

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.

UNIT I 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.

UNIT II NETWORK THEOREMS 15

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

UNIT III 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.

UNIT IV 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.

UNIT V 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 analyse various 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	-	-	-	-	-	-	-	-	-	-	-	-



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 Edition
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														
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CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	3
CO4	3	3	3	-	-	-	-	-	-	-	2	-	3	3
CO5	3	3	3	-	-	-	-	-	-	-	2	-	3	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 Measurements”, New Age International (P)Ltd, Delhi, 2001

WEB LINKS

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

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



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. Gangadhar K.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.Griffiths, 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:														
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CO4	3	3	2	-	-	-	-	-	-	-	-	2	2	2
CO5	3	3	2	-	-	-	-	-	-	-	-	2	2	2



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 HANDLING 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.

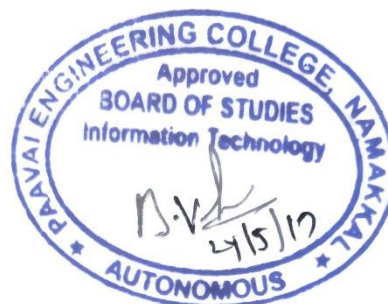
REFERENCES

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>

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



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

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



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**

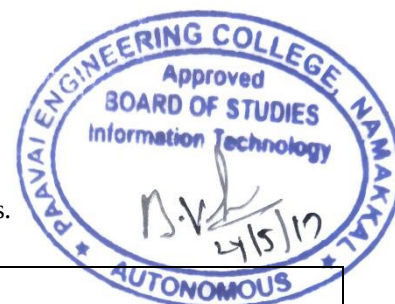
At the end of this course, students will be able to

- 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.

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CO4	1	2	3	2	1.5	3	1.5	-	2	2	1	2	-	3

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 OF ROTATING MACHINES 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 DC GENERATORS 15

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

UNIT III DC MOTORS 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 MACHINES AND TRANSFORMERS 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. Smarajit Ghosh, "Electrical Machines", Pearson Education, 2012.
3. Parkar Smith, N.N., "Problems in Electrical Engineering" CBS Publishers and Distributors, 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

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CO5	3	3	3	3	-	-	-	-	-	-	3	-	3	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.

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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 Prahua 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.

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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:														
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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



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", 4th Edition, S. Salivahanan & Kanchana Bhaskaran 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

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



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 – Synchronous counters– 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.

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1. en.wikipedia.org/wiki/Digital_electronics
2. <http://freevidelectures.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														
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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



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 & Schilling “Principles of communication systems” Tata McGraw hill 2007.
2. J.Das “Principles of digital communication” New Age International, 1986.
3. Theodore.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.

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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](http://www.nptel.ac.in/courses/117101051)

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



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. Separation 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

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CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3



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 INTEGRATED CIRCUITS**

1. Inverting and non inverting amplifier
2. Summing amplifier and Difference amplifier
3. Integrator and Differentiator
4. Astable and monostable multivibrator 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**

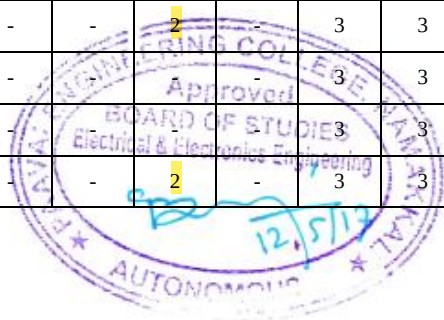
At the end of this course, students will be able to

- 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

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



COURSE OBJECTIVES

- To impart knowledge on operation of AC generators and methods for determining regulation of AC generator
- To understand the operation of AC motors and starting methods
- To learn the concepts of operating principle and predetermination of parameters of induction motor.
- To study the starters and speed control methods of various motors.
- To 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.
- study the performance of three phase induction motor.
- understand the concept of starting and speed control of induction motors.
- know 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, 2009.
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 publishingCompany 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.

WEB LINKS

1. <http://www.nptel.ac.in/courses/Webcourse>
2. http://geosci.uchicago.edu/~moyer/GEOS24705/Readings/Klempner_Ch1.pdf
3. http://educyclopedia.karadimov.info/library/eet_ch6.pdf

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



COURSE OBJECTIVES

- To impart the knowledge about the basic concepts of computer organization, instruction formats.
- To gain the knowledge about control and central processing unit, various addressing modes.
- To study about computer arithmetic and pipeline processing in computers.
- To learn the different ways of communicating with I/O devices and standard I/O interfaces.
- To obtain the knowledge about the memory organization in computers.

UNIT I DATA REPRESENTATION, ORGANIZATION AND DESIGN 9

Data representation: Data types, complements, fixed-point representation, floating-point representation, other Binary codes, error detection codes. Basic computer organization and design: Instruction codes, computer registers, computer instructions, timing and control, instruction cycle, memory reference instructions, input output and interrupt. Complete computer description, design of basic computer, design of accumulator logic.

UNIT II CONTROL AND CENTRAL PROCESSING UNIT 9

Micro programmed control : Control memory, address sequencing, micro-program example, Design of control unit. Central processing unit: General register organization, stack organization, instruction formats, addressing modes, data transfer and manipulation, program control, reduced instruction set computer.

UNIT III COMPUTER ARITHMETIC, PIPELINE AND VECTOR PROCESSING 9

Computer arithmetic: Addition and subtraction, multiplication algorithms, division algorithms- floating-point- Arithmetic operations: decimal arithmetic unit, decimal arithmetic operations. Pipeline and vector processing: Parallel processing, pipelining, arithmetic pipeline, instruction pipeline, RISC pipeline- vector processing array processors.

UNIT IV INPUT-OUTPUT AND INTERFACES 9

Input - output organization, Peripheral devices - input-output interface, asynchronous data transfer, modes of transfer, priority interrupt, direct memory access, input-output processor, serial communication.

UNIT V MEMORY ORGANIZATION 9

Memory organization: Memory hierarchy, main memory, auxiliary memory, associative memory, cache memory, Virtual memory, memory management hardware.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- understand the organization of basic computer.
- know the concept of memory organization and the basic parallel processing.
- analyze the operation of central processing and arithmetic logic units.
- perform pipelining and vector processing operations.
- obtain knowledge on input output organization of computers.

TEXT BOOKS

1. Morris Mano M, "Computer System Architecture", Prentice Hall of India , New Delhi, Third Edition, 2009.
2. B. Parhami, "Computer Architecture", Oxford University Press, 2005.

REFERENCES

1. J.P. Hayes, Sivarama. P. Dandamudi, Computer Architecture, McGraw-Hill 2004.
2. Vincent P. Heuring and Harry F. Jordan, 'Computer Systems Design and Architecture', Pearson Education Asia Publications, 2008.
3. John P. Hayes, 'Computer Architecture and Organization', Tata McGraw Hill, 2012.
4. Andrew S. Tanenbaum, 'Structured Computer Organization', 6th Edition, Prentice Hall of India/Pearson Education, 2012.
5. William Stallings, "Computer Organization and Architecture" 6th Edition, Prentice Hall of India/Pearson Education,

WEB LINKS

1. www.inetdaemon.com/tutorials/computers/hardware/cpu
2. <http://faculty.qu.edu.qa/malmeer/503263/ch9.pdf>
3. http://www.zeepedia.com/read.php?virtual_memory_organization_advance_computer_architecture

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



COURSE OBJECTIVES

- To understand basic concepts of thermal and hydro power plants.
- To know the basic structure and operation of nuclear and diesel power plants.
- To study basic concepts and applications of solar photovoltaic power conversion systems.
- To understand basic concepts of wind power conversion system and types of power generators.
- To learn the 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

- know the concept of thermal and hydro electric power plants.

- enumerate the operation of nuclear and diesel power plants.
- categorize the advantages of solar photovoltaic power conversion systems
- discriminate the advantages of wind power conversion system.
- obtain knowledge on tariff and economic.

TEXT BOOKS

1. P.K. Nag, “Power Plant Engineering” Tata McGraw Hill, Second Edition , Fourth reprint 2014.
2. G.D. Rai, “An introduction to power plant technology” Khanna Publishers 2016.

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1. Bernhardt G.A.Skrotzki and William A. Vopat, “Power station Engineering and Economy”, Tata McGraw Hill, 20th reprint 2002.
2. L.Monition , Mle Nir, 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.

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



COURSE OBJECTIVES

- know the regulation of Three Phase Alternator using various methods.
- understand the parallel operations of alternators.
- obtain the V and inverted V curves of synchronous motors.
- know the performance characteristics of AC motor , know the equivalent circuits of induction motor

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.
1. No load and blocked rotor test on three-phase induction motor
2. Separation of No-load losses of three-phase induction motor.
3. Load test on single-phase induction motor
4. No load and blocked rotor test on single-phase induction motor.
5. Load test on three phase Alternator.

COURSE OUTCOMES**TOTAL PERIODS 60**

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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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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CO3	3	3	3	3	3	-	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	-	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To understand their capabilities & enhance their grooming and showcasing his/ her capabilities to a prospective employer
- To provide opportunity for the students to become acquainted with corporate opportunities relevant to their academic learning
- To articulate their thoughts on a given topic – in english and also to make decent write ups in english on any given topic
- To practice & score well in Aptitude tests conducted by corporates / prospective employers
- To prepare for any group discussion evaluation or presenting their credentials during a face- to-face interview leading to selection and employment

UNIT I PERSONALITY DEVELOPMENT 1 6

Introduction – self explorations – character building – self esteem- self confidence- positive thinking – leadership qualities- time management.

UNIT II PERSONALITY DEVELOPMENT 2 6

Grooming- role play – good etiquettes - extempore - writing skills: email, paragraph – team building- body language - non verbal communication

UNIT III QUANTITATIVE APTITUDE (QA) 1 6

Time , speed & distance -- simple interest & compound interest – percentage – height & distance – time & work – number systems – L.C.M & H.C.F – ratio proportion- area – directions.

UNIT IV LOGICAL REASONING (LR) 1 6

Analogies - letter & symbol series – number series – cause & effect – essential part – verbal reasoning.

UNIT V VERBAL REASONING (VR) 1 6

Blood relation – venn diagrams – analogy – character puzzles – logical sequence – classification – verification of truth – seating arrangement

TOTAL PERIODS 30**COURSE OUTCOMES**

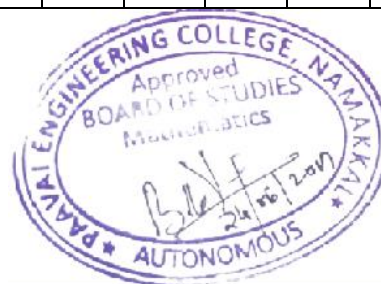
At the end of this course, students will be able to

- demonstrate aptitude & reasoning skills
- enhance verbal & written ability.
- improve his/her grooming and presentation skills.
- interact effectively on any recent event/happenings/ current affairs.
- be a knowledgeable person on the various evaluation processes leading to employment and face the same with Confidence.

REFERENCES

1. Agarwal, R.S.” A Modern Approach to Verbal & Non Verbal reasoning”, S.Chand & co ltd, New Delhi.
2. Abhijit guha, “Quantitative Aptitude “, Tata-Mcgraw hill.
3. word power made easy by norman lewis ,W.R.Goyal publications.
4. Johnson, D.W. reaching out – interpersonal effectiveness and self actualization.Boston: Allyn and Bacon.
5. Agarwal, R.S.“ objective general English”,S.Chand & co
6. Infosys campus connect program – students’ guide for soft skills.

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SEMESTER VI

EE15601

DESIGN OF ELECTRICAL APPARATUS

3 2 0 4

COURSE OBJECTIVES

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

UNIT I MAGNETIC CIRCUITS AND COOLING OF ELECTRICAL MACHINES 15

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 15

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 15

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 15

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 15

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 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", Dhanpat Rai 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. Shanmuga Sundaram, G. Gangadharan, R. Palani 'Electrical Machine Design Data Book', New Age International 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.

WEB LINKS

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2. <http://oldquestionpaper.in/category/anna-university-chennai/b-e-b-tech-eee/design-of-electrical-apparatus/>

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



COURSE OBJECTIVES

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

UNIT I CHARACTERISTICS OF ELECTRIC DRIVES 9

Electric Drives – Drive classifications – 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 – Multiquadrant 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. Vedam Subramanyan, “Thyristor control of Electrical Drives”, Tata McGraw Hill Publishing Company, New Delhi 2007.
3. Gaekward, “Analog and Digital control systems”, Wiley Eastern Ltd, New Delhi 2007
4. Shaahin Felizadeh, “Electric Machines and Drives”, CRC Press (Taylor and Francis Group), 2013.
5. Bimal K.Bose. Modern Power Electronics and AC Drives, Pearson Education, 2002.

WEB LINKS

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2. <http://www.ssd.noaa.gov>
3. <http://www.shodhganga.inflibnet.ac.in>

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



COURSE OBJECTIVES

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

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2. Pai M A, ‘Computer Techniques in Power System Analysis’, Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, Second Edition, 2007.
3. J. Duncan Glover, Mulukutla S. Sarma, Thomas J. Overbye, ‘Power System Analysis & Design’, Cengage Learning, 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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2. <http://freevideolectures.com/Course/2353/Power-Systems-Analysis>

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



COURSE OBJECTIVES

- To understand 8085 architecture and memory interacting
- To acquire programming knowledge of 8085.
- To understand peripheral interface with 8085
- To learn 8051 architecture, interrupts and programming.
- To know internal peripheral units of 8051.

UNIT I 8085 PROCESSOR**9**

8085 Architecture – Pin diagram - Functional block diagram – Memory Interfacing – Interrupts.

UNIT II INSTRUCTIONS SET OF 8085**9**

Interrupts Instruction set – Addressing modes – Timing diagrams – Assembly language programming.

UNIT III PERIPHERAL INTERFACING WITH 8085**9**

Architecture and programming of ICs: 8255 PPI, 8259 PIC, 8251 USART, 8279 Key board display controller and 8254 Timer/ Counter – Interfacing with 8085

UNIT IV 8051 MICROCONTROLLER**9**

8051 Functional block diagram - Instruction set - addressing modes – Interrupt structure – Timer – I/O ports – Serial communication-Assembly language programming.

UNIT V MICRO CONTROLLER APPLICATIONS**9**

Interfacing: LCD, ADC, DAC, Sensors, Stepper Motor, Keyboard and DC motor speed control

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- explain the architecture of 8085 microprocessor and design memory interfacing.
- develop the program 8085 microprocessor.
- Interfacing peripheral device with 8085 proessor.
- develop the programming skills of 8051 microcontroller.
- perform investigation on microcontrollers application.

TEXT BOOKS

1. R.S. Gaonkar, “Microprocessor Architecture, Programming, and Applications with the 8085”, 5th Edition, Prentice Hall, 2012.
2. A.K. Ray and K.M. Bhurchandi, “Advanced Microprocessors and peripherals”, 2nd Edition, Tata McGraw-Hill, 2012.

REFERENCES

1. Douglas V.Hall, "Microprocessors and Digital Systems", McGraw Hill Publishing Co. Ltd. 2010
2. Kenneth J Ayala, "The 8051 Micro controller", Thomson Delmer Learning, 2013
William Kleitz, 'Microprocessor and Micro Controller Fundamental of 8085 and 8051Hardware and Software', Pearson Education, 1998
3. Krishna Kant, "Microprocessor and Microcontrollers", Eastern Company Edition, Prentice – Hall of India, New Delhi , 2007

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2. http://www.soc.napier.ac.uk/~bill/pdf/Io_ch01.PDF

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



COURSE OBJECTIVES

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

UNIT I DISCRETE TIME SIGNAL AND SYSTEMS 15

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 15

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 15

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 15

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 15

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 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 filters.
- 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.

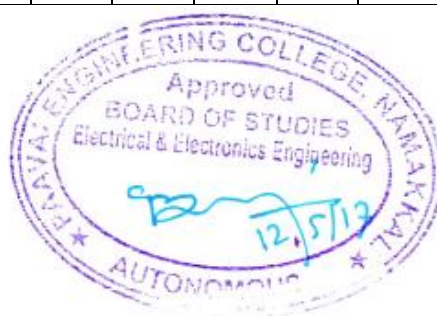
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1. Simon Haykin and Barry Van Veen, “Signals and Systems”, 2nd Edition, Willey Publication (Reprint), 2010.
2. Sanjit K.Mitra, “Digital Signal Processing”, Tata McGraw Hill, 2009.
3. P. Ramesh Babu and R.Ananda Natarajan, “Signals and Systems”, SciTech 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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1. <http://www.radio-electronics.com/info/rf-technology-design/digital-signal-processing/dsp-basics-tutorial.php>
2. <http://www.mikroe.com/chapters/view/73/chapter-3-iir-filters/>

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CO5	3	3	-	-	-	-	-	-	-	-	-	-	3	-



COURSE OBJECTIVES

- To understand and analyze the operation of induction and synchronous motor drives through simulation packages.
- To control the speed of electrical drives using DSP and Micro controllers
- To understand about speed control using dual converter
- To 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 3 phase Rectifier.
4. Speed control of 3 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 Brush Less 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
- implement PLC drives

**CO-PO MAPPING:**

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COURSE OBJECTIVES

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

LIST OF EXPERIMENTS**I. PROGRAMS USING 8085**

- 8 bit Addition, Subtraction, Multiplication and Division
- Arithmetic mean of N Numbers
- Sorting given set of Numbers in Ascending & Descending Order
- Finding largest & smallest of given Numbers
- Code Conversion
- Interfacing with 8255, 8253, 8279
- Interfacing with DAC to generate a. Triangular wave b. Square Wave c. Saw tooth Wave d. Staircase
- Interfacing with Stepper Motor and Traffic Light Controller

II. PROGRAMS USING 8051

- 8 bit Addition, Subtraction, Multiplication and Division
- Arithmetic mean of N Numbers
- Sorting given set of Numbers in Ascending & Descending Order
- Finding largest & smallest of given Numbers
- RAM direct addressing
- Bit Addressing

TOTAL PERIODS 60**COURSE OUTCOMES**

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

- develop programming skills in 8085 microprocessor and 8051 microcontroller based on its instruction sets
- build up their 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														
CO's	PO's												PSO'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
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CO3	3	3	3	3	3	1	-	-	-	-	3	-	3	3
CO4	3	3	3	3	3	1	-	-	-	-	3	-	3	3



COURSE OBJECTIVES

- To enhance career competency and employability skills
- To demonstrate effective leadership and interpersonal skills
- To improve professional capabilities through advanced study and researching current market strategy.
- To develop problem solving and decision making capabilities
- To improve their reasoning skills to get placed in reputed companies

UNIT I CORPORATE READINESS**6**

Business Communication – Inter and Intra Personal skills – Business Etiquettes – Corporate ethics – Communication media Etiquette.

UNIT II INTERVIEW SKILLS**6**

Resume building – Group discussions – Presentation skills – Entrepreneur skills – Psychometric assessment – Mock interview.

UNIT III QUANTITATIVE APTITUDE (QA) 2**6**

Profit and Loss – Clock – Power and Square roots – Train – Boats and streams – Probability – Calendars – Permutations and Combinations - Partnership – Simplification – Pipes and Cisterns – Puzzles.

UNIT IV LOGICAL REASONING (LR) 2**6**

Statements and Assumptions – Matching Definitions – Logical Games – Making judgments – Statements and conclusions – Verbal classifications.

UNIT V VERBAL REASONING (VR) 2**6**

Syllogisms – Data sufficiency – Dice – Series completion – Character puzzles – cube and cuboids – Arithmetic Reasoning.

TOTAL PERIODS 30**COURSE OUTCOMES**

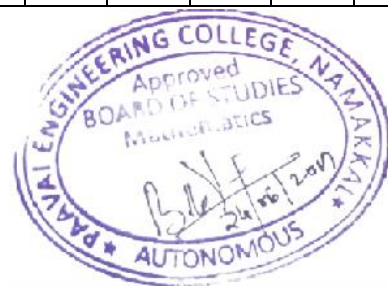
At the end of this course, students will be able to

- develop team work capabilities
- boost their problem solving skills
- enhance the transformation from college to corporate.
- compute problems based on quantitative aptitude
- reveal their logical and verbal reasoning by scoring the expected percentage to get placed in reputed companies

REFERENCES

1. Agarwal, r.s.” a modern approach to verbal & non verbal reasoning”, , S.Chand & co ltd, New Delhi.
2. Abhijit guha, “quantitative aptitude for competitive examinations “, Tata Mcgraw hill
3. Word power made easy by norman lewis ,wr.goyal publications.
4. Johnson, d.w. (1997). Reaching out – interpersonal effectiveness and self Actualization -- Boston: Allyn and bacon.
5. Infosys Campus Connect Program – students’ guide for soft skills.
6. Mitra ,barun.k, “ Personalaity Development & Softskills “ , Oxford University.

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



LIST OF ELECTIVES

EE15151

BIO MEDICAL ENGINEERING

3 0 0 3

COURSE OBJECTIVES

- To understand the knowledge about the organs of human body and measure the parameters
- To learn the bio potential electrodes, transducers and their types
- To gain the knowledge about the various measurements of blood pressure.
- To study about the modern imaging systems.
- To 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. Pfeiffer, "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

WEB LINKS

1. <http://www.medcom.dk/dwn1177>
2. <http://www.artannlabs.com/bone-ultrasonic.html#>

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



COURSE OBJECTIVES

- To impart knowledge on the basic concepts of electrical safety
- To acquaint to the concepts of electrical safety.
- To understand the protection systems for electrical equipments.
- To learn the installation, operation and maintenance of electrical circuits.
- To 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 equipments-over current and short circuit current-heating effects of current-electromagnetic forces-corona effect- static electricity–definition, sources, hazardous conditions, control, electrical causes of fire and explosion-ionization spark and arc - ignition energy -national electrical safety code ANSI. Lightning, hazards, lightning arrestor, installation – earthing, specifications, earth resistance, earth pit maintenance.

UNIT III PROTECTION SYSTEMS**9**

Fuse, circuit breakers and overload relays – protection against over voltage and under voltage – safe limits of amperage –voltage – safe distance from lines - capacity and protection of conductor – joints – and connections, 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 out and work permit system-discharge rod and earthing devices - safety in the use of portable tools- cabling and cable joints -preventive maintenance.

UNIT V HAZARDOUS ZONES**9**

Classification of hazardous zones - intrinsically safe and explosion proof electrical apparatus -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.
- discuss on the hazards and issues.

TEXT BOOKS

1. Fordham Cooper, W., "Electrical Safety Engineering" Butterworth and Company, London, 1994.

REFERENCES

1. N.S.C., Chicago, "Accident prevention manual for industrial operations", 1982.
2. Indian Electricity Act and Rules, Government of India.
3. Power Engineers-Handbook of TNEB, Chennai, 1989.
4. Martin Glov, Electrostatic Hazards in powder handling, Research Studies Pvt.Ltd., England, 1988.

WEB LINKS

1. https://www.osha.gov/dte/grant_materials/fy09/sh-18794-09/electrical_safety_manual.pdf
2. https://www.osha.gov/dte/grant_materials/fy07/sh-16615-07/train-the-trainer_manual2.pdf

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



COURSE OBJECTIVES

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

- understand 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 using DSP", Prentice Hall Pvt. Ltd, 1999.
3. Richard C. Dorf, Robert H. Bishop, "Modern Control systems", Addison Wesley, 1999.
4. Michael P Lukas, "Distributed Control Systems", Van Nostrand Reinhold Company, New York, 1995.
5. K. Ogata, Modern Control Engineering, Pearson Education, New Delhi, 2009.

WEB LINKS

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2. <http://lorien.ncl.ac.uk/ming/digicont/control/digital3.htm>

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



COURSE OBJECTIVES

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

UNIT I CONCEPTS OF NANOSTRUCTURES 9

Electronic states in crystal energy bands, Concepts of 2D nanostructures (quantum wells), 1D nanostructures (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.ISTM 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 bandgap 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

Nanocomposites Electronic and atomic structure of aggregates and nanoparticles Theory and modeling of nanoparticles fictionalization processes.

UNIT V CHARACTERIZATION OF NANOPOLYMERS 9

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

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- explain concept of nano physics and quantum dots.
- understand the behavior of materials at nano scale
- analyze the energy level to different materials
- know 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) 1993,
2. J.H. Davies, An introduction to the physics of 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.

WEB LINKS

1. <http://www.acclab.helsinki.fi/~knordlun/nanotiede/nanosc1nc.pdf>
2. https://www.ttu.ee/public/m/Mehaanikateaduskond/Instituudid/Materjalitehnika_NanoMat.pdf

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



COURSE OBJECTIVES

- To understand the concept of S-domain network.
- To know the concept of frequency response.
- To learn the concept of network topology.
- To have an indepth knowledge on the design of two-port networks & Filters.
- To 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 3phase 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 & 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.

TEXT BOOKS

1. Kuo. F.F., 'Network Analysis and Synthesis', Wiley International Edition, Second Edition, 1966.
2. Wadhwa C L 'Network analysis and synthesis' New Age International publishers (P) ltd., Second edition, Delhi., 2016.

REFERENCES

1. Paranjothi, S.R., 'Electric Circuit Analysis', New age International Publishers, Second Edition, 2017. Karunya University Division of Electrical & Electronics Engineering
2. Van Valkenburg, M.E., 'Network Analysis', Prentice-Hall of India Private Ltd., New Delhi, Third Edition, 1974.
3. ShyamMohan S.P., Sudhakar A, "Circuits and Network Analysis & Synthesis", Tata McGraw Hill, 2011.
4. Arumugam .M and Premkumar .N, Electric circuit theory, Khanna & Publishers, 2006.
5. Soni M.L and Gupta J.C, "Electrical circuit Analysis", Dhanpat Rai and Sons, Delhi, 1990.

WEB LINKS

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2. <https://books.google.co.in/books>

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



COURSE OBJECTIVES

- To study the basics of MEMS and parts of MEMS
- To understand the sensors and transducers used in MEMS.
- To know design methodology of MEMS for various mechanics
- To learn the process of lithography in MEMS
- To 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 microfabrications. Materials: Materials for MEMS - Metal and metal alloys for MEMS - Polymers for MEMS – Other materials for MEMS .Metals : Evaporation –Sputtering. Semiconductors :Electrical and chemical properties-Growth and deposition.Thin films for MEMS and their deposition techniques.

UNIT II MICROSENSING FOR MEMS**9**

Piezoresistive 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**

Micromachning : 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

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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.

WEB LINKS

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2. <http://eelixee.usm.maine.edu/courses/ele498/Lecture%20Material/MEMS-Overview.PDF>

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



COURSE OBJECTIVES

- To learn Robotic technology
- To understand about the Peripherals used and vision process
- To get idea about Programming of robots.
- To know the Robotic applications in different industrial domains.
- To know robot manufacturing

UNIT I INTRODUCTION**9**

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

UNIT II PERIPHERAL, SENSORS & MACHINE VISION**9**

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

UNIT III PROGRAMMING FOR ROBOTS**9**

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

UNIT IV ROBOT KINEMATICS & APPLICATION**9**

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

UNIT V ROBOTIC APPLICATION IN MANUFACTURING**9**

Material transfer, Machine loading & unloading, Processing operations, Assembly & Inspectors, Robotic Cell Design & 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.
- Analyze the concept of robot manufacturing.

TEXT BOOKS

1. Robotics, control vision and intelligence-Fu, Lee and Gonzalez. McGraw Hill International, 2nd edition, 2007.
2. Introduction to Robotics- John J. Craig, 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. Robotics for Engineers -YoramKoren, McGraw Hill International, 1st edition, 1985.
3. Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
4. Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition, 2009.
5. Robotics for Engineers - Yorem Koren 2009.

WEB LINKS

1. https://eprints.usq.edu.au/3997/1/Industrial_Robotics.pdf
2. <http://zums.ac.ir/files/research/site/ebooks/Robotics/Industrial.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	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



COURSE OBJECTIVES

- To understand the artificial intelligence, various types of production systems, characteristics of production systems.
- To expose the neural networks, architecture, functions and various algorithms involved.
- To learn the basic Fuzzy logic functions, various fuzzy systems and their functions.
- To study the fuzzy set theory based on applications.
- To 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 Multilayer 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 & 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.

WEB LINKS

1. <http://users.du.se/~jwe/fuzzy/NFL/F9.PDF>
2. https://www.vssut.ac.in/lecture_notes/lecture1423723637.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														
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CO1	3	-	-	-	2	3	1	-	1	-	2	1	-	2
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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



COURSE OBJECTIVES

- To impart knowledge on the energy availability in the field renewable energy.
- To acquire knowledge about the wind generators and about wind hybrid technology
- To understand the developing processes involved in wind energy system
- To impart detailed knowledge On photovoltaic System and role of power electronics in PV system
- To 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: Stand alone 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

- understand about the fundamentals of wind & solar energy and the requirements of renewable energy in India
- obtain knowledge of various wind turbines and importance of hybrid wind energy system
- know the design procedure of wind energy systems
- gather knowledge 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.

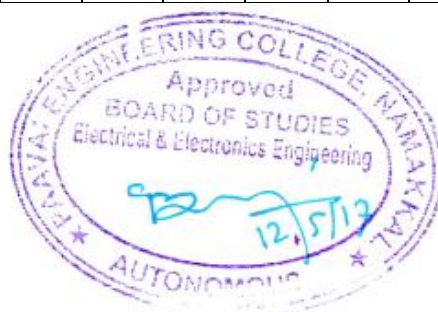
REFERENCES

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 Mc GrawHill, 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.

WEB LINKS

1. <http://prod.sandia.gov/>
2. <http://electrical4u.com/>
3. <http://www.icrepq.com/>

CO-PO MAPPING:														
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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



COURSE OBJECTIVES

- To instigate on reactive elements in power electronic systems.
- To understand the concepts of Switched Mode power converters.
- To introduce the Isolated and non-isolated topologies and modelling of dc-to-dc converters
- To implicit the awareness of resonant converters.
- To study the closed loop control of switching converters with compensator design and applications of rectifiers

UNIT I REACTIVE CIRCUIT ELEMENTS**9**

Reactive Elements in Power Electronic Systems, Design of inductor, Design of transformer, Capacitors for power electronic applications.

UNIT II DC-TO-DC CONVERTERS**9**

Basic concepts of Switched Mode power converters. Primitive DC to DC Power Converter-Operating Principle, Exact and Approximate Analysis.

UNIT III TOPOLOGIES OF DC-TO-DC CONVERTERS**9**

Non-isolated DC to DC Power Converter- Buck, Boost, Buck-Boost, Cuk, Sepic and Quadratic Converters. Isolated DC to DC Power Converter - Forward, Flyback, Half/Full Bridge Converters. - Steady - state model, dynamic model, analysis, modeling and performance functions of switching power converters

UNIT IV RESONANT CONVERTERS**9**

Classification of resonant converters, Basic resonant circuit concepts, Load resonant converters, resonant switch converters, Zero voltage and current switching.

UNIT V CLOSED LOOP CONTROL OF POWER CONVERTERS**9**

Closed Loop Control of Switching Converters- Steady State Error, Control Bandwidth, and Compensator Design- Closed Loop Dynamic Performance Functions- Design of feed- back compensators. Unity power factor rectifiers, resistor emulation principle - applications of rectifiers.

TOTAL PERIODS 45**COURSE OUTCOMES**

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

- design the reactive elements in power electronic systems.
- explain the functions of various DC to DC power converters.
- perform analysis of DC-DC converters.
- design and analyze the resonant converters.
- apply the concept of feed- back to power converters.

TEXT BOOKS

1. Ramanarayanan V., "Course Material on Switched Mode Power Conversion", IISc , Bangalore, 2007
2. Umanand L., Bhat S.R., "Design of magnetic components for Switched Mode Power Converters" , Wiley Eastern Ltd.,2002

REFERENCES

1. Ned Mohan, Tore M. Undeland, William P. Robbins, "Power Electronics: Converters, Applications and Design", John Wiley and Sons, Third edition, 2003.
2. Philip T. Krein, "Elements of Power Electronics", Oxford University Press, 2004.
3. Simon S. Ang, "Power Switching Converter", Marcel Dekker Inc., 1995.
4. Issa Batarseh, 'Power Electronic Circuits', John Wiley, 2004.

WEB LINKS

1. <file:///C:/Users/Paavai/Downloads/Topologije%20prekidackih%20izvora%20napajanja.pdf>
2. <http://www.smps.us/topologies.html>

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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



guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments
- Ability to face the placement interviews

EE6701

HIGH VOLTAGE ENGINEERING

L T P C
3 0 0 3

OBJECTIVES:

- To understand the various types of over voltages in power system and protection methods.
- Generation of over voltages in laboratories.
- Measurement of over voltages.
- Nature of Breakdown mechanism in solid, liquid and gaseous dielectrics.
- Testing of 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 overvoltages, Corona and its effects – Reflection and Refraction of Travelling waves- Protection against overvoltages.

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 : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. S.Naidu and V. Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. E. Kuffel and W.S. Zaengl, J.Kuffel, 'High voltage Engineering fundamentals', Newnes Second

Edition Elsevier , New Delhi, 2005.

3. Subir Ray,' An Introduction to High Voltage Engineering' PHI Learning Private Limited, New Delhi, Second Edition, 2013.

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.

EE6702

PROTECTION AND SWITCHGEAR

L T P C
3 0 0 3

OBJECTIVES:

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

UNIT I PROTECTION SCHEMES

9

Principles and need for protective schemes – nature and causes of faults – types of faults – fault current calculation using symmetrical components – Methods of Neutral grounding – Zones of protection and essential qualities of protection – Protection schemes

UNIT II ELECTROMAGNETIC RELAYS

9

Operating principles of relays - the Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Overcurrent, Directional, Distance, Differential, Negative sequence and Under frequency relays.

UNIT III APPARATUS PROTECTION

9

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

UNIT IV STATIC RELAYS AND NUMERICAL PROTECTION

9

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

UNIT V CIRCUIT BREAKERS

9

Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6 and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Sunil S.Rao, 'Switchgear and Protection', Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', New Age International (P) Ltd., First Edition 2011.
3. M.L.Soni, P.V.Gupta, U.S.Bhatnagar, A.Chakrabarti, 'A Text Book on Power System Engineering', Dhanpat Rai & Co.,1998.

REFERENCES:

1. Badri Ram ,B.H. Vishwakarma, 'Power System Protection and Switchgear', New Age International Pvt Ltd Publishers, Second Edition 2011.
2. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', Second Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.
3. C.L.Wadhwa, 'Electrical Power Systems', 6th Edition, New Age International (P) Ltd., 2010
4. Ravindra P.Singh, ' Switchgear and Power System Protection', PHI Learning Private Ltd., New Delhi, 2009.
5. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chotani,'Protection and Switchgear' Oxford University Press, 2011.

EE6703**SPECIAL ELECTRICAL MACHINES****LT P C
3 0 0 3****OBJECTIVES:**

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

UNIT I SYNCHRONOUS RELUCTANCE MOTORS**9**

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

UNIT II STEPPER MOTORS**9**

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

UNIT III SWITCHED RELUCTANCE MOTORS (SRM) 9

Constructional features – Rotary and Linear SRM - 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 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 : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system

TEXT BOOKS:

1. K.Venkataratnam, 'Special Electrical Machines', Universities Press (India) Private Limited, 2008.
2. T.J.E. Miller, 'Brushless Permanent Magnet and Reluctance Motor Drives', Clarendon Press, Oxford, 1989.
3. T. Kenjo, 'Stepping Motors and Their Microprocessor Controls', Clarendon Press London, 1984.

REFERENCES:

1. R.Krishnan, 'Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application', CRC Press, New York, 2001.
2. P.P. Aearnley, 'Stepping Motors – A Guide to Motor Theory and Practice', Peter Perengrinus London, 1982.
3. T. Kenjo and S. Nagamori, 'Permanent Magnet and Brushless DC Motors', Clarendon Press, London, 1988.
4. E.G. Janardanan, 'Special electrical machines', PHI learning Private Limited, Delhi, 2014.

MG6851 PRINCIPLES OF MANAGEMENT

**LT P C
3 0 0 3**

OBJECTIVES:

- To enable the students to study the evolution of Management, to study the functions and principles of management and to learn the application of the principles in an organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

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

UNIT II PLANNING**9**

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

UNIT III ORGANISING**9**

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

UNIT IV DIRECTING**9**

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING**9**

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS**OUTCOMES:**

- Upon completion of the course, students will be able to have clear understanding of managerial functions like planning, organizing, staffing, leading & controlling and have same basic knowledge on international aspect of management

TEXT BOOKS:

1. Stephen P. Robbins & Mary Coulter, “ Management”, Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. JAF Stoner, Freeman R.E and Daniel R Gilbert “Management”, Pearson Education, 6th Edition, 2004.

REFERENCES:

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management” Pearson Education, 7th Edition, 2011.
2. Robert Kreitner & Mamata Mohapatra, “ Management”, Biztantra, 2008.
3. Harold Koontz & Heinz Weihrich “Essentials of Management” Tata McGraw Hill,1998.
4. Tripathy PC & Reddy PN, “Principles of Management”, Tata McGraw Hill, 1999.

OBJECTIVES:

To provide better understanding of power system analysis through digital simulation

LIST OF EXPERIMENTS:

1. Computation of Parameters and Modelling of Transmission Lines
2. Formation of Bus Admittance and Impedance Matrices and Solution of Networks.
3. Load Flow Analysis - I : Solution of load flow and related problems using Gauss-Seidel Method
4. Load Flow Analysis - II: Solution of load flow and related problems using Newton Raphson.
5. Fault Analysis
6. Transient and Small Signal Stability Analysis: Single-Machine Infinite Bus System
7. Transient Stability Analysis of Multi machine Power Systems
8. Electromagnetic Transients in Power Systems
9. Load – Frequency Dynamics of Single- Area and Two-Area Power Systems
10. Economic Dispatch in Power Systems.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

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

OBJECTIVES:

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

METHOD OF EVALUATION:

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

TOTAL : 30 PERIODS

OUTCOMES:

- Ability to review, prepare and present technological developments

OBJECTIVES:

- To analyze the various concepts behind renewable energy resources.
- To introduce the energy saving concept by different ways of illumination.
- To understand the different methods of electric heating and electric welding.
- To introduce knowledge on Solar Radiation and Solar Energy Collectors
- To introduce concepts of Wind Energy and its utilization

UNIT I ELECTRIC DRIVES AND TRACTION**9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT II ILLUMINATION**9**

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

UNIT III HEATING AND WELDING**9**

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

UNIT IV SOLAR RADIATION AND SOLAR ENERGY COLLECTORS**9**

Introduction - solar constant - solar radiation at the Earth's surface - solar radiation geometry – estimation of average solar radiation - physical principles of the conversion of solar radiation into heat – flat-plate collectors - transmissivity of cover system - energy balance equation and collector efficiency - concentrating collector - advantages and disadvantages of concentrating collectors - performance analysis of a cylindrical - parabolic concentrating collector – Feedin Invertors.

UNIT V WIND ENERGY**9**

Introduction - basic principles of wind energy conversion - site selection considerations - basic components of a WECS (Wind Energy Conversion System) - Classification of WECS - types of wind Turbines - analysis of aerodynamic forces acting on the blade - performances of wind.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

TEXT BOOKS:

1. N.V. Suryanarayana, "Utilisation of Electric Power", Wiley Eastern Limited, New Age International Limited, 1993.
2. J.B.Gupta, "Utilisation Electric power and Electric Traction", S.K.Kataria and Sons, 2000.
3. G.D.Rai, "Non-Conventional Energy Sources", Khanna Publications Ltd., New Delhi, 1997.

REFERENCES:

1. R.K.Rajput, Utilisation of Electric Power, Laxmi publications Private Limited., 2007.

2. H.Partab, Art and Science of Utilisation of Electrical Energy”, Dhanpat Rai and Co., New Delhi, 2004.
3. C.L.Wadhwa, “Generation, Distribution and Utilisation of Electrical Energy”, New Age International Pvt.Ltd., 2003.
4. S. Sivanagaraju, M. Balasubba Reddy, D. Srilatha,’ Generation and Utilization of Electrical Energy’, Pearson Education, 2010.
5. Donals L. Steeby,’ Alternative Energy Sources and Systems’, Cengage Learning, 2012.

EE6811

PROJECT WORK

L T P C
0 0 12 6

OBJECTIVES:

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

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

TOTAL: 180 PERIODS

OUTCOMES:

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

OBJECTIVES :

- To study about the concepts of windows programming models, MFC applications, drawing with the GDI, getting inputs from Mouse and the Keyboard.
- To study the concepts of Menu basics, menu magic and classic controls of the windows programming using VC++.
- To study the concept of Document/View Architecture with single & multiple document interface, toolbars, status bars and File I/O Serialization.
- To study about the integrated development programming event driven programming, variables, constants, procedures and basic ActiveX controls in visual basic.
- To understand the database and the database management system, visual data manager, data bound controls and ADO controls in VB.

UNIT I FUNDAMENTALS OF WINDOWS AND MFC**9**

Messages - Windows programming - SDK style - Hungarian notation and windows data types - SDK programming in perspective. **The benefits of C++ and MFC - MFC design philosophy – Document / View architecture** - MFC class hierarchy - AFX functions. Application object - Frame window object - Message map. Drawing the lines – Curves – Ellipse – Polygons and other shapes. GDI pens – Brushes - GDI fonts - Deleting GDI objects and deselecting GDI objects. Getting input from the mouse: Client & Non-client - Area mouse messages - Mouse wheel - Cursor. Getting input from the keyboard: Input focus - Keystroke messages - Virtual key codes - Character & dead key messages.

UNIT II RESOURCES AND CONTROLS**9**

Creating a menu – Loading and displaying a menu – Responding to menu commands – Command ranges - Updating the items in menu, **update ranges – Keyboard accelerators. Creating menus programmatically - Modifying menus programmatically - The system menu** - Owner draw menus – Cascading menus - Context menus. The C button class – C list box class – C static class - The font view application – C edit class – C combo box class – C scrollbar class. Modal dialog boxes – Modeless dialog boxes.

UNIT III DOCUMENT / VIEW ARCHITECTURE**9**

The in existence function revisited – Document object – View object – Frame window object – Dynamic object creation. SDI document template - Command routing. Synchronizing multiple views of a document – **Mid squares application – Supporting multiple document types – Alternatives to MDI. Splitter Windows: Dynamic splitter window** – Static splitter windows. Creating & initializing a toolbar - Controlling the toolbar's visibility – Creating & initializing a status bar - Creating custom status bar panes – Status bar support in appwizard. Opening, closing and creating the files - Reading & Writing – C file derivatives – Serialization basics - Writing serializable classes.

UNIT IV FUNDAMENTALS OF VISUAL BASIC**9**

Menu bar – Tool bar – Project explorer – Toolbox – Properties window – Form designer – Form layout – Intermediate window. Designing the user interface: Aligning the controls – Running the application – Visual development and event driven programming.

Variables: Declaration – Types – Converting variable types – User defined data types - Lifetime of a variable. Constants - Arrays – Types of arrays. Procedures: Subroutines – Functions – Calling procedures. Text box controls – List box & Combo box controls – Scroll bar and slider controls – File controls.

UNIT V DATABASE PROGRAMMING WITH VB**9**

Record sets – Data control – Data control properties, methods. Visual data manager: Specifying indices with the visual data manager – Entering data with the visual data manager. Data bound list control – Data bound combo box – Data bound grid control. Mapping databases: Database object – Table def object, Query def object. Programming the active database objects – ADO object model – Establishing a connection - Executing SQL statements – Cursor types and locking mechanism – Manipulating the record set object – Simple record editing and updating.

TOTAL = 45 PERIODS**OUTCOMES:**

- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Jeff Prosise, 'Programming Windows With MFC', Second Edition, WP Publishers & Distributors (P) Ltd, Reprinted, 2002.
2. Evangelos Petroutsos, 'Mastering Visual Basic 6.0', BPB Publications, 2002.

REFERENCES:

1. Herbert Schildt, 'MFC Programming From the Ground Up', Second Edition, Tata McGraw Hill, reprinted, 2002.
2. John Paul Muller, 'Visual C++ 6 From the Ground Up Second Edition', Tata McGraw Hill, Reprinted, 2002.
3. Curtis Smith & Micheal Amundsen, 'Teach Yourself Database Programming with Visual Basic 6 in 21 days', Techmedia Pub, 1999.

IC6601**ADVANCED CONTROL SYSTEM**

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3	0	0	3

OBJECTIVES :

- To provide knowledge on design in state variable form
- To provide knowledge in phase plane analysis.
- To give basic knowledge in describing function analysis.
- To study the design of optimal controller.
- To study the design of optimal estimator including Kalman Filter

UNIT I STATE VARIABLE DESIGN**9**

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT II PHASE PLANE ANALYSIS**9**

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

UNIT III DESCRIBING FUNCTION ANALYSIS**9**

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

9

UNIT V OPTIMAL ESTIMATION

9

TOTAL : 45 PERIODS

- Ability to apply advanced control theory to practical engineering problems.

1. K. P. Mohandas, "Modern Control Engineering", Sanguine Technical Publishers, 2006.
2. G. J. Thaler, "Automatic Control Systems", Jaico Publishing House, 1993.
3. M. Gopal, Modern Control System Theory, New Age International Publishers, 2002.

1. William S Levine, "Control System Fundamentals," The Control Handbook, CRC Press, Taylor and Francis Group, 2011.
2. Ashish Tewari, 'Modern Control Design with Matlab and Simulink', John Wiley, New Delhi, 2002.
3. K. Ogata, 'Modern Control Engineering', 4th edition, PHI, New Delhi, 2002.
4. T. Glad and L. Ljung,, "Control Theory –Multivariable and Non-Linear Methods", Taylor & Francis, 2002.
5. D.S.Naidu, "Optimal Control Systems" First Indian Reprint, CRC Press, 2009.

POWER SYSTEM TRANSIENTS

LT P C
3 0 0 3

- To study the generation of switching transients and their control using circuit – theoretical concept.
- To study the mechanism of lightning strokes and the production of lightning surges.
- To study the propagation, reflection and refraction of travelling waves.
- To study the impact of voltage transients caused by faults, circuit breaker action, load rejection on integrated power system.

UNIT I INTRODUCTION AND SURVEY

9

Review and importance of the study of transients - **causes for transients. RL circuit transient with sine wave excitation - double frequency transients** - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II SWITCHING TRANSIENTS

9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - **load switching and equivalent circuit** - waveforms for transient

voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - capacitance switching with a restrike, with multiple restrikes. Illustration for multiple restriking transients - ferro resonance.

UNIT III LIGHTNING TRANSIENTS

9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS

9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewley's lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V TRANSIENTS IN INTEGRATED POWER SYSTEM

9

The short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults -switching surges on integrated system Qualitative application of EMTP for transient computation.

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', Tata McGraw Hill, Fifth Edition, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," Wiley, 2012.

OBJECTIVES:

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

UNIT I LINEAR PROGRAMMING**9**

Introduction - formulation of linear programming model-Graphical solution-solving LPP using simplex algorithm – Revised Simplex Method.

UNIT II ADVANCES IN LPP**9**

Dualit theory- Dual simplex method - Sensitivity analysis--Transportation problems– Assignment problems-Traveling sales man problem -Data Envelopment Analysis.

UNIT III NON LINEAR PROGRAMMING**9**

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

UNIT IV INTERIOR POINT METHODS**9**

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

UNIT V DYNAMIC PROGRAMMING**9**

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

TOTAL: 45 PERIODS**OUTCOMES:**

- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

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

REFERENCES:

1. Philips, Ravindran and Solberg, "Operations Research", John Wiley, 2002.
2. Ronald L.Rardin, "Optimization in Operation Research" Pearson Education Pvt. Ltd. New Delhi, 2005.

OBJECTIVES:

- To expose the basic concepts of optical fibers and their industrial applications.
- To provide adequate knowledge about Industrial application of optical fibres.
- To provide basic concepts of lasers.
- To provide knowledge about Industrial application of lasers
- To provide knowledge about Industrial application of Holography and Medical applications of Lasers.

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

Principles of light propagation through a fibre - Different types of fibres and their properties, fibre characteristics – Absorption losses – Scattering losses – Dispersion – Connectors and splicers – Fibre termination – Optical sources – Optical detectors.

UNIT II INDUSTRIAL APPLICATION OF OPTICAL FIBRES**9**

Fibre optic sensors – Fibre optic instrumentation system – Different types of modulators – Interferometric method of measurement of length – Moire fringes – Measurement of pressure, temperature, current, voltage, liquid level and strain.

UNIT III LASER FUNDAMENTALS**9**

Fundamental characteristics of lasers – Three level and four level lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching and mode locking – Cavity damping – Types of lasers – Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

UNIT IV INDUSTRIAL APPLICATION OF LASERS**9**

Laser for measurement of distance, length, velocity, acceleration, current, voltage and Atmospheric effect – Material processing – Laser heating, welding, melting and trimming of material – Removal and vaporization.

UNIT V HOLOGRAM AND MEDICAL APPLICATIONS**9**

Holography – Basic principle - Methods – Holographic interferometry and application, Holography for non-destructive testing – Holographic components – Medical applications of lasers, laser and tissue interactive – Laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. R.P.Khare, Fiber Optics and Optoelectronics, Oxford university press, 2008.
2. J. Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2001.

REFERENCES:

1. Asu Ram Jha, Fiber Optic Technology Applications to commercial, Industrial, Military and Space Optical systems, PHI learning Private limited, 2009.
2. M. Arumugam, Optical Fibre Communication and Sensors, Anuradha Agencies, 2002.
3. John F. Read, Industrial Applications of Lasers, Academic Press, 1978.

OBJECTIVES:

- To Introduce Fundamentals of Biomedical Engineering
- To study the communication mechanics in a biomedical system with few examples
- To study measurement of certain important electrical and non-electrical parameters
- To understand the basic principles in imaging techniques
- To have a basic knowledge in life assisting and therapeutic devices

UNIT I FUNDAMENTALS OF BIOMEDICAL ENGINEERING 9

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column and limbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

UNIT II NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES 9

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

UNIT III ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS 9

Electrodes – Limb electrodes –floating electrodes – pregelled disposable electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipments.

UNIT IV IMAGING MODALITIES AND ANALYSIS 9

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

UNIT V LIFE ASSISTING, THERAPEUTIC AND ROBOTIC DEVICES 9

Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery – Advanced 3D surgical techniques- Orthopedic prostheses fixation.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

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

3. Khandpur R.S, Handbook of Biomedical Instrumentation, , Tata McGraw-Hill, New Delhi, 2nd Edition, 2003.

REFERENCES:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

EE6004

FLEXIBLE AC TRANSMISSION SYSTEMS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the reactive power control techniques
- To educate on static VAR compensators and their applications
- To provide knowledge on Thyristor controlled series capacitors
- To educate on STATCOM devices
- To provide knowledge on FACTS controllers

UNIT I INTRODUCTION

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 –Modelling of SVC for power flow and fast transient stability – Applications: Enhancement of transient stability – Steady state power transfer – Enhancement of power system damping.

UNIT III THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS

9

Operation of the TCSC – Different modes of operation – Modelling of TCSC – Variable reactance model – Modelling for Power Flow and stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping.

UNIT IV VOLTAGE SOURCE CONVERTER BASED FACTS CONTROLLERS

9

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics. Applications: Steady state power transfer-enhancement of transient stability - prevention of voltage instability. SSSC-operation of SSSC and the control of power flow –modelling of SSSC in load flow and transient stability 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.

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

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

REFERENCES:

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

EE6005**POWER QUALITY****L T P C
3 0 0 3****OBJECTIVES:**

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

UNIT I INTRODUCTION TO POWER QUALITY**9**

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

UNIT II VOLTAGE SAGS AND INTERRUPTIONS**9**

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

UNIT III OVERVOLTAGES**9**

Sources of over voltages - Capacitor switching – lightning - ferro resonance. Mitigation of voltage swells - surge arresters - low pass filters - power conditioners. Lightning protection – shielding - line

arresters - protection of transformers and cables. An introduction to computer analysis tools for transients, PSCAD and EMTP.

UNIT IV HARMONICS

9

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

UNIT V POWER QUALITY MONITORING

9

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

TOTAL : 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. McGranaghan, Surya Santoso, H.Wayne Beaty, 'Electrical Power Systems Quality' McGraw Hill, 2003. (For Chapters 1, 2, 3, 4 and 5).
2. **Eswald.F.Fudis and M.A.S.Masoum**, "Power Quality in Power System and Electrical Machines," Elsevier Academic Press, 2013.
3. J. Arrillaga, N.R. Watson, S. Chen, 'Power System Quality Assessment', Wiley, 2011.

REFERENCES:

1. G.T. Heydt, 'Electric Power Quality', 2nd Edition. (West Lafayette, IN, Stars in a Circle Publications, 1994). (For Chapter 1, 2, 3 and 5)
2. M.H.J Bollen, 'Understanding Power Quality Problems: Voltage Sags and Interruptions', (New York: IEEE Press, 1999). (For Chapters 1, 2, 3 and 5)
3. G.J.Wakileh, "Power Systems Harmonics – Fundamentals, Analysis and Filter Design," Springer 2007.
4. E.Aeha and M.Madrigal, "Power System Harmonics, Computer Modelling and Analysis, " Wiley India, 2012.
5. R.S.Vedam, M.S.Sarma, "Power Quality – VAR Compensation in Power Systems," CRC Press 2013.
6. C. Sankaran, 'Power Quality', CRC press, Taylor & Francis group, 2002.

OBJECTIVES:

- To expose the students to the concepts of feed forward neural networks.
- To provide adequate knowledge about feedback neural networks
- To provide adequate knowledge about fuzzy and neuro-fuzzy systems
- To provide comprehensive knowledge of fuzzy logic control to real time systems.
- To provide adequate knowledge of genetic algorithms and its application to economic dispatch and unit commitment problems.

UNIT I ARCHITECTURES – ANN**9**

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

UNIT II NEURAL NETWORKS FOR CONTROL**9**

Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.

UNIT III FUZZY SYSTEMS**9**

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

UNIT IV APPLICATION OF FUZZY LOGIC SYSTEMS**9**

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

UNIT V GENETIC ALGORITHMS**9**

Introduction-Gradient Search – Non-gradient search – Genetic Algorithms: binary and real representation schemes, selection methods, crossover and mutation operators for binary and real coding - constraint handling methods – applications to economic dispatch and unit commitment problems.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and apply basic science, circuit theory, Electro-magnetic field theory control theory and apply them to electrical engineering problems.
- To understand and apply computing platform and software for engineering problems.

TEXT BOOKS:

1. Laurance Fausett, Englewood cliffs, N.J., 'Fundamentals of Neural Networks', Pearson Education, 1992.
2. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', Tata McGraw Hill, 1997.
3. S.N.Sivanandam and S.N.Deepa, Principles of Soft computing, Wiley India Edition, 2nd Edition, 2013.

REFERENCES:

1. Simon Haykin, 'Neural Networks', Pearson Education, 2003.
2. John Yen & Reza Langari, 'Fuzzy Logic – Intelligence Control & Information', Pearson Education, New Delhi, 2003.

3. M.Gen and R.Cheng, Genetic algorithms and Optimization, Wiley Series in Engineering Design and Automation, 2000.
4. Hagan, Demuth, Beale, " Neural Network Design", Cengage Learning, 2012.
5. N.P.Padhy, " Artificial Intelligence and Intelligent Systems", Oxford, 2013.
6. William S.Levine, "Control System Advanced Methods," The Control Handbook CRC Press, 2011.

GE6081

FUNDAMENTALS OF NANOSCIENCE

L T P C
3 0 0 3

OBJECTIVES:

To learn about basis of nanomaterial science, preparation method, types and application

UNIT I INTRODUCTION

8

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

UNIT II GENERAL METHODS OF PREPARATION

9

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

UNIT III NANOMATERIALS

12

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

UNIT IV CHARACTERIZATION TECHNIQUES

9

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

UNIT V APPLICATIONS

7

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

TOTAL : 45 PERIODS

OUTCOMES:

- Will familiarize about the science of nanomaterials
- Will demonstrate the preparation of nanomaterials
- Will develop knowledge in characteristic nanomaterial

TEXT BOOKS :

1. A.S. Edelstein and R.C. Cammearata, eds., "Nanomaterials: Synthesis, Properties and Applications", Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, "Nanoscale Charecterisation of surfaces & Interfaces", 2nd edition, Weinheim Cambridge, Wiley-VCH, 2000.

REFERENCES:

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

IC6002**SYSTEM IDENTIFICATION AND ADAPTIVE CONTROL****LT P C****3 0 0 3****OBJECTIVES:**

- To introduce Non parametric methods
- To impart knowledge on parameter estimation methods
- To impart knowledge on Recursive identification methods
- To impart knowledge on Adaptive control schemes
- To introduce stability, Robustness and Applications of adaptive control method

UNIT I NON PARAMETRIC METHODS**9**

Non parametric methods: **Transient analysis–frequency analysis**–Correlation analysis–Spectral analysis.

UNIT II PARAMETER ESTIMATION METHODS**9**

Least square estimation – best linear unbiased estimation under linear constraints – updating the parameter estimates for linear regression models–prediction error methods: description of prediction methods – **optimal prediction – relation between prediction error methods and other identification methods** – theoretical analysis - Instrumental variable methods: Description of instrumental variable methods – Input signal design for identification.

UNIT III RECURSIVE IDENTIFICATION METHODS**9**

The recursive least square method – the recursive instrumental variable methods- the recursive prediction error methods – **Maximum likelihood. Identification of systems operating in closed loop: Identifiability considerations** – direct identification – indirect identification.

UNIT IV ADAPTIVE CONTROL SCHEMES**9**

Introduction – **Types of adaptive control–Gain scheduling controller–Model reference adaptive control schemes–Self tuning controller–MRAC** and STC: Approaches–The Gradient approach – Lyapunov functions – Passivity theory – pole placement method – Minimum variance control – Predictive control.

UNIT V ISSUES INADAPTIVE CONTROL AND APPLICATIONS**9**

Stability – Convergence – Robustness –Applications of adaptive control.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to apply advanced control theory to practical engineering problems.

TEXT BOOKS:

1. Soder Storm T and Peter Stoica, System Identification, Prentice Hall International, 1989.
2. Astrom, K.J. and Wittenmark, B., "Adaptive Control", Pearson Education, 2nd Edition, 2001.
3. Sastry, S. and Bodson, M., "Adaptive Control– Stability, Convergence and Robustness", Prentice Hall inc., New Jersey, 1989.

REFERENCES:

1. Ljung L, System Identification: Theory for the user, Prentice Hall, Engle wood Cliffs, 1987.
2. Bela.G.Liptak., "Process Control and Optimization", Instrument Engineers' Handbook., volume 2, CRC press and ISA, 2005.
3. William S. Levine, "Control Systems Advanced Methods, the Control Handbook, CRC Press, 2011.

EE6007

MICRO ELECTRO MECHANICAL SYSTEMS

LT P C
3 0 0 3

OBJECTIVES:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

UNIT I INTRODUCTION

9

Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - **Silicon based MEMS processes** – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.

UNIT II SENSORS AND ACTUATORS-I

9

Electrostatic sensors – Parallel plate capacitors – Applications – Interdigitated Finger capacitor – **Comb drive devices – Micro Grippers – Micro Motors** - Thermal Sensing and Actuation – Thermal expansion – Thermal couples – Thermal resistors – Thermal Bimorph - Applications – Magnetic Actuators – Micromagnetic components – **Case studies of MEMS in magnetic actuators- Actuation using Shape Memory Alloys.**

UNIT III SENSORS AND ACTUATORS-II

9

Piezoresistive sensors – Piezoresistive sensor materials - Stress analysis of mechanical elements – Applications to **Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators** – piezoelectric effects – piezoelectric materials – Applications to Inertia , Acoustic, Tactile and Flow sensors.

UNIT IV MICROMACHINING

9

Silicon Anisotropic Etching – Anisotropic Wet Etching – Dry Etching of Silicon – Plasma Etching – **Deep Reaction Ion Etching (DRIE) – Isotropic Wet Etching – Gas Phase Etchants** – Case studies - Basic surface micro machining processes – Structural and Sacrificial Materials – Acceleration of sacrificial Etch – Striction and Antistrication methods – LIGA Process - Assembly of 3D MEMS – Foundry process.

UNIT V POLYMER AND OPTICAL MEMS**9**

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

TOTAL : 45 PERIODS**OUTCOMES:**

- Ability to understand the operation of micro devices, micro systems and their applications.
- Ability to design the micro devices, micro systems using the MEMS fabrication process.

TEXT BOOKS:

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

REFERENCES:

1. Nadim Maluf, "An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Baco Raton, 2001.
3. Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices, John Wiley & Son LTD, 2002.
4. James J.Allen, Micro Electro Mechanical System Design, CRC Press Publisher, 2005.
5. Thomas M.Adams and Richard A.Layton, "Introduction MEMS, Fabrication and Application," Springer, 2010.

EE6008**MICROCONTROLLER BASED SYSTEM DESIGN****L T P C****3 0 0 3****OBJECTIVES:**

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

UNIT I INTRODUCTION TO PIC MICROCONTROLLER**9**

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture–PIC16cxx– Pipelining - Program Memory considerations – Register File Structure - Instruction Set - Addressing modes – Simple Operations.

UNIT II INTERRUPTS AND TIMER**9**

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

UNIT III PERIPHERALS AND INTERFACING**9**

I²C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM–Analog to

Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT IV INTRODUCTION TO ARM PROCESSOR 9

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V ARM ORGANIZATION 9

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

TOTAL: 45 PERIODS

OUTCOMES:

- To understand and apply computing platform and software for engineering problems.
- To understand ethical issues, environmental impact and acquire management skills.

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers"PearsonEducation,3rdEdition, 2004.
2. Furber,S., "ARM System on Chip Architecture" Addison Wesley trade Computer Publication, 2000.

REFERENCE:

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

**EE6009 POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS LT P C
3 0 0 3**

OBJECTIVES:

- To Provide knowledge about the stand alone and grid connected renewable energy systems.
- To equip with required skills to derive the criteria for the design of power converters for renewable energy applications.
- To analyse and comprehend the various operating modes of wind electrical generators and solar energy systems.
- To design different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To develop maximum power point tracking algorithms.

UNIT I INTRODUCTION 9

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) - Qualitative study of different renewable energy resources: Solar, wind, ocean, Biomass, Fuel cell, Hydrogen energy systems and hybrid renewable energy systems.

UNIT II ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION 9

Reference theory fundamentals-principle of operation and analysis: IG, PMSG, SCIG and DFIG.

9

UNIT IV ANALYSIS OF WIND AND PV SYSTEMS

9

UNIT V HYBRID RENEWABLE ENERGY SYSTEMS

9

TOTAL : 45 PERIODS

- Ability to understand and analyze power system operation, stability, control and protection.
- Ability to handle the engineering aspects of electrical energy generation and utilization.

1. S. N. Bhadra, D.Kastha, S.Banerjee, "Wind Electrical Systems", Oxford University Press, 2005.
2. B.H.Khan Non-conventional Energy sources Tata McGraw-hill Publishing Company, New Delhi, 2009.

1. Rashid .M. H “power electronics Hand book”, Academic press, 2001.
2. Ion Boldea, “Variable speed generators”, Taylor & Francis group, 2006.
3. Rai. G.D, “Non conventional energy sources”, Khanna publishes, 1993.
4. Gray, L. Johnson, “Wind energy system”, prentice hall linc, 1995.
5. Andrzej M. Trzynadlowski, ‘Introduction to Modern Power Electronics’, Second edition, wiley India Pvt. Ltd. 2012.

LTPC
3003

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters.
- To study about the HVDC system control.
- To analyze harmonics and design of filters.
- To model and analysis the DC system under study state.

9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – **Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers** – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II	ANALYSIS OF HVDC CONVERTERS	9
Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.		
UNIT III	CONVERTER AND HVDC SYSTEM CONTROL	9
Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.		
UNIT IV	REACTIVE POWER AND HARMONICS CONTROL	9
Reactive power requirements in steady state – Sources of reactive power – SVC and STATCOM – Generation of harmonics – Design of AC and DC filters – Active filters.		
UNIT V	POWER FLOW ANALYSIS IN AC/DC SYSTEMS	9
Per unit system for DC quantities – DC system model – Inclusion of constraints – Power flow analysis – case study.		

TOTAL: 45 PERIODS

OUTCOMES:

- Ability to understand and analyze power system operation, stability, control and protection.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", New Age International (P) Ltd., New Delhi, Second Edition, 2010.
2. Edward Wilson Kimbark, "Direct Current Transmission", Vol. I, Wiley interscience, New York, London, Sydney, 1971.
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", New Age International (P) Ltd., New Delhi, 1990.

REFERENCES:

1. Kundur P., "Power System Stability and Control", McGraw-Hill, 1993.
2. Colin Adamson and Hingorani N G, "High Voltage Direct Current Power Transmission", Garraway Limited, London, 1960.
3. Arrillaga, J., "High Voltage Direct Current Transmission", Peter Pregrinus, London, 1983.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission', Tata McGraw Hill Education Private Limited, 2011.

EE6011

POWER SYSTEM DYNAMICS

L T P C
3 0 0 3

OBJECTIVES:

- To introduce the basics of dynamics and stability problems
- To educate on modeling of synchronous machines
- To educate on the excitation system and speed-governing controllers.
- To study small signal stability of a single-machine infinite bus system with excitation system and power system stabilizer.
- To educate on the transient stability simulation of multi machine power system.

9

UNIT II SYNCHRONOUS MACHINE MODELLING

9

UNIT III MACHINE CONTROLLERS

9

UNIT IV TRANSIENT STABILITY

9

UNIT V DYNAMIC STABILITY

9

TOTAL : 45 PERIODS

- Ability to understand and analyze power system operation, stability, control and protection.

1. P.M. Anderson and A.A.Fouad, 'Power System Control and Stability', Galgotia Publications, New Delhi, 2003.
2. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc., USA, 1994.
3. R.Ramanujam, "Power System Dynamics – Analysis and Simulation", PHI, 2009.

1. M.A.Pai and W.Sauer, 'Power System Dynamics and Stability', Pearson Education Asia, India, 2002.
2. James A.Momoh, Mohamed. E. El-Hawary. " Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. C.A.Gross, "Power System Analysis," Wiley India, 2011.
4. B.M.Weedy, B.J.Lory, N.Jenkins, J.B.Ekanayake and G.Strbac," Electric Power Systems", Wiley India, 2013.
5. K.Umarao, "Computer Techniques and Models in Power System," I.K. International, 2007.

OBJECTIVES:

- To introduce the functional elements of Robotics
- To impart knowledge on the direct and inverse kinematics
- To introduce the manipulator differential motion and control
- To educate on various path planning techniques
- To introduce the dynamics and control of manipulators

UNIT I BASIC CONCEPTS

9

Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and control issues- Various manipulators – Sensors - work cell - Programming languages.

UNIT II DIRECT AND INVERSE KINEMATICS

9

Mathematical representation of Robots - Position and orientation - Homogeneous transformation-Variou joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics-PUMA560 & SCARA robots- Solvability - Solution methods-Closed form solution.

UNIT III MANIPULATOR DIFFERENTIAL MOTION AND STATICS

9

Linear and angular velocities-Manipulator Jacobian-Prismatic and rotary joints–Inverse -Wrist and arm singularity - Static analysis - Force and moment Balance.

UNIT IV PATH PLANNING

9

Definition-Joint space technique-Use of p-degree polynomial-Cubic polynomial-Cartesian space technique - Parametric descriptions - Straight line and circular paths - Position and orientation planning.

UNIT V DYNAMICS AND CONTROL

9

Lagrangian mechanics-2DOF Manipulator-Lagrange Euler formulation-Dynamic model -Manipulator control problem-Linear control schemes-PID control scheme-Force control of robotic manipulator.

TOTAL: 45 PERIODS**OUTCOMES:**

- Ability to understand and analyze Instrumentation systems and their applications to various industries.

TEXT BOOKS:

1. R.K.Mittal and I.J.Nagrath, Robotics and Control,Tata McGraw Hill,New Delhi,4th Reprint, 2005.
2. JohnJ.Craig ,Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009.
3. M.P.Groover, M.Weiss,R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996.

REFERENCES:

1. Ashitava Ghoshal, Robotics-Fundamental Concepts and Analysis', Oxford University Press, Sixth impression, 2010.
2. K. K.Appu Kuttan, Robotics, I K International, 2007.
3. Edwin Wise, Applied Robotics, Cengage Learning, 2003.
4. R.D.Klafter,T.A.Chimielewski and M.Negin, Robotic Engineering–An Integrated Approach, Prentice Hall of India, New Delhi, 1994.

5. B.K.Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
6. S.Ghoshal, “ Embedded Systems & Robotics” – Projects using the 8051 Microcontroller”, Cengage Learning, 2009.

GE6083

DISASTER MANAGEMENT

**L T P C
3 0 0 3**

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS

9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR)

9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj

Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Process and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT

9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA

9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS

9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man

Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarios in the Indian context, Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy, 2009.

GE6075

PROFESSIONAL ETHICS IN ENGINEERING

**LT P C
3 0 0 3**

OBJECTIVES:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES

10

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

UNIT II ENGINEERING ETHICS

9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION

9

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

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS

9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk -

Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – **Employee Rights – Intellectual Property Rights (IPR) – Discrimination**.

UNIT V GLOBAL ISSUES

8

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

TOTAL: 45 PERIODS

OUTCOMES:

- Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society.

TEXT BOOKS:

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

REFERENCES:

1. Charles B. Fleddermann, "Engineering Ethics", Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Cengage Learning, 2009.
3. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
5. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility" Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013.
6. World Community Service Centre, ' Value Education', Vethathiri publications, Erode, 2011.

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6757

TOTAL QUALITY MANAGEMENT

L T P C
3 0 0 3

OBJECTIVES:

- To facilitate the understanding of Quality Management principles and process.

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 sectors.

TOTAL: 45 PERIODS

OUTCOMES:

- The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXT BOOK:

1. Dale H. Besterfield, et al., "Total quality Management", Pearson Education Asia, Third Edition, Indian Reprint, 2006.

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.

EC6002

ADVANCED DIGITAL SIGNAL PROCESSING

L T P C

3 0 0 3

OBJECTIVES:

- To bring out the concepts related to stationary and non-stationary random signals
- To emphasize the importance of true estimation of power spectral density
- To introduce the design of linear and adaptive systems for filtering and linear prediction
- To introduce the concept of wavelet transforms in the context of image processing

UNIT I DISCRETE-TIME RANDOM SIGNALS 9

Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, White noise, Power Spectral Density, Spectral Factorization, Innovations Representation and Process, Filtering random processes, ARMA, AR and MA processes.

UNIT II	SPECTRUM ESTIMATION	9
Bias and Consistency, Periodogram, Modified periodogram, Blackman-Tukey method, Welch method, Parametric methods of spectral estimation, Levinson-Durbin recursion.		
UNIT III	LINEAR ESTIMATION AND PREDICTION	9
Forward and Backward linear prediction, Filtering - FIR Wiener filter- Filtering and linear prediction, non-causal and causal IIR Wiener filters, Discrete Kalman filter.		
UNIT IV	ADAPTIVE FILTERS	9
Principles of adaptive filter – FIR adaptive filter – Newton's Steepest descent algorithm – LMS algorithm – Adaptive noise cancellation, Adaptive equalizer, Adaptive echo cancellers.		
UNIT V	WAVELET TRANSFORM	9
Multiresolution analysis, Continuous and discrete wavelet transform, Short Time Fourier Transform, Application of wavelet transform, Cepstrum and Homomorphic filtering.		
		TOTAL: 45 PERIODS

OUTCOMES:

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

- Explain the parametric methods for power spectrum estimation.
- Discuss adaptive filtering techniques using LMS algorithm and the applications of adaptive filtering.
- Analyze the wavelet transforms.

TEXT BOOKS:

1. Monson H, Hayes, "Statistical Digital Signal Processing and Modeling", John Wiley and Sons Inc., New York, Indian Reprint, 2007.
2. John G.Proakis, Dimitris G. Manolakis, "Digital Signal Processing", Pearson, Fourth, 2007.
3. Dwight F. Mix, "Random Signal Processing", Prentice Hall, 1995.

REFERENCE:

1. Sophocles J. Orfanidis, "Optimum Signal Processing, An Introduction", McGraw Hill, 1990.

EE6012

COMPUTER AIDED DESIGN OF ELECTRICAL APPARATUS

**LT P C
3 0 0 3**

OBJECTIVES:

- To introduce the importance of computer aided design method.
- To provide basic electromagnetic field equations and the problem formulation for CAD applications.
- To get familiarized with Finite Element Method as applicable for Electrical Engineering.
- To introduce the organization of a typical CAD package.
- To introduce Finite Element Method for the design of different Electrical apparatus.

UNIT I	INTRODUCTION	9
Conventional design procedures – Limitations – Need for field analysis based design – Review of Basic principles of energy conversion – Development of Torque/Force.		

UNIT II	MATHEMATICAL FORMULATION OF FIELD PROBLEMS	9
Electromagnetic Field Equations – Magnetic Vector/Scalar potential – Electrical vector /Scalar potential – Stored energy in Electric and Magnetic fields – Capacitance - Inductance- Laplace and Poisson's Equations – Energy functional.		
UNIT III	PHILOSOPHY OF FEM	9
Mathematical models – Differential/Integral equations – Finite Difference method – Finite element method – Energy minimization – Variational method- 2D field problems – Discretisation – Shape functions – Stiffness matrix – Solution techniques.		
UNIT IV	CAD PACKAGES	9
Elements of a CAD System –Pre-processing – Modelling – Meshing – Material properties- Boundary Conditions – Setting up solution – Post processing.		
UNIT V	DESIGN APPLICATIONS	9
Voltage Stress in Insulators – Capacitance calculation - Design of Solenoid Actuator – Inductance and force calculation – Torque calculation in Switched Reluctance Motor.		
		TOTAL : 45 PERIODS

OUTCOMES:

- Ability to model and analyze electrical apparatus and their application to power system.

TEXT BOOKS:

1. S.J Salon, 'Finite Element Analysis of Electrical Machines', Springer, YesDEE publishers, Indian reprint, 2007.
2. Nicola Bianchi, 'Electrical Machine Analysis using Finite Elements', CRC Taylor & Francis, 2005.

REFERENCES:

1. Joao Pedro, A. Bastos and Nelson Sadowski, 'Electromagnetic Modeling by Finite Element Methods', Marcell Dekker Inc., 2003.
2. P.P.Silvester and Ferrari, 'Finite Elements for Electrical Engineers', Cambridge University Press, 1983.
3. D.A.Lowther and P.P Silvester, 'Computer Aided Design in Magnetics', Springer Verlag, New York, 1986.
4. S.R.H.Hoole, 'Computer Aided Analysis and Design of Electromagnetic Devices', Elsevier, New York, 1989.
5. User Manuals of MAGNET, MAXWELL & ANSYS Softwares.

EC6601	VLSI DESIGN	L T P C
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OBJECTIVES:

- In this course, the MOS circuit realization of the various building blocks that is common to any microprocessor or digital VLSI circuit is studied.
- Architectural choices and performance tradeoffs involved in designing and realizing the circuits in CMOS technology are discussed.
- The main focus in this course is on the transistor circuit level design and realization for digital operation and the issues involved as well as the topics covered are quite distinct from those encountered in courses on CMOS Analog IC design.

UNIT I	MOS TRANSISTOR PRINCIPLE	9
NMOS and PMOS transistors, Process parameters for MOS and CMOS, Electrical properties of CMOS circuits and device modeling, Scaling principles and fundamental limits, CMOS inverter scaling, propagation delays, Stick diagram, Layout diagrams		
UNIT II	COMBINATIONAL LOGIC CIRCUITS	9
Examples of Combinational Logic Design, Elmore's constant, Pass transistor Logic, Transmission gates, static and dynamic CMOS design, Power dissipation – Low power design principles		
UNIT III	SEQUENTIAL LOGIC CIRCUITS	9
Static and Dynamic Latches and Registers, Timing issues, pipelines, clock strategies, Memory architecture and memory control circuits, Low power memory circuits, Synchronous and Asynchronous design		
UNIT IV	DESIGNING ARITHMETIC BUILDING BLOCKS	9
Data path circuits, Architectures for ripple carry adders, carry look ahead adders, High speed adders, accumulators, Multipliers, dividers, Barrel shifters, speed and area tradeoff		
UNIT V	IMPLEMENTATION STRATEGIES	9
Full custom and Semi custom design, Standard cell design and cell libraries, FPGA building block architectures, FPGA interconnect routing procedures.		
		TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, students should

- Explain the basic CMOS circuits and the CMOS process technology.
- Discuss the techniques of chip design using programmable devices.
- Model the digital system using Hardware Description Language.

TEXTBOOKS:

1. Jan Rabaey, Anantha Chandrakasan, B.Nikolic, "Digital Integrated Circuits: A Design Perspective", Second Edition, Prentice Hall of India, 2003.
2. M.J. Smith, "Application Specific Integrated Circuits", Addison Wesley, 1997

REFERENCES:

1. N.Weste, K.Eshraghian, "Principles of CMOS VLSI Design", Second Edition, Addison Wesley 1993
2. R.Jacob Baker, Harry W.Li., David E.Boyee, "CMOS Circuit Design, Layout and Simulation", Prentice Hall of India 2005
3. A.Pucknell, Kamran Eshraghian, "BASIC VLSI Design", Third Edition, Prentice Hall of India, 2007.