant Converters.

UNIT IV INVERTERS 9

Single phase and three phase voltage source inverters (both120^0mode and180^0mode) - PWM techniques: Sinusoidal PWM, modified sinusoidal PWM - multi PWM - Introduction to space vector modulation - Current source inverter - Introduction to multilevel inverter.

UNIT V AC TO AC CONVERTORS 9

Single phase and three phase AC voltage controllers - control strategy - power factor control - multistage sequence control - single phase and three phase cycloconverters - Introduction to matrix converters.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- identify and select the switching devices for different power converter applications.
- apply the different converter based on the application.

- design a suitable DC power supply for given load specification from DC supply.
- describe and analyze the single and three phase inverter.
- explain an AC voltage controller electromagnetic compatibility of power converters.

TEXT BOOKS

1. M.H.Rashid, Power Electronics: Circuits, Devices Applications, Pearson, 2016.
2. M.D. Singh and Khanchandani K.B., Power Electronics, Tata Mc.Graw Hill., 2016

REFERENCES

1. L.Umanand, Power Electronics Essentials and Applications, Wiley India Pvt Ltd, Reprint, 2010.
2. G.K. Dubey, S.R. Doradla, A. Joshi and R.M.K. Sinha, Thyristorised Power Controllers, New Age,International Publishers, 2012.
3. Ned Mohan,Tore M. Undeland and William P.Robins, Power Electronics – Converters, Applications and Design Third Edition, John Wiley and Sons, 2008.
4. R.S. Ananda Murthy and V. Nattarasu, Power Electronics: A Simplified Approach, Pearson/Sanguine Technical Publishers,2009 .
5. Daniel W.Hart, Power Electronics, McGraw-Hill Publishing Company Ltd, 2011.

CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO3	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	-	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	3

EE16504 DIGITAL SIGNAL PROCESSING 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- understand the classification of signals and systems & their mathematical representation.
- analyze the discrete time systems using Z transform
- perform frequency analysis of signals and computation of discrete Fourier transform
- study the concepts and design of digital IIR filter
- learn the concepts and design of digital FIR filter

UNIT I DISCRETE TIME SIGNAL AND SYSTEMS 9+6

Characteristics and classification of signals-discrete time signal-basic definitions - representation of signals, discrete time systems-linear time invariant systems-properties of LTI systems-linear constant coefficient difference equations - Fourier transform of discrete time signals, sampling techniques - Nyquist rate, aliasing effect.

UNIT II Z- TRANSFORM AND FILTER REALIZATION 9+6

Z Transform and its properties - inverse Z transform - stability - causality - linear difference equations with Constant coefficients and their solutions -digital filter realization: direct form I, II, cascade, parallel types.

UNIT III FREQUENCY ANALYSIS OF SIGNALS 9+6

Fourier transform - discrete time Fourier series - discrete Fourier transform-properties of discrete Fourier transform- computation of discrete Fourier transform - FFT algorithms- radix-2 FFT algorithm-decimation in time-decimation in frequency.

UNIT IV DIGITAL IIR FILTER 9+6

Introduction - types of filters, digital filter design-design of IIR filters-impulse invariance and bilinear transform methods- analog to digital transformation.

UNIT V DIGITAL FIR FILTER 9+6

FIR filter - design of FIR filter using windows: rectangular, triangular, hanning, hamming, Blackman windows - comparison of IIR and FIR digital filter- Effect of word length and quantization-fixed point and floating point arithmetic.

TOTAL PERIODS 45+30=75

COURSE OUTCOMES

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

- perform classification of signals and systems.
- apply Z transform and analyze discrete time systems.
- compute DFT and obtain perform frequency response analysis.

- design IIR fliters.
- apply windowing technique to design FIR filters.

TEXT BOOKS

1. John G.Proakis, Dimitris G.Manolakis, "Digital Signal Processing", Prentice Hall of India, Pvt, Ltd., 3rd edition. 2007.
2. Alan V.Oppenheim, Ronald W.Schafer "Digital Signal Processing", Prentice Hall of India, Pvt Ltd., 2006.

REFERENCES

1. Simon Haykin and Barry Van Veen, "Signals and Systems", 2nd Edition, Willey Publication (Reprint), 2010.
2. SanjitK.Mitra, "Digital Signal Processing", Tata McGraw Hill, 2009.
3. P. Ramesh Babu and R.AnandaNatarajan, "Signals and Systems", SciTech Publications, 4th Edition, 2010.
4. Poorna Chandra S, Sasikala. B , "Digital Signal Processing", Vijay Nicole/TMH,2013
5. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing",Wiley,2013

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CO4	3	3	-	-	2	-	-	-	-	-	3		3	3
CO5	3	3	-	-	2	-	-	-	-	-	3		3	3

EE16505 TRANSMISSION AND DISTRIBUTION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the basics of transmission and distribution of power system.
- develop expression for computation of fundamental parameters of lines.
- categorize the lines into different classes and develop equivalent circuits for these classes.
- analyze the voltage distribution in insulator strings and methods to improve the same
- impart knowledge for estimation of sag and tension.

UNIT I INTRODUCTION 9

General layout of power system - Standard voltages for transmission - Advantages of high voltage transmission. Feeders, distributors and service mains. Distribution- Requirements of power distribution - Radial & Ring main systems - Overhead versus Underground System - AC and DC distribution: Calculation for concentrated and uniform loading.

UNIT II TRANSMISSION LINE PARAMETERS 9

Line parameters: Calculation of Resistance, Inductance and Capacitance of single phase and three phase overhead lines with Symmetrical and Unsymmetrical spacing for solid, stranded conductors and bundled conductors - Transposition of line conductors - Applications of self and mutual GMD - Skin and proximity effects- Interference with neighboring communication circuits.

UNIT III ANALYSIS OF TRANSMISSION LINE PERFORMANCE 9

Performance of power transmission lines- Short transmission lines - Medium transmission lines- End condenser, Nominal T and Nominal π model - Transmission efficiency and voltage regulation - Long transmission lines - ABCD constants of transmission lines, Ferranti effect.

UNIT IV INSULATORS AND CABLES 9

Insulators - Properties and types of insulators - potential distribution over a string of insulators - String efficiency - Methods of improving string efficiency. Underground Cables - Construction of LT and HT Cables - Insulation resistance, Capacitance and dielectric stress of a single core cable - Grading of cables-Capacitance of 3-corecables.

UNIT V OVERHEAD TRANSMISSION LINES AND SAG 9

Overhead Transmission Lines- Types of supporting structures and line conductors used. Sag calculation- Effect of wind and ice loading - Corona - Substation layout -Overhead transmission system in India.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- compute transmission line parameters such as resistance, inductance and capacitance of overhead transmission lines and underground cables.
- compute voltage drop and power loss in DC and AC radial, ring and interconnected distribution networks.
- categorize the different types of insulators and cables.
- evaluate the performance of overhead transmission lines based on their models
- design insulator strings for high voltage overhead transmission lines.

TEXT BOOKS

1. Soni Gupta &Bhatnaagar , "A Course in Electrical Power", DhanpatRai& Sons,2008.
2. C. L. Wadhwa, "Electrical Power Systems", New Age International,2016.
3. V.K.Mehta, Rohit Mehta, "Principles of Power Systems", S. Chand &Co., 2012.

REFERENCES

1. W.D. Stevenson, "Elements of Power System Analysis", TMH, 2017
2. S. M. Singh, "Electric power generation Transmission & Distribution", PHI, 2009.
3. Dr. S. L. Uppal, "Electrical Power", Khanna Publications, 2003.
4. B. R. Gupta, "Power System Analysis and Design", S. Chand, 2003.
5. G.Ramamurthy, "Handbook of Electrical power Distribution", Universities Press, 2013.

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CO3	3	2	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	3	-	-	-	-	-	-	-	-	-	-	2
CO5	-	3	-	-	-	-	-	-	-	-	-	-	-	2

EE16506 ELECTRICAL MACHINES II LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- conduct relevant experiments for determining the performance characteristics of AC machines.
- calculate the regulation of three phase alternator using various methods.
- estimate the parallel operations of alternators.
- attain the V and inverted V curves of synchronous motors, forecast the performance characteristics of AC motors.

LIST OF EXPERIMENTS

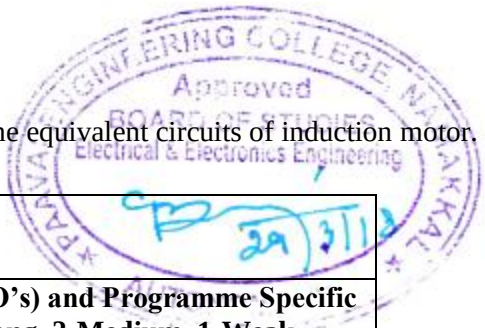
1. Regulation of three phase alternator by EMF and MMF methods
2. Regulation of three phase alternator by ZPF and ASA methods
3. Regulation of three phase salient pole alternator by slip test
4. Synchronization and parallel operation of alternators
5. V and Inverted V curves of three phase synchronous motor.
6. Load test on three-phase induction motor.
7. No load and blocked rotor test on three-phase induction motor
8. Separation of No-load losses of three-phase induction motor.
9. Load test on single-phase induction motor
10. No load and blocked rotor test on single-phase induction motor.
11. Load test on three phase alternator.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- compute the regulation of three phase alternator using various methods.
- evaluate the parallel operations of alternators.
- obtain the V and inverted V curves of synchronous motors.
- predict the performance characteristics of AC motors, obtain the equivalent circuits of induction motor.



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CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EE16507 **CONTROL SYSTEM LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- acquire programming skills in the analysis and design of control systems.
- gain the knowledge for deriving transfer function of systems
- analyze the stability of systems
- test the performance of standard control equipments using analog simulation methods.

LIST OF EXPERIMENTS

1. Digital simulation of first and second order system
2. Stability Analysis of Linear systems by Routh-Hurwitz polynomial.
3. Stability Analysis of Linear systems by Root locus, Bode plot and Nyquist plot
4. Design of Lag and lead compensator.
5. Design of P, PI, PD, PID controllers.
6. Transfer function of DC and AC servomotor
7. Study of synchros.
8. Analog simulation of type 0 type 1system
9. Stepper motor control
10. Transfer function of armature controlled and field controlled DC Motor.
11. Transfer function of DC generator
12. AC and DC closed loop control system

TOTAL PERIODS 60

COURSE OUTCOMES

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

- gain basic knowledge on simulation of control system
- design the feedback loop to achieve the desired output
- analyze the stability of systems
- investigate servo motor speed and position control principles

CO-PO MAPPING:

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CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3

EE16508 **POWER ELECTRONICS LABORATORY** **0 0 4 2**

(Common to EEE & MCT)

COURSE OBJECTIVES

To enable the students to

- study the characteristics of switching devices
- study the applications of rectifiers
- analyze performance of inverters and choppers
- design AC voltage controllers, and its controlling techniques.

LIST OF EXPERIMENTS

1. Characteristics of SCR and TRIAC.
2. Characteristics of MOSFET and IGBT.
3. Gate Pulse Generation using R, RC and UJT.
4. Voltage commutation.
5. Current commutation.
6. AC to DC half controlled converter.
7. AC to DC fully controlled converter.
8. Step down and step up MOSFET based choppers.
9. IGBT based single phase PWM inverter.
10. IGBT based three phase PWM inverter.
11. AC Voltage controller.
12. Cycloconverter.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- compare and contrast the performance and applications of various power semi converter devices.
- design the various phase controlled rectifiers with different loads.
- analyze the chopper circuit using MOSFET, IGBT and PWM inverters
- evaluate the performance of AC voltage converters.

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SEMESTER VI

EE16601 DESIGN OF ELECTRICAL APPARATUS 3 2 0 4

COURSE OBJECTIVES

To enable the students to

- study MMF calculation and thermal rating of various types of electrical machines.
- design the armature and field systems for D.C. machines.
- calculate the core, yoke, windings and cooling systems of transformers.
- design stator and rotor of induction machines
- analyze stator and rotor of synchronous machines and study their thermal behaviour.

UNIT I MAGNETIC CIRCUITS AND COOLING OF ELECTRICAL MACHINES 9+6

Concept of magnetic circuit - MMF calculation for various types of electrical machines - real and apparent flux density of rotating machines - leakage reactance calculation for transformers, induction and synchronous machine - thermal rating continuous, short time and intermittent short time rating of electrical machines.

UNIT II D.C. MACHINES 9+6

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

UNIT III TRANSFORMERS 9+6

Introduction - output rating of single phase and three phase transformers - optimum design of transformers - design of core, yoke and windings for core and shell type transformers - equivalent circuit parameter from designed data - losses and efficiency calculations - design of tank and cooling tubes of transformers.

UNIT IV THREE PHASE INDUCTION MOTORS 9+6

Introduction - output equation - main dimensions - choice of Specific loadings - design of stator - design of squirrel cage and slip ring rotor - equivalent circuit parameters from designed data - losses and efficiency calculations.

UNIT V SYNCHRONOUS MACHINES 9+6

Introduction - output equation - choice of specific loadings - main dimensions - short circuit ratio - design of stator and rotor of cylindrical pole and salient pole machines - design of field coil - performance calculation from designed data - introduction to computer aided design.

TOTAL PERIODS 45+30=75

COURSE OUTCOMES

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

- determine the MMF and thermal rating of electrical machine.
- design of D.C Machines.
- analyze and design the cooling system of transformer.
- design of induction machines.
- design of synchronous machine.

TEXT BOOKS

1. A.K. Sawhney, "A Course in Electrical Machine Design", DhanpatRai and Sons, New Delhi,2014.
2. S.K. Sen, "Principles of Electrical Machine Design with Computer Programmes", Oxford and IBH Publishing Co.Pvt Ltd., New Delhi, 2007.

REFERENCES

1. R.K. Agarwal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi, 2014.
2. V.N. Mittle and A. Mittle, "Design of Electrical Machines", Standard Publications and Distributors, Delhi, 2012.
3. A.ShanmugaSundaram, G.Gangadharan, R.Palani "Electrical Machine Design Data Book", New AgeInternational Pvt. Ltd., Reprint, 2007.
4. M.V.Deshpande —"Design and Testing of Electrical Machine Design" Wheeler Publications, 2010.
5. K.G. Upadhyay, "Design of Electrical Machines", New Age International Publishers, 2008.

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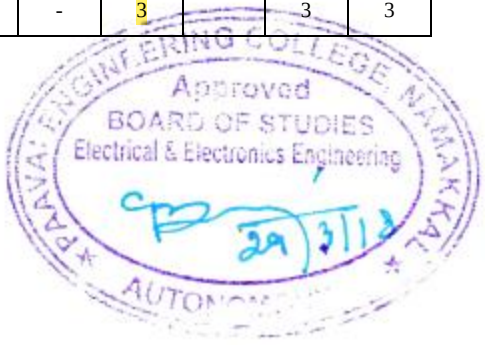

EE16602 SOLID STATE DRIVES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the stable steady-state operation and transient dynamics of a motor-load system.
- study and analyze the operation of the converter / chopper fed dc drive and to solve simple problems.
- learn and understand the operation of both classical and modern induction motor drives.
- comprehend the differences between synchronous motor drive and induction motor drive and to learn the basics of permanent magnet synchronous motor drives.
- analyze and design the current and speed controllers for a closed loop solid-state DC motor drive.

UNIT I CHARACTERISTICSOF ELECTRIC DRIVES 9

Electric Drives - Drive classification - Advantage of Electric Drives - Equations governing motor load dynamics Equilibrium operating point and its steady state stability - Mathematical condition for steady state stability - Selection of drives – Multi quadrant operation

UNIT II SOLID STATE CONTROL OF DC DRIVES 9

DC motor and their performance-Braking - Steady state analysis -Ward Leonard drives - Controlled rectifier fed DC drives - Chopper controlled DC drives - Time ratio control and current limit control - Four quadrant operation - Effect of ripples on the DC motor performance

UNIT III SOLID STATE CONTROL OF INDUCTION MOTOR DRIVES 9

Stator control- Steady state analysis - Stator voltage and frequency control - V/F control - Closed loop control of Voltage Source Inverter, Current Source Inverter and cycloconverter fed induction motor drives - Rotor control - Rotor resistance control and slip power recovery schemes- Sub synchronous and super synchronous operation - Closed loop speed control

UNIT IV SOLID STATE CONTROL OF SYNCHRONOUS MOTOR DRIVES 9

Types of synchronous Motors - Open loop v/f control -Self-controlled synchronous motor - Closed loop control Of Voltage Source Inverter, Current Source Inverter and cycloconverter fed synchronous motor drives - Margin angle control and power factor control - permanent magnet synchronous motor

UNIT V DESIGN OF CONTROLLERS FOR SOLID STATE DRIVES 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- obtain the stable steady-state and transient dynamics of a motor-load system.
- analyze the operation of the converter / chopper fed dc drive.
- perform analysis of classical and modern induction motor drives.
- differentiate between synchronous motor drive and induction motor drive.
- design the current and speed controllers for a closed loop solid-state DC motor drive.

TEXT BOOKS

1. Dubey.G.K., "Fundamental of Electrical Drives", Narosa publishing House, New Delhi 2010.
2. R.Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", Prentice Hall of India, 2009.

REFERENCES

1. Murphy, J.M.D and Turnbull.F.G. , "Thyristor control of AC Motors", Pergamon Press, New Delhi 2003
2. VedamSubramanyan, "Thyristor control of Electrical Drives", Tata McGraw Hill Publishing Combany, New Delhi 2007.
3. Gaekward, "Analog and Digital control systems", Wiley Eastern Ltd, New Delhi 2007
4. ShaahinFelizadeh, "Electric Machines and Drives", CRC Press (Taylor and Francis Group), 2013.
5. BimalK. Bose. "Modern Power Electronics and AC Drives", Pearson Education, 2002.

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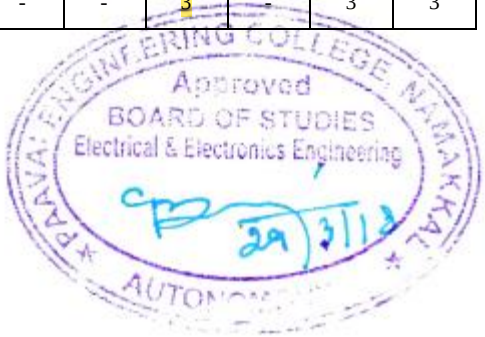

EE16603 POWER SYSTEM ANALYSIS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- familiarize the different aspects of modeling of power system components.
- solve the power flow problems using efficient simulation and numerical methods.
- understand the concept of symmetrical and un symmetrical faults in power system studies.
- study the stability status of power system under transient condition.
- perform unsymmetrical fault analysis in power system

UNIT I THE POWER SYSTEM – AN OVERVIEW AND MODELING 9

Modern Power System - Basic Components of a power system - Per Phase Analysis-Generator model - Transformer model - line model - Per unit system -Change of base.

UNIT II POWER FLOW ANALYSIS 9

Introduction - Bus Classification - Bus admittance matrix - Solution of non-linear Algebraic equations - Gauss-Seidal method - Newton-Raphson method - Fast decoupled method - Flow charts and comparison of the three methods.

UNIT III FAULT ANALYSIS-BALANCED FAULT 9

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

UNIT IV FAULT ANALYSIS SYMMETRICAL COMPONENTS AND UNBALANCED FAULT 9

Introduction - Fundamentals of symmetrical components - sequence impedances - sequence networks single line to ground fault - line-line fault - Double line to ground fault - Unbalanced fault analysis using bus impedance matrix.

UNIT V POWER SYSTEM STABILITY 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- understand the modeling and analytical concepts of power system components in power systems.

- perform power flow analysis.
- solve for symmetrical faults in power system.
- compute unsymmetrical faults in power system.
- analyze the stability of power system.

TEXT BOOKS

1. I.J.Nagrath and D.P.Kothari, "Modern Power System Analysis", Tata McGraw-Hill publishing company, New Delhi, 2011.
2. P.Kundur, "Power System Stability and Control", Tata McGraw Hill Publishing Company, New Delhi, 2008.

REFERENCES

1. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", Tata McGraw Hill Publishing Company Limited, New Delhi, Second Edition, 2012.
2. Pai M A, "Computer Techniques in Power System Analysis", Tata McGraw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, "Power System Analysis & Design", CengageLearning, Fifth Edition, 2012.
4. John J. Grainger and W.D. Stevenson Jr., "Power System Analysis", Tata McGraw-Hill, Sixth reprint, 2010. Education, 2012.
5. P. Venkatesh, B.V. Manikandan, S. Charles Raja, A. Srinivasan, "Electrical Power Systems Analysis, Security and Deregulation", PHI Learning Private Limited, New Delhi, 2012.

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CO3	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	2	-	-	-	-	-	3	-	3	3

EE16604 MICROPROCESSORS AND MICROCONTROLLERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the architecture of 8085 & 8086.
- study the addressing modes, instruction set and programming of 8085.
- introduce the need & use of interrupt structure of 8085.
- learn 8051 architecture, interrupts and serial communication.
- develop skill in simple program writing for 8051 and its applications.

UNIT I 8085 AND 8086 PROCESSOR 9

Hardware Architecture, pin diagram - Signals - Memory interfacing - I/O ports and data transfer concepts - Timing Diagram - Interrupt structure.

UNIT II PROGRAMMING OF 8085 PROCESSOR 9

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

UNIT III PERIPHERAL INTERFACING WITH 8085 9

Study of Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8253 Timer/ Counter - Interfacing with 8085.

UNIT IV 8051 MICRO CONTROLLER 9

Functional block diagram - Instruction format and addressing modes - Interrupt structure - Timer - I/O ports - Serial communication.

UNIT V MICRO CONTROLLER PROGRAMMING & APPLICATIONS 9

Data Transfer, Manipulation, Control & I/O instructions - Simple programming exercises -key board and display interface - stepper motor control - Washing Machine Control.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the architecture of 8085 microprocessor and write assembly language program.
- design the interfacing schemes of memory & peripheral devices with 8085 processor
- enumerate the architecture of 8086 microprocessor.
- develop the programming skills of 8051 microcontroller.
- perform investigation on microcontrollers application.

TEXT BOOKS

1. "Microprocessor and Microcontrollers", Krishna Kant Eastern Company Edition, Prentice – Hall of India, New Delhi, 2007.
2. Muhammad Ali Mazidi& Janice GilliMazidi, R.D.Kinely „The 8051 Micro Controller and Embedded Systems", PHI Pearson Education, 5th Indian reprint, 2003.
3. A.K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and peripherals", 2nd Edition, Tata McGraw-Hill, 2006.

REFERENCES

1. R.S. Gaonkar, "Microprocessor Architecture Programming and Application", Wiley Eastern Ltd., New Delhi,2007.
2. "The 8088 & 8086 Microprocessors", Walter A Tribal &Avtar Singh, Pearson, 2007, Fourth Edition.
3. John E Uffenbeck, "The 80x86 Family, Design, Programming and Interfacing", Third Edition. Prentice Hall, 2001.
4. Douglas V.Hall, "Microprocessors and Digital Systems", McGraw Hill Publishing Co. Ltd. 2008
5. Kenneth J Ayala, "The 8051 Micro controller", Thomson Delmer Learning, 2004
6. William Kleitz, "Microprocessor and Micro Controller Fundamental of 8085 and 8051Hardware and Software", Pearson Education, 2010.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	3	3	3	-	-	-	-	-	3	-	3	3
CO2	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO3	3	-	-	-	2	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	2	-	-	-	-	-	3	-	3	3
CO5	3	-	-	3	-	-	-	-	-	-	3	-	3	3

EE16605 PROGRAMMABLE LOGIC CONTROLLERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- develop basic knowledge about PLC architecture.
- study the logical operation of ladder diagram.
- learn operation of peripheral devices used in the PLC.
- gain knowledge of the data handling methods.
- develop skill in simple program writing for PLC.

UNIT I PROGRAMMABLE LOGIC CONTROLLERS 9

Controllers- Hardware- Internal architecture- PLC systems- Input devices Output devices- Number systems: The binary system- Octal and hexadecimal- Binary arithmetic- PLC data- Input/output units- Signal conditioning- Remote connections- Processing inputs- I/O addresses

UNIT II LADDER AND FUNCTIONAL BLOCK PROGRAMMING & INTERNAL RELAYS 9

Ladder diagrams- Logic functions - Latching- Multiple outputs- Entering programs- Function blocks- Internal relays- Ladder programs - Battery-backed relays- One-shot operation- Set and reset- Master control relay

UNIT III TIMERS, COUNTERS AND REGISTERS 9

Types of timers - Programming timers- Off-delay timers- Pulse timers- Forms of counter- Programming- Up and down counting- Timers with counters - Sequencer- Shift registers- Ladder programs

UNIT IV DATA HANDLING AND DESIGNING SYSTEMS 9

Registers and bits- Data handling- Arithmetic functions- Closed loop control- Program development- Safe systems - Commissioning- Fault finding- System documentation

UNIT V PROGRAMMING APPLICATIONS 9

Temperature control- Valve sequencing- Conveyor belt control- Control of a process- Problems

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the architecture of PLC.
- develop logical operation of ladder diagram in PLC.
- design various interfaces to the PLC.
- analyze the parameters of designing systems.
- gain adequate knowledge about various application of PLC

TEXT BOOKS

1. W. Bolton "Programmable Logic Controllers" Fourth Edition 2006
2. Petruzella"Industrial Electronics" McGraw Hill, 2010.
3. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co.,Canada,2011

REFERENCES

1. Hughes, T.A "Programmable Controllers"- 4th Edition, ISA Press, 2005
2. John W Webb and Ronald A Reis —"Programmable Logic Controllers – Principles andApplications", Prentice Hall Inc., New Jersey, Third edition, 2003.
3. W. Bolton"Programmable Logic Controllers" Elsevier Newnes publications
4. E.A.Parr "Programmable Controllers An engineer"s guide" Elsevier Newnes publications

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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CO1	3	-	-	-	2	3	2	1	3	-	2	1	1	1
CO2	3	2	2	-	2	3	2	2	3	-	2	1	1	1
CO3	3	2	2	-	2	3	2	2	3	-	2	1	1	1
CO4	3	2	2	-	2	3	2	2	3	-	2	1	1	1
CO5	3	2	2	-	2	3	2	2	3	-	2	1	1	1

EE16606 ELECTRICAL DRIVES LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to

- understand and analyze the operation of induction and synchronous motor drives through simulation packages.
- control the speed of electrical drives using DSP and microcontrollers
- understand about speed control using dual converter
- know PLC drives

LIST OF EXPERIMENTS

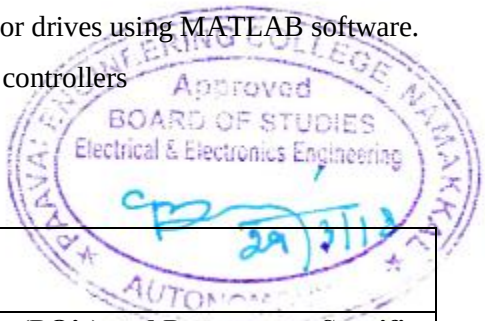
1. Simulation of VSI fed 3 phase induction motor.
2. Simulation of DC motor drive.
3. Speed control of DC motor using three phase rectifier.
4. Speed control of three phase induction motor using PWM inverter.
5. DSP based closed loop drive for induction motor.
6. Induction motor speed control using FPGA.
7. Speed control of brushless DC motor.
8. DSP based chopper fed DC motor drive.
9. Speed Control of DC Motor using dual converter.
10. PLC based drives.

TOTAL PERIODS 60

COURSE OUTCOMES

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

- understand the operation of induction and synchronous motor drives using MATLAB software.
- control the speed of electrical drives using DSP and Micro controllers
- analyse speed control using dual converter
- implemenyt PLC drives



CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO2	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	3	-	3	3

EE16607 **MICROPROCESSORS AND MICROCONTROLLERS LABORATORY** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- understand 8085 programming and instruction sets.
- interface8085 I/O interfacing peripheral devices such as keyboard, ADC, DAC and stepper motor with 8085.
- train 8051 programming and instruction sets.
- understand bit addressing in 8051 programming

LIST OF EXPERIMENTS

I. PROGRAMS USING 8085

1. 8 bit addition and subtraction
2. 8 bit multiplication and division
3. Sorting the given set of numbers in ascending and descending order
4. Finding the largest and smallest of given numbers
5. Code conversion
6. Interfacing with 8279
7. Interfacing with ADC & DAC
8. Interfacing with stepper motor

II.PROGRAMS USING 8051

1. 16 bit addition and subtraction
2. 16 bit multiplication and division
3. RAM direct addressing
4. Bit addressing

TOTAL PERIODS 60

COURSE OUTCOMES

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

- develop programming skills in 8085 microprocessors and 8051 microcontroller, based on its instruction sets.
- develop programming skills to interface the Peripheral Devices with 8085 and 8051 hardware components
- Implement 8051 programming
- Interface devices using programming.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO2	3	3	-	-	-	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	3	-	3	3

PROGRAMME ELECTIVE I

EE16151 BIO MEDICAL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the knowledge about the organs of human body and measure the parameters
- learn the bio potential electrodes, transducers and their types
- gainthe knowledge about the various measurements of blood pressure.
- study about the modern imaging systems.
- know the latest technologies in biomedical engineering.

UNIT I ELECTRO PHYSIOLOGY 9

Cell and Its Structure - Electrical, Mechanical and Chemical Activities - Action and Resting Potential- Organization of Nervous System - CNS - PNS - Neurons - Axons - Synapse - Propagation of Electrical Impulses along the Nerve - Sodium Pump - Cardio Pulmonary System- Physiology of Heart, Lung, Kidney.

UNIT II BIO POTENTIAL ELECTRODES AND TRANSDUCERS 9

Design of Medical Instruments - Components of Biomedical Instrument System - Electrodes: Micro Electrodes, Needle Electrodes, Surface Electrodes - Transducers -Piezo Electric, Ultrasonic, Passive Transducers - Resistive, Capacitive, Inductive - Biomedical Measurements Like PH, PCO2, PO2 of Blood, Isolation Amplifier, Preamplifier, Current Amplifier, Chopper Amplifier.

UNIT III INSTRUMENTS USED FOR DIAGNOSIS 9

ECG, Einthoven Triangle, Leads, Electrodes, Vector Cardiograph, Measurement of Cardiac Output, EEG, EMG, Plethysmography, Blood Flow Measurements, Holter Monitor- Respiratory Rate Measurement - Oximeter, Patient Monitoring System, ICCU.

UNIT IV MODERN IMAGING SYSTEM 9

Ultrasonic Diagnosis, Ultrasonic Scanning, Isotopes in Medical Diagnosis - Pace Makers, Defibrillators, Doppler Monitor(colour), Medical imaging-X-ray generation, Radiographic & Fluoroscopic Techniques - Image Intensifiers-Computer Aided Tomography, PET, SPECT- Laser Applications – Echocardiography-CT Scan-MRI/NMR-Endoscopy.

UNIT V RECENT TRENDS & INSTRUMENTS FOR THERAPY 9

Dialysers - Surgical Diathermy - Electro Anaesthetic and Surgical Techniques, Sources of Electric Hazards and Safety Techniques. Single Channel Telemetry, Multi-channel Telemetry, Implantable Telemetry, Wireless Telemetry, Telemedicine, Telemedicine Applications.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- acquaint the physiology of the heart, lung, blood circulations, respirations, patient monitoring and electrical safety in clinical environment.
- apply the proper electrodes and transducers based on the application.
- obtain the knowledge in various electrical origins of recording methods of ECG, EEG, EMG, ERG
- know how to use the latest medical equipments available for measurement of non-electrical parameters in the physiological systems of the human body and also the modern methods of imaging techniques used for diagnostic purpose in the health care centre
- identify the latest procedure adopted for providing Medical assistance through Telemedicine and the Therapeutic equipments used for diagnostic and surgery purposes.

TEXT BOOKS

1. Khandpur, "Handbook of Biomedical Instrumentation" 2nd Edition, Tata McGraw Hill, 2003.
2. M.Arumugam, "Biomedical Instrumentation", Anuradha Publications, Reprint 2009.

REFERENCES

1. Leslie Cromwell, Fred J. Werbell and Eruch A. Pfeigger, "Biomedical Instrumentation and Measurements" 2nd Edition 2011
2. WQ. J.Tompskins and J.G. Webster, Design of Microcomputer Based Medical Instrumentation Prentice-Hall, 2000.
3. Geddes and Baker, Principle of Applied Biomedical Instrumentation John Wiley and Sons, New York, 2001.
4. John G. Webster, "Medical Instrumentation Application and Design", John Wiley and sons, India, 3rd Edition, 2013.
5. Geddes L.A. and Baker L.E., "Principles of Applied Bio-Medical Instrumentation", John Wiley & Sons, 3rd. Edition, 2013

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	2	2	-	2	-	-	-	-	2	2	2	2
CO2	3	2	2	-	-	2	2	-	-	-	2	2	2	2
CO3	3	2	2	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	2	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	2	-	-	2	-	-	-	-	2	2	2	2

EE16152 ELECTRICAL SAFETY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the basic concepts of electrical safety
- acquaint to the concepts of electrical safety.
- understand the protection systems for electrical equipments.
- learn the installation, operation and maintenance of electrical circuits.
- gain knowledge on the hazards and issues.

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 equipment‟s- 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, Over load 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 outand work permit system-discharge rod and earthing devices - safety in the use of portable tools- cabling and cable joints -preventive maintenance.

UNIT V HAZARDOUS ZONES **9**

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

TOTAL PERIODS 45

COURSE OUTCOMES

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

- apply the basic concepts of electrical safety during practical‟s
- explain concepts of electrical safety.
- use the appropriate protection systems for electrical equipments.
- enumerate the installation, operation and maintenance of electrical circuits.
- discusson the hazards and issues.

TEXT BOOKS

1. Fordham Cooper, W., “Electrical Safety Engineering” Butterworth and Company, London, 2010.

REFERENCES

1. N.S.C.,Chicago, “Accident prevention manual for industrial operations”, 2009.
2. Indian Electricity Act and Rules, Government of India.
3. “Power Engineers–Handbook of TNEB”, Chennai, 2011.
4. Martin Glov, “Electrostatic Hazards in powder handling, Research Studies” Pvt.Ltd., England, 2013.

CO-PO MAPPING:

Mapping of Course Outcome (CO’s) with Programme Outcomes (PO’s) and Programme Specific Outcomes PSO’s (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO’s	Programme Outcomes PO’s												PSO’s	
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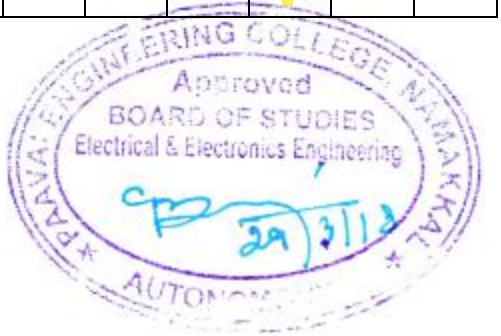
CO1	3	2	3	2	-	2	-	-	-	-	2	2	2	2
CO2	3	2	3	-	-	2	2	-	-	-	2	2	2	2
CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2



EE16153 DIGITAL CONTROL ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the digital control systems and pulse transfer function
- acquaint to the concepts of state variable approach for the analysis of discrete time systems
- understand the concepts of stability analysis of discrete time systems
- obtain the solutions of state equations.
- gain knowledge on the design of controllers for digital design

UNIT I INTRODUCTION 9

Introduction - closed loop sampled data control system - typical digital control systems - sampling theorem - sample and hold operation - advantages of sampling - pulse transfer function - Z-domain equivalence to S- domain.

UNIT II STATE SPACE ANALYSIS 9

Advantages of State model - State Space model-Companion Canonical Form, Canonical form, Jordan Canonical form - State diagram

UNIT III STABILITY ANALYSIS 9

Stability analysis - Jury stability test - Bilinear transformation method - root locus method - effect of pole zero configuration in Z-plane - dominant pole concept - transient response of sampled data control systems

UNIT IV SOLUTIONS TO STATE EQUATIONS 9

Eigen values and eigen vectors-Solutions of State equations - Laplace transformation technique, Cayley Hamilton Method - Transfer function from State equations-concepts of controllability and observability

UNIT V DESIGN 9

Transform of digital control system - Design specifications - Design on the W plane- Digital PID controller - Introduction to design on the Z plane.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe the digital control systems and pulse transfer function
- obtain the state model of systems.
- determine the stability of discrete time systems
- obtain the solutions of state equations.
- design controllers for digital design.

TEXT BOOKS

1. Gopal M, “Digital Control Engineering”,Wiley Eastern Publishers, 1997.
2. Kuo B C, “Digital control system”, Prentice Hall.PA, 1996

REFERENCES

1. K. P. Mohandas, “Modern Control Engineering”, Sanguine Technical Publishers, 2006
2. Farzad Nekoogar, Genemoriarty, “Digital control usingDSP”, Prentice Hall Pvt.Ltd, 2010.
3. Richard C.Dorf, Robert H.Bishop, “Modern Control systems”, Addison Wesley, 2013.
4. Michael P Lukas, “Distributed Control Systems”, Van NostrandReinhold Company, New York, 2009.
5. K. Ogata, “Modern Control Engineering”, Pearson Education, New Delhi, 2009.

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CO’s	Programme Outcomes PO’s												PSO’s	
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CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE16154 NANO SCIENCE 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the basics about the semiconductor & optoelectronic materials.
- know about the nano structure semiconducting materials.
- understand the different applications of nano semiconductor & nano magnetic particles in different area
- have an insight on the characteristics of nano composites and zeolites.
- comprehend the characterization of polymers.

UNIT I CONCEPTS OF NANOSTRUCTURES 9

Electronic states in crystal energy bands, Concepts of 2D nanostructures (quantum wells), 1 D nano structures (quantum wires) 0D nanostructures (quantum dots), artificial atomic clusters.

UNIT II PROPERTIES AND ANALYSIS OF NANOSTRUCTURES 9

Size dependent properties, Size dependent absorption spectra, Blue shift with smaller sizes, Phonons in nanostructures, Contacts at Nano level, AFM. lSTM tip on a surface.

UNIT III ANALYSIS OF QUANTUM TECHNIQUES 9

Charging of quantum dots, Coulomb blockade, Quantum mechanical treatment of quantum wells, wires and dots, Widening of band gap in quantum dots, Strong and weak confinement, Properties of coupled quantum dots, Optical scattering from Nan defects.

UNIT IV CHARACTERISTIC OF NANO COMPOSITES AND ZEOLITES 9

Nano composites Electronic and atomic structure of aggregates and nano particles theory and modeling of nano particles fictionalization processes.

UNIT V CHARACTERIZATION OF NANOPOLYMERS 9

Nano systems: Synthesis and characterization Methods of Synthesis: Molecular beam epitaxy, MOCVD, chemical routes, nano particles on polymers, pulsed laser deposition, ion beam assisted techniques including embedded nano particles, RF sputtering.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the concept of nano physics anf quantum dots.
- determinethe behavior of materials at nano scale
- analyze the energy level to different materials
- analyze the characteristics of nano composite materials.

- give details about the synthesis of polymer and their characteristics

TEXT BOOKS

1. K.Bamam and D.Vvedensky ,"Low Dimensional Semiconductor Structures", 2011.
2. B. H. Bransden, Charles Jean Joachain "Quantum Mechanics" Prentice Hall, 2010

REFERENCES

1. L.Banyai and S.W.Koch ,"Semiconductor Quantum Dots", (World Scientific) 2010,
2. J.H. Davies, "An introduction to the physics-af low dimensional semiconductors", Cambridge Press, 2008.
3. Karl Goser, Peter Glosekotter, Jan Dienstuhl "Nanoelectronics and Nanosystems" , Springer, 2004
4. Krause P. C. and Wasynczuk O., "Electromechanical Motion Devices", McGraw-Hill, New York, 2009.
5. Lyshevski S. E., "Integrated control of microactuators and integrated circuits: a new turning approach in MEMS \technology," Proceedings Conference Decision and Control", Phoenix, AZ, pp. 2611-2616, 2009.

CO-PO MAPPING:

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CO's	PO's												PSO's	
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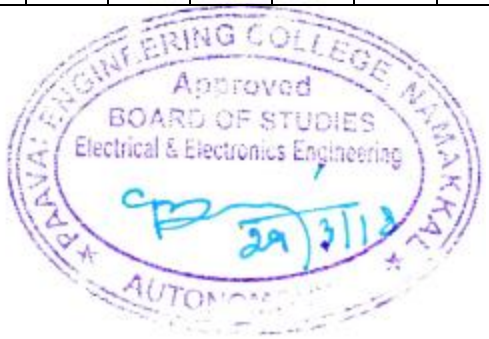
CO2	3	2	3	-	-	2	2	-	-	-	2	2	2	2
CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2



EE16155 NETWORK ANALYSIS AND SYNTHESIS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concept of S-domain network.
- know the concept of frequency response.
- learn the concept of network topology.
- have an indepth knowledge on the design of two-port networks and filters.
- synthesize an electrical network from a given impedance/admittance function.

UNIT I S-DOMAIN ANALYSIS 9

S-domain network -driving point and transfer impedances and their properties - transform network analysis - Time response of series RC, RL and RLC circuits

UNIT II FREQUENCY DOMAIN ANALYSIS 9

Immittance - loci of RLC network - Frequency response of three phase RLC networks - frequency response from pole- zero- Bode plots

UNIT III NETWORK TOPOLOGY 9

Network graph, tree and cut-sets - tie set and cut-set schedules - v-shift and I-shift - Primitive impedance and admittance matrices -Application to network solutions.

UNIT IV TWO-PORT NETWORKS AND FILTERS 9

Characterization of two-port networks in terms of z, y, h-and T-parameters - Network Equivalents -Relations between network parameters - Analysis of T, ladder, bridged - T and lattice networks -Transfer function of terminated two - port networks. Filters and attenuators - Design of constant -k, m-derived and composite filters -qualitative treatment of active filters -Butterworth and Chebyshev filters.

UNIT V ELEMENTS OF NETWORK SYNTHESIS 9

Realisability of one-port network - Hurwitz polynomials and properties - Positive real functions and properties -synthesis of RL, RC and LC one-port networks

TOTAL PERIODS 45

COURSE OUTCOMES

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

- perform analysis of electrical circuits in s domain
- analyze electric circuits in frequency domain.
- apply network topology to find the electrical parameters.
- examine two port networks and design constant K and m derived filters.
- synthesize one port electrical circuits.

OPEN ELECTIVE I

EE16901 MICRO ELECTRO MECHANICAL SYSTEM 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- study the basics of MEMS and parts of MEMS
- understand the sensors and transducers used in MEMS.
- know design methodology of MEMS for various mechanics
- learn the process of lithography in MEMS
- identify the applications of optical and RF based MEMS.

UNIT I INTRODUCTION 9

MEMS- Micro fabrications for MEMS - Surface micromachining of silicon - Wafer bonding for MEMS - LIGA process - Micromachining of polymeric MEMS devices -Three-dimensional micro fabrications. Materials: Materials for MEMS - Metal and metal alloys for MEMS - Polymers for MEMS - Other materials for MEMS. Metal: Evaporation - Sputtering. Semiconductors: Electrical and chemical properties-Growth and deposition. Thin films for MEMS and their deposition techniques.

UNIT II MICROSENSING FOR MEMS 9

Piezo-resistive sensing - Capacitive sensing - Piezoelectric sensing - Resonant sensing -Surface acoustic wave sensors. Transducers: Electromechanical transducers - Piezoelectric transducers -Electrostrictive transducers - Magnetostrictive transducers - Electrostatic actuators-Electromagnetic transducers - Electrodynamic transducers - Actuators: Electrothermal actuators-Comparison of electromechanical actuation schemes.

UNIT III MICRO MACHINING 9

Micromachining : Bulk micromachining for silicon-based MEMS -Isotropic and orientation-dependent wet etching - Dry etching - Buried oxide process - Silicon fusion bonding - Anodic bonding - Silicon surface micromachining Sacrificial layer technology - Material systems in sacrificial layer technology - Surface micromachining using plasma etching -Combined integrated-circuit technology and anisotropic wet etching

UNIT IV LITHOGRAPHY 9

Micro stereo lithography for polymer MEMS - Scanning method -Two-photon micro stereo lithography Surface micromachining of polymer MEMS - Projection method - Polymeric MEMS architecture with silicon, metal and ceramics - Microstereolithography integrated with thick film lithography

UNIT V APPLICATIONS **9**

Switching: Introduction - Switch parameters - Basics of switching - Mechanical switches -Electronic switches - Switches for RF and microwave applications - Mechanical RF switches - PIN diode RF switches - Metal oxide semiconductor field effect transistors and monolithic microwave integrated circuits. RF MEMS switches: Integration and biasing issues for RF switches -Actuation mechanisms for MEMS devices-Electrostatic switching.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- integrate the knowledge of semiconductors and solid mechanics MEMS device fabrication.
- understand the rudiments of micro fabrication techniques
- identify and understand the various sensors and actuators
- select different materials used for MEMS
- apply MEMS to various disciplines

TEXT BOOKS

1. Vijay K.Varadan, K.J.Vinoy and K.A.Jose, "RF MEMS and Their Applications(ISBN 0-470-84308-X)", 1st Edition, John Wiley &SonsLtd., West Sussex, England, 2003.
2. James J.Allen, "Micro electro mechanical system design", CRC Press published in 2005

REFERENCES

1. P. Rai-choudhury, "MEMS and MEMS Technology and Applications", 1st Edition PHI, 2009.
2. S. Senturia, "Microsystem Design", Kluwer, 2001.
3. J.W. Gardner, V.K. Varadan, O.O. Awadelkarim, "Microsensors, MEMS & Smart Devices"John Wiley,2013.
4. S. Campbell, "The Science and Engineering of Microelectronic Fabrication", Oxford Univ. Press, 2001
5. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2007.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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CO2	3	2	3	-	-	2	2	-	-	-	2	2	2	2
CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE16902 INDUSTRIAL ROBOTICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn robotic technology
- understand about the peripherals used and vision process
- get idea about programming of robots.
- know the robotic applications in different industrial domains

UNIT I INTRODUCTION 9

Automation and robotics, Robotic System and Anatomy Classification, Future Prospects - Drive: Control Loops, Basic. Control System Concepts and Models, Control System Analysis, Robot Activation and Feedback Components, Position and Velocity Sensors, Actuators , Power Transmission Systems

UNIT II PERIPHERAL, SENSORS AND MACHINE VISION 9

End Effecters - types, Mechanical and other grippers, Tool as end effecter - sensors: Sensors in Robotics, Tactile Sensors, Proximity and Range Sensors, Sensor Based Systems, Uses Vision Systems - Equipment-introduction, Low level and High level vision, Sensing and Digitizing, Image processing and analysis, Segmentation, Edge detection, Object description and recognition, Interpretation, Applications

UNIT III PROGRAMMING FOR ROBOTS 9

Methods, Robot programme as a path in space, Motion interpolation, level and task level languages, Robot languages; Programming in suitable languages Characteristics of robot.

UNIT IV ROBOT KINEMATICS AND APPLICATION 9

Forward, Reverse - Homogeneous Transformations, Manipulator Path Control, Robot Dynamics

UNIT V ROBOTIC APPLICATION IN MANUFACTURING 9

Material transfer, Machine loading and unloading, Processing operations, Assembly and Inspectors, Robotic Cell Design and Control.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the basic principles of robotic technology, configurations, control and programming of robots.
- design an industrial robot which can meet kinematic and dynamic constraints.
- choose the appropriate sensor and machine vision system for a given application.
- clarify the basic principles of programming and apply it for typical Pick & place, loading & unloading and palletizing applications.

TEXT BOOKS

1. Fu, Lee and Gonzalez "Robotics, control vision and intelligence". McGraw Hill International, 2nd edition, 2007.
2. John J. Craig, "Introduction to Robotics" Addison Wesley Publishing, 3rd edition, 2010.

REFERENCES

1. M.P. Groover , M. Weiss, R.N. Nagel, N.G. Odrey "INDUSTRIAL ROBOTICS,"Mcgra – Hill International. 2007
2. YoramKoren, "Robotics for Engineers" McGraw Hill International, 1st edition, 2011.
3. Groover, Weiss, Nagel,"Industrial Robotics" McGraw Hill International, 2nd edition, 2012.
4. Klafter, Chmielewski and Negin, "Robotic Engineering - An Integrated approach", PHI, 1st edition,
5. YoremKoren, "Robotics for Engineers"2009.

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CO3	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO4	3	2	3	-	-	2	-	-	-	-	2	2	2	2
CO5	3	2	3	-	-	2	-	-	-	-	2	2	2	2

EE16903 SOFT COMPUTING TECHNIQUES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the artificial intelligence, various types of production systems, characteristics of production systems.
- expose the neural networks, architecture, functions and various algorithms involved.
- learn the basic fuzzy logic functions, various fuzzy systems and their functions.
- Study the fuzzy set theory based on applications.
- Know the genetic algorithms, its applications and advances.

UNIT I NEURAL NETWORKS-I 9

Artificial neural networks - definition and fundamental concepts - engineering approaches to neural computing- biological neural networks - Artificial neural activation functions - setting of weights - typical architectures - biases and thresholds - learning and its methods - LMS learning rule - MADALINE - XOR Problem - training algorithm. Supervised Learning Neural Networks - Perceptrons - Adaline - Back propagation Mutilayer Perceptrons

UNIT II NEURAL NETWORKS-II 9

Radial Basis Function Networks - Support Vector Machines - Unsupervised Learning Neural Networks - Competitive Learning Networks - Kohonen Self-Organizing Networks - Learning Vector Quantization - Hebbian Learning.

UNIT III FUZZY SET THEORY-I 9

Introduction to Neuro - Fuzzy and Soft Computing - Fuzzy Sets - Basic Definition and Terminology - Set-theoretic Operations - Member Function Formulation and Parameterization - Fuzzy Rules and Fuzzy Reasoning - Extension Principle and Fuzzy Relations - Fuzzification and Defuzzification

UNIT IV FUZZY SET THEORY-II 9

Fuzzy If-Then Rules - Fuzzy Reasoning - Fuzzy Inference Systems - Mamdani Fuzzy Models -Sugeno Fuzzy Models - Tsukamoto Fuzzy Models - Input Space Partitioning and Fuzzy Modeling.

UNIT V GENETIC ALGORITHM 9

Introduction to genetic algorithm-history - basic concepts-creation of offspring-working principle-encoding-binary encoding-octal encoding - hexadecimal encoding - permutation encoding - value encoding - tree encoding-fitness function. Application of GA in power system optimization problems, AC drives, DC drives, neuro - GA applications, GA based optimal weight training for neural networks

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain about soft computing techniques and their applications
- analyze various neural network architectures
- define the fuzzy systems
- perform analysis of systems based on fuzzy set theory.
- examine the genetic algorithms and their applications.

TEXT BOOKS

1. Laurance Fausett, Englewood cliffs, N.J., "Fundamentals of Neural Networks", Pearson Education,2008.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Tata McGraw Hill, 2007.

REFERENCES

1. Simon Haykin, "Neural Networks", Pearson Education, 2003.
2. John Yen & Reza Langari, "Fuzzy Logic – Intelligence Control & Information", Pearson Education, New Delhi, 2003
3. M.Gen and R,Cheng, "Genetic algorithms and Optimization", Wiley Series in Engineering Design and Automation, 2000
4. Hagan, Demuth, Beale, "Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, "Artificial Intelligence and Intelligent Systems", Oxford, 2013.

CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO1	3	-	-	-	2	3	1	-	1	-	2	1	-	2
CO2	3	-	-	-	2	3	1	-	1	-	2	1	-	2
CO3	3	-	-	-	2	3	1	-	1	-	2	1	-	2
CO4	3	-	-	-	2	3	1	-	1	-	2	1	-	2
CO5	3	-	-	-	2	3	1	-	1	-	2	1	-	2

EE16904 WIND AND SOLAR ENERGY SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on the energy availability in the field renewable energy.
- acquire knowledge about the wind generators and about wind hybrid technology.
- understand the developing processes involved in wind energy system.
- impart detailed knowledge on photovoltaic system and role of power electronics in PV system.
- get basic idea of hybrid wind and solar system.

UNIT I INTRODUCTION 9

Recent trends in energy consumption - World energy scenario - Energy sources and their availability - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems - need to develop new energy technologies

UNIT II WIND ENERGY CONVERSION SYSTEMS 9

Basic principle of wind energy conversion - nature of wind - Wind survey in India - Power in the wind - components of a wind energy - conversion system - Performance of induction generators for WECS - classification of WECS - Analysis of different wind power generators - IG - PMSG - DFIG – SEIG.

UNIT III GRID CONNECTED WIND ENERGY SYSTEMS 9

Grid Connected WECS: Grid connectors concepts - wind farm and its accessories - Systems for Feeding into the Grid - Induction Generators for Direct Grid Coupling - Asynchronous Generators in Static Cascades - Synchronous. Generators Grid related problems - Generator control - Performance improvements - Different schemes - AC voltage controllers - Harmonics and PF improvement

UNIT IV SOLAR ENERGY CONVERSION SYSTEMS 9

Photovoltaic Energy Conversion: Solar radiation and measurement - solar cells and their characteristics - PV arrays - Electrical storage with batteries - Switching devices for solar energy conversion Grid connection Issues - Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing. PV Applications: Standalone inverters - Charge controllers - Water pumping, audio visual. equipments, street lighting - analysis of PV systems

UNIT V OPERATION OF POWER SYSTEM WITH WIND AND SOLAR ENERGY SYSTEMS **9**

Interface requirement - synchronizing with grid - operating limit - energy storage and load scheduling - utility Resource planning - electrical performance - voltage, current and power efficiency - component design for maximum efficiency - static bus impedance and voltage regulation - quality of power - renewable capacity limit - Plant economy

TOTAL PERIODS 45

COURSE OUTCOMES

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

- describe about the fundamentals of wind and solar energy and the requirements of renewable energy in India
- find various wind turbines and importance of hybrid wind energy system
- design wind energy systems
- enumerate about the principle of conversion of solar energy through power electronics converters
- acquire knowledge about the importance of hybrid wind and solar system

TEXT BOOKS

1. Rai ,G.D., "Non- conventional resources of energy" , Khanna publishers ,Fourth edition , 2010.

REFERENCES

1. Rashid. M. H, "Power Electronics Handbook", Academic press, 2001.
2. Erickson. R., Angkrtitrakul. S, Al – Nasean. O and Lujan. G, "Novel power electronics systems for wind energy applications" – Final report, National Renewable Energy Laboratory, Colorado, US. – Aug 24, 1999 Nov 30, 2002.
3. Rai. G. D, "Non conventional energy sources", Khanna publishers, 4th Edition 2000.
4. B.H.Khan, "Non Conventional Energy Resources", Tata McGrawHill, 2nd Edition 2006.
5. J.K.Manwell, J.G.McGowan, A.L.Rogers, "Wind energy explained – Theory Design and applications", John Wiley& Sons, 2nd Edition 2009.

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CO3	3	3	3	2	2	1	-	-	-	-	3	-	3	3
CO4	3	3	3	2	2	1	-	-	-	-	3	-	3	3
CO5	3	3	3	2	2	1	-	-	-	-	3	-	3	3

EE15701 POWER SYSTEM OPERATION AND CONTROL 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basics of power system operation and control.
- model and design power-frequency dynamics and power-frequency controller.
- characterize reactive power-voltage interaction and the control actions varying system load.
- learn the economic operations available in power system.
- comprehend computer control of SCADA and its application for real time operation and control of power systems.

UNIT I INTRODUCTION 9

Introduction of power system operation and control - structure of electrical power system- importance of load forecasting, quadratic and exponential curve fitting techniques of forecasting - plant level and system level controls.

UNIT II REAL POWER FREQUENCY CONTROL 9

Basics of speed governing mechanism and modeling - speed - load characteristics – load sharing between two synchronous machines in parallel - control area concept - LFC control of a single - area system - static and dynamic analysis of uncontrolled and controlled cases - two-area system - modeling - static analysis of uncontrolled - state variable model

UNIT III REACTIVE POWER VOLTAGE CONTROL 9

Introduction of excitation systems and its types - generation and absorption of reactive power- methods of voltage control: tap changing transformer, SVC (TCR + TSC) and STATCOM

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH 9

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

UNIT V COMPUTER CONTROL OF POWER SYSTEMS 9

Needs for computer control of power systems - Energy control centre: Functions, system monitoring, data acquisition and control - SCADA and EMS functions: Contingency Analysis - state transition diagram showing various state transitions and control strategies

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- elucidate the basics of power system control.
- model and design power frequency controllers.
- create power voltage interaction for various loads.
- perform analysis for economic dispatch and unit commitment
- enumerate and discuss on the computer control of power systems

TEXT BOOKS

1. I J Nagarath and D P Kothari, "Modern Power System Analysis" Tata McGraw Hill Education Pvt. Ltd, 3rd Edition, 2017
2. Allen J Wood & Woollenberg, **"**Power generation, operation and control" John Wiley and Sons Second Edition, 2013
3. O.J Elgerd, "Electrical Energy Systems Theory" Tata McGraw Hill Education Pvt. Ltd, 2nd Edition, 2017.

REFERENCES

1. Kundur P "Power System Stability and Control" Tata McGraw Hill Education Pvt. Ltd., New Delhi, Fifth Edition, 2014.
2. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis, Operation and Control" PHI, Second Edition, 2010
3. G.L.Kusic, "Computer Aided Power System Analysis" PHI, 2010.
4. B.M.Weedy and B.J. Cory, "Electric Power Systems", Wiley Fifth Edition, 2012
5. R.N. Dhar, "Computer Aided Power System Operation and Analysis" Tata McGraw-Hill, 2012.

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CO3	3	3	2	3	-	-	-	-	-	-	3	1	3	3
CO4	-	3	-	3	-	-	-	-	-	3	3	1	3	3
CO5	3	3	-	3	-	-	-	-	-	-	3	1	3	3

EE15702 SPECIAL ELECTRICAL MACHINES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the construction, principle of operation, control and performance of stepping motors.
- acquire knowledge on the construction, principle of operation, control and performance of switched reluctance motors.
- know about the construction, principle of operation and performance of synchronous reluctance motors
- update their knowledge on the construction, principle of operation, control and performance of permanent magnet brushless D.C. motors.
- identify the construction, principle of operation and performance of permanent magnet synchronous motors.

UNIT I STEPPER MOTORS 9

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

UNIT II SWITCHED RELUCTANCE MOTORS 9

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

UNIT III SYNCHRONOUS RELUCTANCE MOTORS 9

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

UNIT IV PERMANENT MAGNET BRUSHLESS D.C. MOTORS 9

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

UNIT V PERMANENT MAGNET SYNCHRONOUS MOTORS (PMSM) 9

Principle of operation - Ideal PMSM - EMF and Torque equations - Armature MMF - Synchronous Reactance - Sine wave motor with practical windings - Phasor diagram - Torque/speed characteristics -

Power controllers - Converter Volt-ampere requirements - Applications.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the construction, control and performance of stepping motors.
- enumerate the construction, control and performance of switched reluctance motors.
- model and analyze synchronous reluctance motors and their application.
- distinguish the concepts of permanent magnet brushless D.C. motors and their application.
- acquire knowledge in construction and performance analysis of permanent magnet synchronous motors and their application.

TEXT BOOKS

1. K.Venkataratnam, "Special Electrical Machines", Universities Press (India) Private Limited, 2008.
2. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives" Clarendon Press, Oxford, 2009.
3. T. Kenjo, "Stepping Motors and Their Microprocessor Controls" Clarendon Press London, 2010.

REFERENCES

1. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application", CRC Press, New York, 2001.
2. P.P. Aearnley, "Stepping Motors – A Guide to Motor Theory and Practice", Pete Perengrinus London, 2011.
3. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", Clarendon Press, London, 2006.
4. E.G. Janardanan, "Special electrical machines", PHI learning Private Limited, Delhi, 2014.

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CO4	-	3	-	3	-	-	-	-	-	3	3	1	3	3
CO5	3	3	-	3	-	-	-	-	-	-	3	1	3	3

EE15703 **PROTECTION AND SWITCHGEAR** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- initiate the characteristics and functions of relays and protection schemes.
- impart knowledge on general protection schemes of the electrical apparatus.
- learn the causes of abnormal operating conditions of the apparatus and system.
- study the functioning of circuit breakers.
- establish the concept of static and numerical relays.

UNIT I PROTECTIVE RELAYS **9**

Principles and need for protective schemes - Methods of Neutral grounding- Zones of protection and essential qualities of Protection - Construction and characteristics of relays - Over current relays - directional, distance and differential relays - Under frequency relays - Negative sequence 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**

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 STATIC RELAYS AND NUMERICAL PROTECTION **9**

Static relays - Phase, Amplitude Comparators - Synthesis of various relays using Static comparators - Block diagram of Numerical relays - Over current protection-transformer differential protection, and distant protection of transmission lines.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- recapitulate the construction and operation of protective relays.
- describe the general protection schemes of the electrical apparatus.
- evaluate the theory of circuit interruption.
- identify the circuit breakers based on the operation and characteristics.

- perform synthesis of numerical protection of transmission line using static comparator.

TEXT BOOKS

1. V.K.Mehta, Rohit Mehta "Principles of Power systems" S.Chand Publications, 2017.
2. Y.G.Paithankar and S.R.Bhide, "Fundamentals of power system protection", Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2016.

REFERENCES

1. Badri Ram ,B.H. Vishwakarma, "Power System Protection and Switchgear", New Age International Pvt Ltd Publishers, Second Edition, 2016.
2. C.L. Wadhwa, "Electrical Power Systems", New Age International (P) Ltd., 2014.
3. RavindraP.Singh, "Switchgear and Power System Protection", PHI Learning Private Ltd., NewDelhi, 2015
4. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, "A Text Book on Power System Engineering", Dhanpat Rai& Co.,2014.

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CO4	-	3	-	3	-	-	-	-	-	3	3	1	3	3
CO5	3	3	-	3	-	-	-	-	-	-	3	1	3	3

EE15704 Power System Simulation Laboratory **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- impart knowledge about load flow analysis through digital simulation.
- study the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modeling issues.
- perform the estimation of different states of a power system.
- understand dispatching schemes in power systems

LIST OF EXPERIMENTS

1. Computation of Transmission Lines Parameter.
2. Formation of Bus Admittance Matrices and Solution of Networks
3. Formation of Bus Impedance Matrices and Solution of Networks.
4. Solution of Load Flow and Related Problems using Gauss-Seidel Method
5. Solution of Load Flow and Related Problems using Newton-Raphson
6. Solution of Load Flow and Related Problems using Fast-Decoupled Methods
7. Electromagnetic Transients in Power System
8. Small Signal Stability Analysis Single Machine Infinite Bus System
9. Small Signal Stability Analysis Multi Machine Infinite Bus System
10. Economic Dispatch in Power Systems.

TOTAL PERIODS 60

COURSE OUTCOMES

At the end this course, students will be able to

- investigate the power flow studies
- reproduce the electromagnetic and electromechanical phenomena in the synchronous generator.
- enumerate the compensations schemes available in power systems.
- develop generation dispatching schemes in power systems.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	3	2	3	-	2	-	-	-	2	-	3	3	3
CO2	3	3	2	3	-	-	-	-	-	2	-	3	3	3
CO3	3	3	2	3	-	-	-	2	-	2	-	3	3	3
CO4	3	3	2	3	-	-	-	-	-	2	-	3	3	3

EE15705 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to

- gain knowledge on literature review.
- categorize the requirements for the project
- develop the ability to implement their engineering knowledge to build products.
- train the students in preparing project reports and to face reviews and viva voce examination

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

TOTAL PERIODS 60

COURSE OUTCOMES

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

- apply the basic fundamentals
- analyze the requirements for the project.
- implement concepts of engineering in developing hardware modules.
- demonstrate the working model.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1	3	2	3	2	3	2	1	1	2	2	3	1	3	2
CO2	3	2	3	2	3	2	1	1	2	2	3	1	3	2
CO3	3	2	3	2	3	2	1	1	2	2	3	1	3	2
CO4	3	2	3	2	3	2	1	1	2	2	3	1	3	2

EE15801 UTILISATION OF ELECTRICAL ENERGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge principle and application of Electric drives and traction.
- illustrate the principle and design of Illumination systems.
- emphasize the basic principle and methods of Heating and welding and the concept of electroplating.
- understand the basic principle and operation of Refrigeration and Air conditioning.
- impart knowledge Economics of Electrical Energy utilization.

UNIT I ELECTRIC DRIVES AND TRACTION 9

Fundamentals of Electric drive - choice of an Electric Motor - Application of speed control in industrial drives, Electric vechile.Introduction - requirements of ideal traction system - supply systems - mechanics of train movement - Traction motors and control - multiple units - braking - current collection systems - recent trends in electric traction - Applications of braking in traction.

UNIT II ILLUMINATION 9

Importance of lighting - properties of good lighting scheme - Nature of radiation - definition - laws - photometry - types of lamps - Lighting calculations - Basic design of illumination systems - residential, industrial, commercial, health care, street lightings, sports ground .- energy efficiency lamps.

UNIT III HEATING AND WELDING 9

Methods of heating- requirement of heating material - design of heating element - furnaces - welding generator - welding transformer and its characteristics- Electro-plating: Methods-estimation of power and current for depositing metals- Current and energy efficiency - Electro-deposition and electroforming - Power supply for electrolysis.

UNIT IV ELECTRICAL CIRCUITS USED IN REFRIGERATION AND AIR CONDITIONING AND WATER COOLER 9

Principle of air conditioning - vapour pressure - refrigeration cycle - eco-friendly refrigerants. Description of Electrical circuit used in Refrigerator - air-conditioner, and water cooler - BEE star rating.

UNIT V ECONOMICS OF ELECTRICAL ENERGY UTILIZATION 9

Economic aspects of power generation - load and load duration curves - number and size of units - cost of electrical energy - tariff. Economics of power factor improvement - power capacitors - power quality. Importance of electrical energy conservation - methods - energy efficient equipments. Introduction to energy auditing.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- gain the knowledge regarding the concept of electric drives and traction systems.
- expand the knowledge regarding design of illumination systems.
- reproduce the concepts of basic principle and methods of heating and welding.
- put on their knowledge regarding refrigeration and air conditioning.
- learn the energy utilization and consumption and economics.

TEXT BOOKS

1. Dr.N.V.Suryanarayana, "Utilisation of Electric power", Wiley Eastern Limited, New Age International Limited, 2009.
2. S.L. Uppal, "Electrical Power", Khanna Publishers, 2012.
3. R.K.Rajput, "Utilisation of Electrical Power", Laxmi publications (P) Ltd., 2012.

REFERENCES

1. H.Partab, "Art and Science of Utilisation of Electrical Energy", Dhanpat Rai and Co., New Delhi – 2014.
2. C.L. Wadhwa, "Generation, Distribution and Utilization of Electrical Energy", New Age International Pvt.Ltd, 2015.
3. J.B. Gupta, "Utilization of Electric Power and Electric Traction", S.K.Kataria and Sons, 2012.
4. B.R. Gupta, "Generation of Electrical Energy", Eurasia Publishing House Ltd, New Delhi, 2010.
5. Gopal.K.Dubey, "Fundamentals of Electrical Drives", Narosa Publishing House, New Delhi, 2008.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
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CO3	-	1	3	-	3	3	-	-	-	-	1	3	3	3
CO4	3	1	3	-	3	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	3	3	-	-	-	-	1-	3	3	3

EE15802 **PROJECT WORK** **0 0 12 6**

COURSE OBJECTIVES

To enable the students to

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

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

TOTAL PERIODS 180

COURSE OUTCOMES

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

- apply the basic fundamentals
- analyze the requirements for the project.
- take up any challenging practical problems.
- find solution by formulating proper methodology.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	PO's												PSO's	
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CO3	3	2	3	2	3	2	1	1	2	2	3	1	3	2
CO4	3	2	3	2	3	2	1	1	2	2	3	1	3	2

PROGRAMME ELECTIVE III

BA15451 ENTREPRENEURSHIP DEVELOPMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- acquire the knowledge about competencies required for an entrepreneur.
- impart knowledge in motivation techniques in entrepreneurship.
- discuss the various factors that has to be considered while preparing a business plan.
- understand the various sources of finance and accounting for business.
- describe the role of government and other agencies in promoting entrepreneurship.

UNIT I ENTREPRENEURSHIP 9

Entrepreneur - Types of Entrepreneurs - Difference between Entrepreneur and Intrapreneur - Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT II MOTIVATION 9

Major Motives Influencing an Entrepreneur - Achievement Motivation Training, Self Rating, Business Games, Thematic Apperception Test - Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS 9

Small Enterprises - Definition, Classification - Characteristics, Ownership Structures - Project - Formulation - Steps involved in setting up a Business - identifying, selecting a Good Business - opportunity, Market Survey and Research, Techno Economic Feasibility Assessment - Preparation of Preliminary Project Reports - Project Appraisal - Sources of Information - Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING 9

Need - Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation - Income Tax, Excise Duty - Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS 9

Sickness in small Business - Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators - Government Policy for Small Scale Enterprises - Growth Strategies in small industry - Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- acquire skills necessary to become an entrepreneur

- exhibit the skills required to manage small business
- analyze and develop a business plan..
- identify the various factors to be considered for launching a small business.
- comprehend the support rendered by government and other agencies in entrepreneurship development

TEXT BOOKS

1. Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, "Entreprenuership – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014

REFERENCES

1. Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2. Mathew J Manimala, "Enterprenuership theory at cross roads: paradigms and praxis" 2nd Edition Dream tech, 2005.
3. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
4. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

CO's	Programme Outcomes PO's												PSO's	
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CO1	3	-	3	-	3	-	-	-	-	-	1	3	3	3
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CO3	-	1	3	-	3	3	-	-	-	-	1	3	3	3
CO4	3	1	3	-	3	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	3	3	-	-	-	-	1-	3	3	3

EE15351 PROGRAMMABLE LOGIC CONTROLLERS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- develop basic knowledge about PLC architecture.
- study the logical operation of ladder diagram.
- learn operation of peripheral devices used in the PLC.
- gain Knowledge of the data handling methods.
- grow skill in simple program writing for PLC.

UNIT I INTRODUCTION TO PLC 9

Controllers - Hardware - Internal architecture - PLC systems - Input devices Output devices - Number systems: The binary system - Octal and hexadecimal - Binary arithmetic - PLC data - Input/output units - Signal conditioning - Remote connections - Processing inputs - I/O addresses

UNIT II LADDER AND INTERNAL RELAYS 9

Ladder diagrams - Logic functions- Latching- Multiple outputs - Entering programs - Function blocks - Internal relays - Ladder programs- Battery-backed relays - One-shot operation - Set and reset- Master control relay

UNIT III TIMERS, COUNTERS, REGISTERS 9

Types of timers - Programming timers - Off-delay timers - Pulse timers - Forms of counter - Programming up and down counting - Timers with counters - Sequencer - Shift registers - Ladder programs

UNIT IV DATA HANDLING, DESIGNING SYSTEMS 9

Registers and bits - Data handling - Arithmetic functions - Closed loop control - Program development - Safe systems - Commissioning - Fault finding - System documentation

UNIT V PROGRAMMING APPLICATIONS 9

Temperature control - Valve sequencing - Conveyor belt control - Control of a process

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- explain the architecture of PLC.
- develop logical operation of ladder diagram in PLC.
- design various interfaces to the PLC.
- analyse the parameters of designing systems.
- gain adequate knowledge about various application of PLC

TEXT BOOKS

1. W. Bolton "Programmable Logic Controllers" Elsevier Newnes publications Fourth Edition 2016
2. E.A.Parr" Programmable Controllers An engineer"s guide" Elsevier Newnes publications, 2015
3. John W Webb and Ronald A Reis ,"Programmable Logic Controllers Principles and Applications" Prentice Hall Inc,Third edition, 2003.

REFERENCES

1. W. Bolton "Programmable Logic Controllers" Elsevier Newnes publications,2015
2. Hughes, T.A "Programmable Controllers"- 4th Edition, ISA Press, 2005
3. Petruzella "Industrial Electronics" McGraw Hill, 2006.
4. Michael P. Lukas, "Distributed Control System", Van Nostrand Reinhold Co.,Canada,2010

CO-PO MAPPING:

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	Programme Outcomes PO's												PSO's	
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CO2	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO3	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO4	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO5	3	2	2	-	2	3	2	2	3	-	2	1	3	3

EE15352 EMBEDDED SYSTEM DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- initiate their knowledge embedded system and is devices, architecture of processor.
- launch the concept of bus communication in processors, Input/output interfacing.
- gain the knowledge of various embedded software tools, design and architecture of memories.
- establish basics of Real time operating system and example tutorials to discuss on one real time operating system tool.
- impart knowledge on embedded system application development.

UNIT I INTRODUCTION TO EMBEDDED SYSTEMS 9

Introduction to Embedded Systems - The build process for embedded systems - Structural units in Embedded processor, selection of processor & memory devices- DMA - Memory management methods - Software architecture of embedded system.

UNIT II EMBEDDED NETWORKING 9

Embedded Networking: Introduction, I/O Device Ports & Buses - Serial Bus communication protocols - RS232 standard - RS422 - RS485 - CAN Bus - Serial Peripheral Interface (SPI) - Inter Integrated Circuits (I^2C) - Parallel Communication PCI/ISA.

UNIT III EMBEDDED SOFTWARE DEVELOPMENT PROCESS AND TOOLS 9

Introduction to Embedded Software Development Process and Tools - host and target machines - linking and locating software - Issues in hardware - software design - Basic concepts of Compiler, linker, loader, simulator, emulators, logic analyzer, watchdog timer and ICE.

UNIT IV RTOS BASED EMBEDDED SYSTEM DESIGN 9

Introduction to basic concepts of RTOS - Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing - Inter process Communication - synchronization between processes - semaphores, Mailbox, pipes, priority inversion, priority inheritance.

UNIT V EMBEDDED SYSTEM APPLICATION DEVELOPMENT 9

Case Study of Washing Machine - Automotive Application - Smartcard System.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- deliver the concepts of embedded communication.
- enumerate the concept of networking architecture.

- identify the software development process and tools of embedded system.
- know the real time based system.
- design in application of embedded system.

TEXT BOOKS

1. Rajkamal, „Embedded System-Architecture, Programming, Design", Mc Graw Hill, 2013.
2. K.V.K.K.Prasad "Embedded /Real-Time Systems: Concepts, Design and Programming "Dream tech, Wiley 2003.
3. Peckol, "Embedded system Design", John Wiley & Sons,2010

REFERENCES

1. Shibu. K.V, "Introduction to Embedded Systems", Tata Mcgraw Hill,2009.
2. Tammy Noergaard, "Embedded Systems Architecture", Elsevier, 2006.
3. Rajib Mall "Real-Time systems Theory and Practice" Pearson Education, 2007.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

	Programme Outcomes PO's												PSO's	
CO's	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	-	-	-	2	3	2	1	3	-	2	1	3	3
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CO3	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO4	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO5	3	2	2	-	2	3	2	2	3	-	2	1	3	3

EE15353 VIRTUAL INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand what is virtual instrumentation and to realize the architecture of VI.
- familiarize with the VI software and learn programming in VI.
- study various instrument interfacing and data acquisition methods.
- understand various analysis tools and develop programs for process control applications.
- use VI for different applications.

UNIT I INTRODUCTION 9

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data - flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II VI PROGRAMMING TECHNIQUES 9

VIs and Sub - VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III DATA ACQUISITION 9

Signals, signal conditioning, DAQ Hardware configuration, ADCs, DACs, Digital I/O, counters and timers, DAQ architecture, Software and hardware installation, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication and industrial applications.

UNIT IV TOOLSETS 9

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory, Creating, Editing and debugging.

UNIT V APPLICATIONS 9

Pressure control system - Flow control system - Level control system - Temperature data acquisition system - Motion control employing stepper motor - PID controller tool box and pendulum.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- explain the architecture of VI
- handle VI software and programming in VI
- interfacing the instrument with help of data acquisition methods.
- develop programs for process control applications.
- gain adequate knowledge about various application of VI.

TEXT BOOKS

1. Dr. Sumathi. S and Prof. Surekha. P, "LabVIEW Based Advanced Instrumentation Systems", 2nd edition,2007
2. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", PHI learning Pvt. Ltd. 2010.
3. Gary Johnson, "LabVIEW Graphical Programming", McGraw Hill, 2006.

REFERENCES

1. Lisa K. wells & Jeffrey Travis, "Lab VIEW for everyone", Prentice Hall, New Jersey, 2006.
2. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
3. Ronald W. Larsen, "LabVIEW for Engineers", Prentice Hall Ltd, USA Jan 2010.
4. Sanjay Gupta and Joseph John, " Virtual Instrumentation using LabVIEW", TataMcGraw-Hill Publishing Company Limited, New Delhi, 1st Edition, 2005.

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	Programme Outcomes PO's												PSO's	
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CO4	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO5	3	2	2	-	2	3	2	2	3	-	2	1	3	3

EE15354 DIGITAL IMAGE PROCESSING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart the image fundamentals and concepts related to pixel analysis.
- gain the knowledge about mathematical transforms which is necessary for image processing.
- make the students understand the concepts of image enhancement by various filtering techniques.
- impart knowledge on image restoration.
- provide the concepts of image encoding.

UNIT I DIGITAL IMAGE FUNDAMENTALS 9

Elements of a Digital Image Processing System - Structure of the human eye - Image formation and contrast sensitivity - Sampling and Quantization - Neighbors of a pixel - Distance measures - Quantization, dither, Two-dimensional mathematical preliminaries, 2D transforms - DFT.

UNIT II IMAGE TRANSFORMS 9

Introduction to Fourier Transform - DFT - Properties of two dimensional FT - Separability, Translation, Periodicity, Rotation, Average value - FFT Algorithm - Walsh Transform - Hadamard transform - Discrete Cosine Transform.

UNIT III IMAGE ENHANCEMENT 9

Definition - Spatial Domain Methods - Frequency Domain methods - Histogram modification Techniques - Neighborhood averaging - Median filtering - Geometric mean, Harmonic mean, Contra harmonic mean filters, Homomorphic filtering - Low Pass Filtering - Averaging of Multiple Images - Image shaping by differentiation and high pass filtering. Image shaping by differentiation and high pass filtering.

UNIT IV IMAGE RESTORATION 9

Definition - Degradation model - Discrete formulation - Circulant matrices - Block Circulant matrices - Effect of diagonalization of circulant matrices - Unconstrained and constrained restorations - Inverse Filtering - Wiener Filter - Restoration in Spatial Domain. Restoration in Spatial Domain.

UNIT V IMAGE ENCODING 9

Objective and subjective fidelity criteria - Basic encoding process - Mapping - Quantizer - Coder - Differential encoding - Run length encoding - Image encoding relative to fidelity criterion - Differential Pulse Code Modulation. Differential Pulse Code Modulation.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- analyse the image acquisition systems and pixel values.

- analyse the kind of transform to be used for different images.
- develop new image enhancement techniques with the knowledge of basic techniques.
- implement image restoration for particular application.
- analyse the concept of image encoding for particular application.

TEXT BOOKS

1. Rafael C Gonzalez and Paul Wintz, "Digital Image Processing", Pearson Education New Delhi 2003.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", PHI / Pearson Education New Delhi 2003

REFERENCES

1. Rafael C Gonzalez and Richard E.Woods, "Digital Image Processing using Matlab", Pearson Education New Delhi 2004
2. Scott E Umbaugh, "Computer Imaging: Digital Image Analysis and Processing" , The CRC Press, Boca Raton, FL, January 2005
3. Pratt, "Digital Image Processing", John Wiley and Sons. USA 2000
4. Kenneth R. Castleman, Digital Image Processing, Pearson, 2006
5. Scott E Umbaugh , "Digital Image Processing and Analysis, 2nd Edition ", The CRC Press, Boca Raton, FL, January 2011

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CO4	3	2	2	-	2	3	2	2	3	-	2	1	3	3
CO5	3	2	2	-	2	3	2	2	3	-	2	1	3	3

PROGRAMME ELECTIVE IV

EE15451 VLSI DESIGN AND CIRCUITS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concept of MOS transistors operations and their characteristics.
- analyze about the fabrication process of CMOS technology and its layout design rules.
- devise the process of CMOS and their circuit families.
- know about sheet resistance, area capacitance of layers gate logic, some clocked sequential circuits.
- identify the concepts of algorithmic design flow and programmable logic devices.

UNIT I MOS TECHNOLOGY AND CIRCUITS 9

Introduction to integrated circuit technology, Basic MOS transistor-depletion mode - enhancement mode, n-MOS fabrication, CMOS fabrication-n well-p well-twin tub - SOI, Basic Electrical properties of MOS device, threshold voltage, body effect, comparison of Cmos and bipolar .

UNIT II MOS CIRCUIT DESIGN PROCESS 9

MOS Layers, Stick Diagrams, NMOS design style - CMOS design style, Design Rules and Layout, lambda based design rules, contact cut, Propagation delays, Combinational Logic, pass transistor and trans conductance.

UNIT III COMBINATIONAL LOGIC CIRCUITS 9

Design of half adder - full adder-multiplexer - demultiplexer, Transmision gates - Elmores delay model - static CMOS design-power dissipation - low power design principles - comparison of circuit families.

UNIT IV SUBSYSTEM DESIGN PROCESS 9

Sheet Resistance, Area Capacitance of Layers, propagation of delays, Some Clocked Sequential Circuits, Adders - ripple carry adder, carry bypass adder, carry skip adder, carry look-ahead adder - Multiplier, dividers, barrel shifters, speed and area trade off.

UNIT V IMPLEMENTATION STRATEGIES 9

Full custom and semi custom ASIC design - classification of gate arrays - programmable logic devices (PLD) - programming of PAL- FPGA building block architectures - ASIC design flow.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- design the CMOS circuits, including logic components.
- Apply CMOS technology-specific layout rules in the placement and routing of transistors and

interconnect.

- verify the functionality, timing, power, and operations of different logic circuits.
- design the logic gates with its characteristics.
- identify to analyze circuits using programmable logic device and design flow.

TEXT BOOKS

1. Neil H.E. Waste and Kamran Eshraghian, "Principles of CMOS VLSI Design", Pearson Education ASIA, 2nd Edition, 2017.
2. D.A.Pucknell, K.Eshraghian, "Basic VLSI Design", 3rd Edition, Prentice Hall of India, NewDelhi, 2016.

REFERENCES

1. Kaushik Roy, Sharat Prasad, "Low Power CMOS VLSI Circuit Design ", (2016)
2. N.H.Weste, "Principles of CMOS VLSI Design", Pearson Education, India, (2015).
3. Wayne Wolf, Modern VLSI Design ", 2nd Edition, Prentice Hall, (2016).
4. S.H.Gerez, "Algorithms for VLSI Design Automation ", (2015).

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

EE15452 **POWER SYSTEM DYNAMICS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the basics of mathematical description of a synchronous machine.
- acquire the knowledge of speed governing systems.
- understand the concept of excitation system and its control and protective schemes.
- know the stability analysis of various power system networks.
- analyse basic concept related to voltage stability in transmission system.

UNIT I SYNCHRONOUS MACHINE MODELING **9**

Synchronous Machine - Physical and Mathematical Description of a Synchronous Machine. Basic equations of a synchronous machine - dq0 Transformation. Per Unit Representation - Equivalent Circuits for direct and quadrature axes.

UNIT II SMALL-SIGNAL STABILITY ANALYSIS **9**

Classification of Stability - Basic Concepts and Definitions: Rotor angle stability. Fundamental Concepts of Stability of Dynamic Systems: State-space representation - stability of dynamic system - Linearization, Eigen properties of the state matrix.Single-Machine Infinite Bus (SMIB) Configuration: Classical Machine Model stability analysis with numerical example. Small signal stability of multimachine system.

UNIT III EXCITATION SYSTEMS AND IT'S MODELLING **9**

Excitation System Modeling - Excitation System Requirements - Types of Excitation.Dynamic performance measures: Large signal and small signal performance measures. Control and protective functions.Modelling of excitation system: Per unit system-modelling of excitation system components - Modeling of complete excitation system - Field testing for model development and verification.

UNIT IV STABILITY ANALYSIS **9**

Introduction - Factors influencing transient stability - Simulation of Power System Dynamic response: Structure of Power system Model, Synchronous machine representation, Excitation system representation, Transmission network and load representation, Overall system equations, solution for overall system equation. Analysis of unbalanced faults: Introduction to symmetrical components - sequence impedance of synchronous machine, transmission lines and transformers - Simulation of different types of faults.

UNIT V VOLTAGE STABILITY **9**

Basic concepts related to voltage stability - Transmission system characteristics, generator and load characteristics - characteristics of reactive compensating devices.Voltage collapse: Modelling requirement, dynamic and static analysis - Determination of shortest distance to instability, the continuous power-flow analysis. Prevention of voltage collapse: System design measures, system operating measures.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- deliver the basic design consideration of synchronous machine.
- describe the fundamental dynamic behavior and controls of power systems to perform basic stability analysis.
- acquire knowledge on excitation system and its design modeling.
- interpret results of system stability studies.
- acquire knowledge on voltage collapse and modeling requirement.

TEXT BOOKS

1. Padiyar K.R., "Power System Dynamics, Stability and Control", Interline Publications, 2008.
2. Prabha, Kundur, "Power System Stability and Control",TMH, 9th Reprint,2006.

REFERENCES

1. MarijaIlic; John Zaborszky. "Dynamics and Control of Large Electric Power Systems",IEEE Press and John Wiley & Sons, Inc, 2007.
2. Chakrabarti A, "Power System Dynamics and Simulation", PHI learning private Ltd.2013.
3. Selected topics from IEEE Transaction and Conference Proceedings.
4. Mircea, Eremia Mohammad Shahidehpour. "Handbook of Electrical Power System Dynamics: Modeling, Stability, and Control",Wiley publication,2013.
5. Jan Machowski, JanuszBialek, Dr Jim Bumby, "Power System Dynamics: Stability and Control",John Wiley&sons,2008.

CO-PO MAPPING:

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CO5	3	2	2	-	-	3	2	2	3	-	2	1	3	3

EE15453 FLEXIBLE AC TRANSMISSION SYSTEMS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of FACTS.
- expose the applications of FACTS controllers in power systems.
- learn about shunt & series compensation schemes.
- study the operation of controllers for enhancing the transmission capability.
- understand the modern controller for FACTS devices.

UNIT I REACTIVE POWER COMPENSATOR 9

Reactive power control in electrical power transmission lines - Uncompensated transmission line - series compensation - Basic concepts of static VAR Compensator (SVC) - Thyristor Controlled Series capacitor (TCSC) - Unified power flow controller (UPFC).

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS 9

Voltage control by SVC - Advantages of slope in dynamic characteristics - influence of SVC on system voltage - Design of SVC voltage regulator - Applications: Enhancement of transient stability - steady state power transfer - Enhancement of power system damping - prevention of voltage instability.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS 9

Operation of the TCSC - Different modes of operation - Modelling of TCSC - Variable reactance model - Modelling for stability studies. Applications: Improvement of the system stability limit - Enhancement of system damping - Voltage collapse prevention.

UNIT IV EMERGING FACTS CONTROLLERS 9

Static Synchronous Compensator (STATCOM) - Principle of operation - V-I Characteristics - Applications: Steady state power transfer - enhancement of transient stability - prevention of voltage instability. Unified Power Flow Controller (UPFC) - Principle of operation - Modes of Operation - Applications - Modelling of UPFC for Power Flow Studies.

UNIT V CO-ORDINATION OF FACTS CONTROLLERS 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- analyze the concept of FACTS.

- design various FACTS controllers
- explain the application of various FACTS controllers.
- describe the various emerging FACTS controllers
- apply the control techniques for FACTS controllers using genetic algorithms

TEXT BOOKS

1. K.R. Padiyar, "FACTS Controllers for Power Transmission and Distribution" New Age International Publishers, 2016.
2. Mohan Mathur R, Rajiv K Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", IEEE press and John Wiley & Sons, Inc., 2002, Reprint 2009.

REFERENCES

1. Xiao-Ping Zhang "Flexible AC Transmission Systems" Springer ,2010.
2. Narain G.Hingorani, LaszioGyugyi, "Understanding FACTS concept and Technology", Standard Publisher, Delhi, 2015.
3. Gyugyi L., "Unified power flow control concept for flexible AC transmission ", IEEEProc-C, Vol.139, No.4, July 2013.
4. A.T.John, "Flexible A.C. Transmission Systems", Institution of Electrical andElectronic Engineers (IEEE), 1999.
5. V.K.Sood,HVDC and "FACTS controllers – Applications of Static Converters in Power System" , APRIL 2004 , Kluwer Academic Publishers, 2004.

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CO5	-	3	-	-	3	-	2	-	-	-	3	-	3	3

MA15153 OPERATIONS RESEARCH 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- provide the concept and an understanding of basic concepts in operations research.
- understand develop and solve mathematical model of transport and assignment problems.
- understand the techniques of optimality.
- develop an understanding and appreciation for the field of inventory and production management.
- provide the student with a rigorous framework with which to model and analyze queuing systems.

UNIT I LINEAR PROGRAMMING MODELS 9

Mathematical Formulation - Graphical Solution of linear programming models - Simplex method - Big M-Method - Two phase method.

UNIT II TRANSPORTATION AND ASSIGNMENT MODELS 9

Mathematical formulation of transportation problem - Methods for finding initial basic feasible solution - optimum solution - degeneracy - Mathematical formulation of assignment models - Variants of the Assignment problem.

UNIT III DYNAMIC PROGRAMMING 9

Dynamic programming - Principle of optimality - Forward and backward recursion - Applications of dynamic programming - Problem of dimensionality.

UNIT IV INVENTORY MODELS AND NETWORKING MODELS 9

Inventory Models - EOQ and EBQ Models (With and without shortages), Quantity Discount Models - Networking Models - PERT & CPM.

UNIT V QUEUEING MODELS 9

Characteristics of Queuing Models - Poisson Queues - (M / M / 1) : (FIFO / ∞ /∞), (M / M / 1) : (FIFO / N / ∞), (M / M / C) : (FIFO / ∞ / ∞), (M / M / C) : (FIFO / N / ∞) models.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- apply linear, integer programming to solve operational problem with constraints.
- apply transportation and assignment models to find optimal solution in warehousing and travelling.
- use optimization concepts in real world problems.
- apply inventory models and techniques to create and recommend appropriate stocking solutions

in various business settings.

- identify and analyze appropriate queuing model to reduce the waiting time in queue.

TEXT BOOKS

1. R.Panneerselvam," Operations research", Second edition, Prentice hall –USA-2007.
2. Operations Research by Kanthiswarup, P.K. Gupta, Manmohan 9thRevised Edition 2001, Reprint 2002. Sultan Chand & Sons, New Delhi

REFERENCES

1. Taha H.A, "Operations Research: An Introduction ", 8th Edition, Pearson Education, 2008
2. Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand & Company Ltd, New Delhi, Third Edition , 2008
3. John W. Chinneck, "Feasibility and Infeasibility in Optimization Algorithms and Computational Methods", Springer, 2008.
4. Ravindran, Phillips, Solberg, "Operations Research: Principles and Practice", Second Edition, John Wiley & Sons, 2007.

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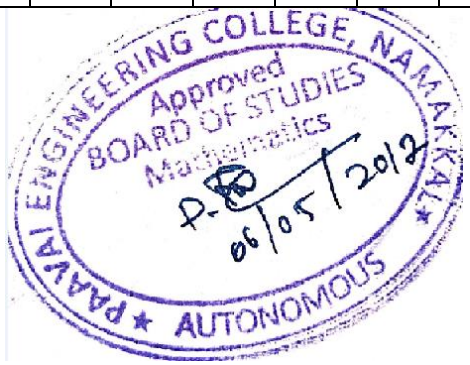
CO3	-	3	3	-	3	-	3	-	-	-	-	2	3	3
CO4	3	3	3	-	3	-	3	-	-	-	3	-	3	3
CO5	-	3	3	-	3	-	3	-	-	-	3	-	3	3



EE15455 OPTOELCETRONICS DEVICES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know the basics of solid state physics and understand the nature and characteristics of light.
- understand different methods of luminescence, display devices and laser types and their applications.
- learn the principle of optical detection mechanism in different detection devices.
- understand different light modulation techniques and the concepts and applications of optical switching.

UNIT I ELEMENTS OF LIGHT AND SOLID STATE PHYSICS 9

Wave nature of light - Polarization - Interference - Diffraction - Light Source - review of Quantum Mechanical concept - Review of Solid State Physics - Review of Semiconductor Physics and Semiconductor Junction Device.

UNIT II DISPLAY DEVICES AND LASERS 9

Introduction, Photo Luminescence - Cathode Luminescence - Electro Luminescence - Injection Luminescence - LED - Plasma Display - Liquid Crystal Displays - Numeric Displays - Laser Emission, Absorption – Radiation - Population Inversion - Optical Feedback - Threshold condition - Laser Modes - Classes of Lasers - Mode Locking - laser applications.

UNIT III OPTICAL DETECTION DEVICES 9

Photo detector - Thermal detector - Photo Devices - Photo Conductors - Photo diodes - Detector Performance.

UNIT IV OPTOELECTRONIC MODULATOR 9

Introduction, Analog and Digital Modulation - Electro-optic modulators - Magneto Optic Devices - Acoustoptic devices - Optical, Switching and Logic Devices.

UNIT V OPTOELECTRONIC INTEGRATED CIRCUITS 9

Introduction - hybrid and Monolithic Integration - Application of Opto Electronic Integrated Circuits - Integrated transmitters and Receivers - Guided wave devices.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- apply the basics of solid state physics and understand the nature and characteristics of light.
- choose the method of luminescence, display devices and laser types based on applications.
- explain the principle of optical detection mechanism in different detection devices.

- analyze light modulation techniques and apply to optical switching.
- design optoelectronic integrated circuits in transmitters and receivers.

TEXT BOOKS

1. Pallab Bhattacharya "Semiconductor Opto Electronic Devices", Prentice Hall of India Pvt., Ltd., New Delhi, 2006.
2. Jasprit Singh, "Opto Electronics – As Introduction to materials and devices", McGraw-Hill International Edition, 2008.

REFERENCES

1. S C Gupta," Opto Electronic Devices and Systems", Prentice Hal of India,2005.
2. J. Wilson and J.Haukes, "Opto Electronics – An Introduction", Prentice Hall, 2010.
3. Xun li, "Opto Electronic Devices and Applications – Design modeling and simulation" Cambridge University Press, 2009.
4. Oleg Sergiyenko, "Optoelectronic Devices and Properties", InTech, 2011.
5. M.A.Parker, "Physics of optoelectronics" CRC Press, 2005.

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CO4	3	3	3	-	3	-	3	-	-	-	3	-	3	3
CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

PROGRAMME ELECTIVE V

EE15551 EHV AC AND DC TRANSMISSION 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart knowledge on EHV AC transmission.
- comprehend the line and ground parameter calculations.
- identify about the effect of electric and magnetic fields of EHV lines.
- understand the planning of DC power transmission and to analyze HVDC converters.
- study about the HVDC system control.

UNIT I INTRODUCTION TO EHV AC TRANSMISSION AND LINE TRENDS 9

Role of EHV AC Transmission- 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 AND GROUND PARAMETERS 9

Resistance of Conductors - Temperature Rise of Conductors and Current - Carrying Capacity - Properties of Bundled Conductors - Calculation of L and C parameters - Sequence Inductances and Capacitances - Line Parameters for Modes of Propagation - Effect of grounding in electrical systems.

UNIT III ELECTROSTATIC AND MAGNETIC FIELDS OF EHV LINES 9

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

UNIT IV INTRODUCTION AND ANALYSIS OF HVDC CONVERTERS 9

Comparison of AC and DC transmission - Description of DC transmission system - Planning for HVDC transmission - Modern Trends-Application - Choice of converter configuration - Converter bridge characteristics - Characteristics of twelve pulse converters.

UNIT V CONVERTER AND HVDC SYSTEM CONTROL 9

Principles of DC Link - Converter control characteristic - System control hierarchy - Firing angle control - Current and extinction angle control - Starting and stopping of DC link - Power control - Higher level controllers.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- examine the role of EHV AC transmission and its basic principles
- evaluate the line and ground parameters of EHV lines

- identify the components of electrostatic and magnetic field effects of EHV lines
- describe the principles of HVDC system and features of converters.
- deliberate the characteristic and control of HVDC system.

TEXT BOOKS

1. RakoshDas Begamudre " Extra high voltage AC transmission Engineering", New Age International Publishers, Third Edition, 2006.
2. K R Padiyar "HVDC Power Transmission Systems",New Age International Publishers, First Edition, Reprint 2005.

REFERENCES

1. S Kamakshaiah& V Kamaraju "HVDC Transmission", Tata McgrawHilll Publishers, 2011.
2. Sunil S. Rao,"EHV-AC, HVDC Transmission & Distribution Engineering", Third Edition, Khanna Publishers, 2008.
3. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 2010.
4. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 2009.
5. P.Kundur" Power System stability and control", Tata McgrawHilll Publishers, 2011.

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CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

EE15552 ENERGY AUDITING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- learn basic concepts, calculation rules and systems for energy savings calculations.
- implement the concept behind economic analysis and load management.
- emphasize the energy management on various electrical equipment.
- identify the various metering for energy management.
- illustrate the concepts of lighting systems and cogeneration.

UNIT I INTRODUCTION 9

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

UNIT II ENERGY COST AND LOAD MANAGEMENT 9

Important concepts in an economic analysis - economic models - time value of money - utility rate tructures - cost of electricity - loss evaluation load management: Demand control technique - utility monitoring and control system - HV AC and energy management - economic justification.

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

Systems and equipment - Electric motors - transformers and reactors - capacitors and synchronous machines.

UNIT IV METERING FOR ENERGY MANAGEMENT 9

Relationships between parameters - units of measure - typical cost factors - utility meters - timing of meter disc - for kilowatt measurement - demand meters - paralleling of current transformer - Instrument transformer burdens Multitasking solid state meters - Metering location Vs requirements - metering techniques and practical examples.

UNIT V LIGHTING SYSTEMS AND COGENERATION 9

Concept of lighting systems - the task and the working space - Light sources - Ballasts - Luminaries - Lighting Controls - Optimizing ligting energy - power factor and effect of harmonic on power quality - Cost analysis technique and energy standards. Cogeneration: Forms of cogeneration - feasibility of cogeneration - Electrical interconnection.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the concepts of energy management and auditing.

- deliver the concepts of economic analysis and load management.
- replicate about the choice and rating of electrical machineries for selected applications.
- illustrate about metering methods, cost analysis techniques and suitable energy standards
- implement knowledge regarding the lighting systems and cogeneration.

TEXT BOOKS

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", Fifth Edition, the Fairmont Press, Inc., 2006
2. Arry C. White, Philip S. Schmidt, David R. Brown, Hemisphere "Industrial Energy Management Systems" Publishing Corporation, New York
3. Albert Thumann, "Fundamentals of Energy Engineering" Prentice Hall Inc, Englewood Cliffs, New Jersey.

REFERENCES

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 2007.
2. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 2010.
3. W.R. Murphy and G. McKay "Energy Management" Butterworths, London 2009.
4. Eastop T.D & Croft D.R, "Energy Efficiency for Engineers and Technologists", Logman Scientific & Technical, ISBN-0-582-03184, 2011.
5. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.

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CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

EE15553 HIGH VOLTAGE ENGINEERING 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- gain knowledge on the various types of over voltages in power system and protection methods.
- know the nature of breakdown mechanism in solid, liquid and gaseous dielectrics.
- impart knowledge on Generation of over voltages in laboratories
- learn measurement of over voltages.
- test power apparatus and insulation coordination.

UNIT I OVER VOLTAGES IN ELECTRICAL POWER SYSTEMS 9

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

UNIT II DIELECTRIC BREAKDOWN 9

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

UNIT III GENERATION OF HIGH VOLTAGES AND HIGH CURRENTS 9

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

UNIT IV MEASUREMENT OF HIGH VOLTAGES AND HIGH CURRENTS 9

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

UNIT V HIGH VOLTAGE TESTING & INSULATION COORDINATION 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- deliver the effects of over voltages and protection techniques in power systems.
- analyze the various breakdown mechanisms in different dielectric materials.
- explain the generation of high voltages and high currents.
- assess the techniques of measuring high voltages and high currents.

- express the testing and insulation mechanism in electrical apparatus.

TEXT BOOKS

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

REFERENCES

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

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CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

EE15554 COMPUTER NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of layering in networking,network architecture and classifications.
- provide the knowledge about various protocols used in different layers of networks.
- study about the switching concepts and routing protocols.
- learn about the transmission control protocol and their functions.
- gain knowledge about applications of various protocol.

UNIT I INTRODUCTION TO NETWORKS 9

Introduction to networks - Network topology - Types of networks - Network architecture - Layering - Design issues - Client/Server model - Protocols - Bridges - Routers - Repeaters - Switches.

UNIT II BASICS OF INTERNET WORKING 9

Introduction to internetworking - Internetworking concepts and architectural model - Internet addressing - Domain Name System (DNS) - Address Resolution Protocol (ARP) - Reverse Address Resolution Protocol (RARP).

UNIT III INTERNET PROTOCOL AND ITS ROUTING 9

Introduction to IP protocol - Virtual networks - Concept of unreliable delivery - Connectionless delivery system - Purpose on internet protocol - Internet data gram - Data gram options. Introduction to routing - IP data gram - Direct and indirect delivery - Table driven IP routing - Next hop routing.

UNIT IV TRANSMISSION CONTROL PROTOCOL 9

Introduction to TCP - Properties of reliable delivery service - TCP protocol - TCP segment format - TCP connection - TCP state machine - Silly window syndrome.

UNIT V APPLICATION PROTOCOL 9

Simple Mail Transfer Protocol (SMTP) - Post Office Protocol (POP) - File Transfer Protocol (FTP) - Telnet - Simple Network Management Protocol (SNMP) - Internet security and firewall design.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- identify the components required to build different types of networks
- describe the functions of layered reference models and functional component namely protocol used for data communication.
- comprehend various flow control and congestion control mechanisms.
- analyze nodes in the networks are uniquely addressed globally and various routing algorithms used for identifying the path to reach the destination

- describe various security mechanisms used securing the data packets in a network.

TEXT BOOKS

1. Douglas E. Comer, "Internet working with TCP/IP: principles, protocols and architecture", Volume 1 ",Sixth Edition, Pearson, 2014.
2. Andrew S.Tananbaum, David J.Wetherall "Computer Networks", Fifth Edition, Prentice Hall of India/Pearson Education, 2013.

REFERENCES

1. Bechrouz A. Forouzan, "TCP/IP Protocol Suite", Fourth Edition, Tata McGraw Hill, 2011.
2. William Stallings, "Data and Computer Communications", Tenth Edition, Prentice Hall of India/ Pearson Education, 2014.
3. A.S.Kernel Explain, "Communication Network Management", Prentice Hall of India Ltd, New Delhi 2005
4. Larry L.Peterson and Bruce S. Davie, "Computer Networks: A Systems Approach", FifthEdition, Morgan Kaufmann Publishers, 2011.

CO-PO MAPPING:

Mapping of Course Outcome (CO's) with Programme Outcomes (PO's) and Programme Specific Outcomes PSO's (1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

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CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

EE15555 DESIGN WITH PIC MICROCONTROLLER AND ARM SYSTEM 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- introduce the architecture of PIC microcontroller.
- educate the use of interrupts and timers.
- instruct about the peripheral devices for data communication and transfer.
- introduce the functional blocks of ARM processor.
- train on the architecture of ARM processors and applications.

UNIT I PIC MICROCONTROLLER 9

Introduction to PIC Microcontroller - PIC 16C6x and PIC16C7x Architecture - Program Memory considerations - Register File Structure - Instruction Set - Addressing modes - Pipelining.

UNIT II INTERRUPTS AND TIMER 9

PIC micro controller Interrupts - External Interrupts - Loop time subroutine - Timers - Timer Programming - Front panel I/O - Soft Keys - State machines and key switches - Display of Constant and Variable strings.

UNIT III PERIPHERALS AND INTERFACING 9

I^2C Bus for Peripherals Chip Access - Bus operation - Bus subroutines - Serial EEPROM - Analog to Digital Converter - UART - Baud rate selection - LCD and keyboard Interfacing - ADC, DAC and Sensor Interfacing.

UNIT IV ARM PROCESSOR 9

ARM Architecture - ARM programmer‟s model - ARM Development tools - Memory Hierarchy - ARM Assembly Language Programming - Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION 9

2- Stage Pipeline ARM Organization - 5-Stage Pipeline ARM Organization - ARM Instruction Execution - ARM Implementation - ARM Instruction Set - ARM coprocessor interface - Architectural support for High Level Languages - Embedded ARM Application.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the architecture of PIC Microcontroller.
- explain about the microcontroller interrupts.
- design various interfaces to the PIC.
- comprehend about the ARM architecture and development tools.

- elucidate the various application of ARM and organization.

TEXT BOOKS

1. Peatman,J.B., “Design with PIC Micro Controllers” Pearson Education, 3rd Edition, 2004.
2. Furber,S., “ARM System on Chip Architecture” Addison Wesley trade Computer Publication, 2000.

REFERENCES

1. Rollin Mckinlay, Danny causey Mazidi, M.A., “PIC Microcontroller” Printice Hall of India, 2007.
2. Balamurugan C.R, “Microcontroller Based System Design”, Magnus Publications, 2016.

CO-PO MAPPING:

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CO4	3	3	3	-	-	-	3	-	-	-	3	-	3	3
CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

PROGRAMME ELECTIVE VI

BA15253 TOTAL QUALITY MANAGEMENT 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts in Quality Management, Customer orientation and retention.
- facilitate the understanding of Quality Management principles and process.
- get the techniques in Six Sigma, Bench marking and FMEA.
- know the basic concepts in Quality Function Development and TPM.
- familiar with Quality System, Quality Auditing and HR practices.

UNIT I INTRODUCTION 9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9

Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering,Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND TECHNIQUES I 9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV TQM TOOLS AND TECHNIQUES II 9

Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9

Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service - Return on Investment - Personnel management. Recruitment, selection and training - Technology in Agri sectors.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- discuss the basic concepts in Quality Management, Customer orientation and retention.
- describe the principles and process of Quality Management.
- implement the quality control techniques in Six Sigma, Bench marking and FMEA.
- explain the basic concepts in Quality Function Development and TPM.
- deliver the elements in Quality System, Quality Auditing and HR practices.

TEXT BOOKS

1. Dale H. Besterfiled, et at., "Total quality Management", Third Edition, Pearson Education Asia, Indian Reprint, 2006
2. D.R Kiran, "Total quality Management", Butterworth-Heinemann, 2016.

REFERENCES

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
4. Dennis AuBuchon, Understanding the Concept of Quality, Pronoun, 2017.
5. Donna C. S. Summers, Quality, Pearson, 5th edition, 2009.

CO-PO MAPPING:

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CO4	3	3	3	-	-	-	3	-	-	-	3	-	3	3
CO5	1	3	3	-	3	-	3	-	-	-	3	1	3	3

EE15651 **TESTING AND COMMISSIONING OF ELECTRICAL EQUIPMENTS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- know the fundamentals of certain guidelines and broad principles regarding the safety
- learn the Installation of electrical equipment
- provide a comprehensive understanding of testing of transformer, plant and equipment
- understand the installation and commissioning of rotating electrical machines
- study the commissioning of transmission line

UNIT I SAFETY OBJECTIVES **6**

Objectives, Safety Management during Operation and Maintenance, Clearance and Creepages - Electric Shock - need of Earthing - different methods of Earthing - factors affecting the EarthResistance - methods of measuring the Earth Resistance - Equipment Earthing and System Grounding,Earthing Procedure - Building installation - Domestic appliances - Industrial premises - Earthing of substation - generating station and overhead line.

UNIT II INSTALLATION OF ELECTRICAL EQUIPMENTS **6**

Inspection of Electrical Equipment at site - Storage Electrical Equipment at site - Foundation of Electrical Equipment at site - Alignment of Electrical Machines - Tools/Instruments necessary for installation - Technical report - Inspection, storage and handling of transformer - switchgear and motors.

UNIT III TESTING OF TRANSFORMER **13**

General Requirements for Type - Routine and Special Tests - Measurement of winding resistance - Measurement of voltage ratio and check of voltage vector relationship - Measurement of impedance voltage/short-circuit impedance and load loss - Measurement of no-load loss and current - Measurement of insulation resistance - Dielectric tests - Temperature-rise - insulation and HV test - dielectric absorption - switching impulse test.

UNIT IV INSTALLATION AND COMMISSIONING OF ROTATING ELECTRICAL MACHINES **12**

Degree of protection - cooling system - degree of cooling with IP - IC code (brief discussion), enclosures - rating of industrial rotating electric machine - installation, commissioning and protection of Induction motor and rotating electric machine - drying out of electric rotating machine - insulation resistance measurement - site testing and checking, care, services and maintenance of motors, commissioning of synchronous generator - protection and automation of synchronous generator,synchronous motor , D.C. generator and motor with reference to Indian Standard (IS).

UNIT V TRANSMISSION LINE **8**

Commissioning of A.C transmission line and HVDC transmission - galvanize steel structure, towers and insulator for transmission and distribution line - tower footing resistance - substation equipment - bus bar system - power cable - low power control cable – Contactor - GIS (gas insulated substation).

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- undertake installation, commissioning and maintenance of various electrical equipment
- prepare maintenance schedule of different equipment and machines
- produce trouble shooting chart for various electrical equipment, machines and domestic appliances
- describe different types of earthing for different types of electrical installations
- familiar about electrical safety regulations and rules during maintenance.

TEXT BOOKS

1. Rao, S., "Testing, commissioning, operation and maintenance of electrical equipment", 6/E., Khanna Publishers, New Delhi, 2010.
2. Paul Gill, "Electrical power equipment maintenance and testing", CRC Press, 2008

REFERENCES

1. Singh Tarlok, "Installation, commissioning and maintenance of Electrical equipment", S.K. Kataria and Sons, New Delhi,
2. Philip Kiameh, "Electrical Equipment Handbook: Troubleshooting and Maintenance", McGrawHill, 2003.

CO-PO MAPPING:

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EE15652 **STATIC RELAYS`** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- understand the principle of static relays.
- know the concept of relay and characteristics.
- identify various types of pilot relaying schemes.
- know the application based microprocessor and DSP based protective relays.
- realize the principle of bus zone protection and application of modern protective devices.

UNIT I GENERAL INTRODUCTION TO STATIC RELAY 9

Basic construction of static relays - Characteristic functions of protective relays - basic relay elements and relay terminology - Classification of Relays - Construction and operation of Electromagnetic relays - merits and demerits of static relays - Applications.

UNIT II STATIC RELAYS AND THEIR CHARACTERISTIC 9

Solid state devices used in static protection - Amplitude comparator and phase comparator - Static Over current relays: Non-directional, Directional - Synthesis of Mho relay, Reactance relay, Impedance relay and Quadrilateral Distance relay using Static comparators, Differential relay.

UNIT III PILOT RELAYING SCHEMES 9

Wire pilot protection: circulating current scheme - balanced voltage scheme - translay schemes - half wave comparison scheme - Carrier current protection: phase comparison type - carrier aided distance protection - carrier blocking scheme - operational comparison of transfer trip and blocking scheme - optical fiber channels.

UNIT IV MICROPROCESSOR AND DSP BASED PROTECTIVE RELAYS 9

Introduction of Microprocessor - over current relays - Impedance relay Directional relay - Reactance relay. Digital signal processing: Digital filtering in protection relays - digital data transmission - relay hardware - relay algorithms. Concepts of modern coordinated control system.

UNIT V BUS ZONE PROTECTION AND MODERN PROTECTIVE DEVICES 9

Bus zone protection: differential current protection-high impedance relay scheme-frame leakage protection. Introduction to Digital Signal Processing - Logic devices and systems - Signal Processing Filters - DSP based relays - Travelling wave relays: Amplitude comparison relay, phase comparison relay, Directional comparison relay, and Fault location.

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- describe the concept of static relays.

- explain the types of various static relays and various protective devices used for relaying systems.
- familiarize in pilot relaying schemes.
- apply the concepts of microprocessor and digital signal processing.
- identify the bus zone protection and modern devices.

TEXT BOOKS

1. Badri Ram &D.N.Vishwakarma, "Power System Protection & Switchgear", 2nd edition, Tata McGraw – Hill, 2013
2. MadhavaRao T.S, "Power System Protection, Static Relays with Microprocessor and Applications",2nd edition, TMH, 2015.

REFERENCES

1. Lewis Blackburn, J., "Protective Relaying – Principles and Applications", Marcel Dekkar, INC, New York, 2015.
2. Stanley, H.Horowitz (ED), "Protective relaying for power systems II", IEEE Press, 2013.
3. Y.G.Paithankar , S.R.Bhide, " Fundamentals of Power System Protection", Prentice – Hall India, 2011.
4. Ravindar P. Singh, "Digital Power System Protection", PHI, NewDelhi, 2009.

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CO5	1	3	2	-	3	-	3	-	-	-	3	1	3	3

EE15653 POWER QUALITY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

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

UNIT I INTRODUCTION TO POWER QUALITY 9

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

UNIT II VOLTAGE SAGS AND INTERRUPTIONS 9

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

UNIT III OVERVOLTAGES 9

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

UNIT IV HARMONICS 9

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

UNIT V POWER QUALITY MONITORING 9

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

TOTAL PERIODS 45

COURSE OUTCOMES

At the end this course, students will be able to

- analyze power quality problem
- determine the voltage sags and interruptions in various concepts
- evaluate the Over voltages in various concepts
- obtain the knowledge in harmonics method and IEEE and IEC standards.
- design the power quality monitoring equipment‟s

TEXT BOOKS

1. Roger. C. Dugan, Mark. F. McGranagham, Surya Santoso, H.WayneBeaty, „Electrical Power Systems Quality‟ McGrawHill, 2003.
2. Eswald.F.Fudis and M.A.S.Masoum, “Power Quality in Power System and Electrical Machines,” Elseviar Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, “Power System Quality Assessment”, Wiley, 2011.

REFERENCES

1. G.J.Wakileh, “Power Systems Harmonics – Fundamentals, Analysis and Filter Design,” Springer2007
2. Wayne Wolf, “Modern VLSI Design ", 2nd Edition, Prentice Hall, (2011).
3. E.Aeha and M.Madrigal, “Power System Harmonics, Computer Modelling and Analysis”, WileyIndia, 2012.
4. R.S.Vedam, M.S.Sarma, “Power Quality – VAR Compensation in Power Systems,” CRC Press2013
5. C. Sankaran, “Power Quality”, CRC press, Taylor & Francis group, 2002

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PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018

(AUTONOMOUS)

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

ONE CREDIT CURRICULUM

REGULATIONS 2016

CHOICE BASED CREDIT SYSTEM

List of the one credit courses

S.No	Category	Course Code	Course Title	L	T	P	C
1	OCC	EE16951	Best Maintenance Practices in Low Voltage Switchgear	1	0	0	1
2	OCC	EE16952	Breaker Maintenance Workshop C-Power Air Circuit Breaker	1	0	0	1
3	OCC	EE16953	Electrical Design of Switchgear Assembly	1	0	0	1
4	OCC	EE16954	Power Distribution in Buildings	1	0	0	1
5	OCC	EE16955	Selection and Application of Drives	1	0	0	1
6	OCC	EE16956	Industrial Protection with Numerical Relays	1	0	0	1
7	OCC	EE16957	Creating a Printed Circuit Board	1	0	0	1
8	OCC	EE16958	Supervisory Control and Data Acquisition	1	0	0	1
9	OCC	EE16959	Design of Control Circuits	1	0	0	1

EE16951 BEST MAINTENANCE PRACTICES IN LOW VOLTAGE SWITCHGEAR 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- expertise with the working of low voltage switch gear.
- acquire knowledge on maintenance practices in low voltage switch gear.

COURSE CONTENTS

Electrical safety - Good maintenance practices, routine, preventive and predictive maintenance Practices; Hands-on workshop sessions on testing, troubleshooting and maintenance of low voltage switchgears - contactors, overload relays, motor starters, MCCBs, air circuit breaker; Good termination practices to LV switchgear, Fitting, setting and testing of various types of accessories/releases on circuit breakers.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- implement the safety concepts in low voltage switch gear.
- test various types of circuit breakers.

EE16952 BREAKER MAINTENANCE WORKSHOP C-POWER AIR CIRCUIT BREAKER **1 0 0 1**

COURSE OBJECTIVES

To enable the students to

- develop their knowledge in breaker maintenance.
- know how the hands-on training is implemented for breaker maintenance.

COURSE CONTENTS

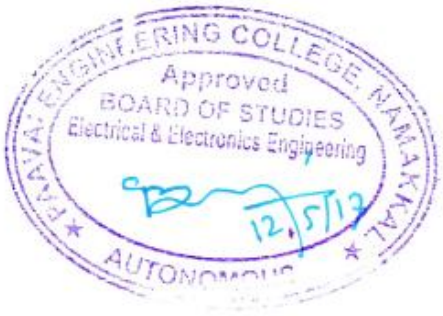
Introduction- electrical air circuit breaker(ACB),understanding the parts, operation of manual, fitting of accessories, changing poles, servicing of arc chutes and arcing contacts; Study of control circuit-closing and tripping operations, various protection releases and protection features, protection settings to achieve the desired protections; Hands-on sessions - testing, setting and programming of various types of ACB with microprocessor based protection releases like SR-71/SR21i, SR18G; Introduction - U-Power OMEGA ACBs.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- implement the maintenance of circuit breaker.
- acquaint with the testing and programming of various types of air circuit breakers.



EE16953 ELECTRICAL DESIGN OF SWITCHGEAR ASSEMBLY 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- enhance their knowledge in switchgear assembly.
- acquire knowledge in designing electrical components.

COURSE CONTENTS

Introduction - various standards for low voltage switchboard assembly including IEC 61439, types of panels, forms of separations, fault current calculations as applicable to low voltage switchgear, busbar selection and design, selection of current transformers, cable selection, sizing of control transformers, earthing as applicable to low voltage switchboards, ingress protection (IP), good termination practices; Test - type tests and routine tests as applicable to low voltage switchboards; Classroom sessions with case studies.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- describe about switchgear components.
- implement the studied concepts in designing aspect.

EE16954 POWER DISTRIBUTION IN BUILDINGS 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- know about the design parameters required for power distribution in buildings.
- calculate the required parameters for the components and equipment's used in design considerations.

COURSE CONTENTS

Design parameters relevant to large buildings; Procedure for load estimation; sizing of transformers and distributed generation sets; Sizing of low voltage switchgears, distribution boards, busbar trunking system (BBT), miniature circuit breaker (MCB), earth leakage circuit breaker (ELCB); Fault current calculations; Earthing basics, relevant IE rules; Classroom session supported by workshop demonstration.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- estimate the load of the buildings.
- size the equipment's required for designing.

EE16955 SELECTION AND APPLICATION OF DRIVES 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- know about the practical advantage of implementing drives.
- analyze about variable frequency drives.

COURSE CONTENTS

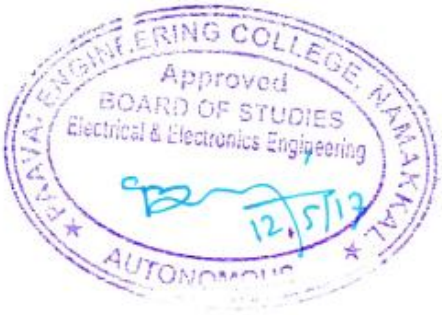
Basics - low voltage motors, inverter duty motor, low voltage AC variable frequency drive (VFD), selection and application of AC VFDs; Wiring diagram, parameter setting, salient features, energy conservation with AC VFDs, Comparison - VFD and soft starter; Classroom sessions supported by workshop demonstrations.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- identify the selection of drives for low speed motor applications.
- describe about variable frequency drives.



EE16956 INDUSTRIAL PROTECTION WITH NUMERICAL RELAYS 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- understand the concept of industrial protection.
- Comprehend the protections provided by relays

COURSE CONTENTS

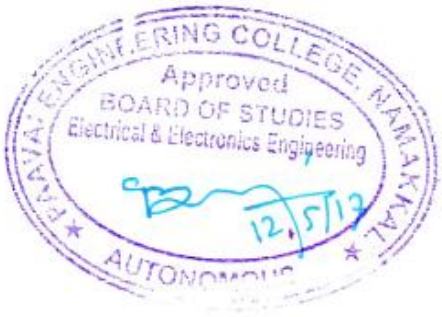
Introduction to protective relaying, terminologies, ANSI codes, current transformer, potential transformer; Fault current calculations, relay co-ordination, feeder protection, motor protection, transformer protection, generator protection; Classroom sessions supported by workshop demonstration (excludes distance protections).

TOTAL PERIODS 15

COURSE OUTCOMES

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

- describe about industrial protection concepts.
- enumerate the concept of numerical relay in industrial protection.



EE16957 CREATING A PRINTED CIRCUIT BOARD 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- comprehend the importance of printed circuit board.
- understand the different concepts in creating printed circuit board.

COURSE CONTENTS

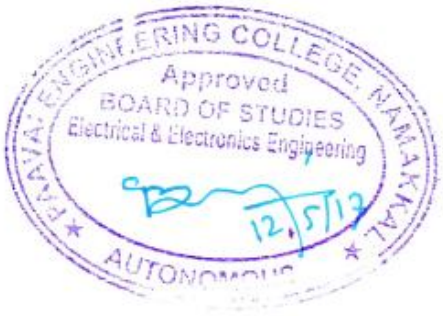
Introduction - Creating a printed circuit board(PCB), setting and checking footprint names; invoking Tina PCB; Advanced editing functions of Tina PCB layout editor; Creating a two-layer, Double-sided surface-mount technology boar ; Creating PCB components; Creating 4 Layer PCB layout , placing parts , draw copper areas for voltage regulators , assigning , routing ground and power , creating split plane layers.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- analyze the printed circuit board concepts.
- Implement the appropriate technology in required field.



EE16958 SUPERVISORY CONTROL AND DATA ACQUISITION 1 0 0 1

COURSE OBJECTIVES

To enable the students to

- understand the importance of supervisory control and data acquisition.
- acquire knowledge on industrial automation techniques.

COURSE CONTENTS

Introduction - Industrial automation, programmable logic controllers (PLC) ; Data and communications PLC , IntegraXor; Project overview - project management, running the project; Graphical animation inkscape SAGE; Web buttons and slider movement ; Visibility mode animations , server-side scripting, client-side scripting, Many side scripting and Inkscape SAGE Script ; Basics - HTML and Database.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- review industrial automation systems.
- explain the project modes and animations required for implementing the control.

EE16959 **DESIGN OF CONTROL CIRCUITS** **1 0 0 1**

COURSE OBJECTIVES

To enable the students to

- know about the control circuits and its types.
- Comprehend the design aspects of control circuits.

COURSE CONTENTS

Fundamentals of control circuits and schemes, graphical symbols and nomenclatures of various components, guidelines for control circuit diagram; Understanding various types of circuits - Power, control, interconnection schemes, current transformer, potential transformer circuits; Development of motor starter schemes- Air circuit breaker incomer bus coupler schemes, electrical / mechanical interlocks in control circuits; Function and usage of various controlling devices, selection of control wires and control transformer, redundancy of control supply.

TOTAL PERIODS 15

COURSE OUTCOMES

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

- elaborate the schemes and types of control circuits.
- describe the function and usage of controlling devices.