09FY11 MATHEMATICS I

ASSESSMENT: THEORY

OBJECTIVE

The objective is to develop the basic Mathematical problem solving skills of Engineering students that are imperative for effective understanding of Engineering subjects. The topics introduced will serve as basic tools for specialized studies in many Engineering fields.

MATRIX AND HYPERBOLIC FUNCTIONS

Eigen values and eigenvectors–Cayley Hamilton theorem (without proof)–Application to find the inverse and higher powers of a matrix–Diagonalization–Quadratic forms–Orthogonal reduction to canonical form. Hyperbolic and inverse hyperbolic functions. **(9)**

DIFFERENTIAL CALCULUS

Curvature–Evolutes–Envelopes–Expansions and extreme values– Functions of two variables – Lagrange's multiplier method for Constrained extrema. **(9)**

INTEGRAL CALCULUS

Beta, Gamma integrals–properties and problems–Double and triple integrals-changing the order of integration-Jacobian of transformation–Application to areas and volumes. **(9)**

ORDINARY DIFFERENTIAL EQUATIONS

Second and higher order linear differential equations with constant coefficients- Euler Cauchy equation-Linear Simultaneous equations—Method of variation of parameters.–Method of reduction of order—Transformation of equation by changing the dependent and independent variables. **(9)**

SOLID GEOMETRY

Planes-Straight lines–coplanar lines–Skew lines. Spheres– orthogonal sphere-tangent plane to the sphere. **(9)**

Theory: 45
Tutorials: 15
Total: 60

TEXT BOOKS

1. Kandasamy. P. *et al*., "Engineering Mathematics for first year B.E/B.Tech",(Volume I & II), Eighth fully Revised Edition, S Chand & Co – New Delhi, 2008.

2. Veerarajan .T, "Engineering Mathematics" For first year, First Revised Edition, TataMc Graw– Hill Publishing Company Ltd., 2008.

3. Venkataraman.M.K., "Engineering Mathematics", First year, The National Publishing Company – 2008.

REFERENCE BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Eighth Edition, John Wiley & Sons (Asia) Pvt Ltd, 2008.

2. Grewal, B.S., "Higher Engineering Mathematics", Fourth Edition, Khanna Publishers – 2007.

09FY25 (S – 9) ELECTRIC CIRCUITS

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the fundamental concepts of analysis of AC and DC circuits that involves the application of different laws and network theorems.

Learning Objectives include the following:

1. *Application of Ohm's law and Kirchhoff's laws in the analysis of electric circuits.*
2. *Analysis of single-phase RLC circuits.*
3. *Analysis of magnetically coupled circuits.*
4. *Fundamental concepts of three-phase circuits.*

BASIC CIRCUIT CONCEPTS AND DC CIRCUITS

Concept of linearity and bilateral property-passive and active elements-independent and dependent sources-Ohm's law-Kirchhoff's laws-analysis of DC series and parallel circuits-network reduction-source transformation-star/delta transformation-mesh current and node voltage methods of analysis of simple DC circuits. **(9)**

SINUSOIDAL STEADY STATE ANALYSIS

Sinusoidal voltage and current-peak, average and rms values-peak (crest) and form factors for sinusoidal and nonsinusoidal periodic waveforms-R, L and C elements and their voltage-current relationships-phasor diagrams-concept of phasor and complex impedance and admittance-analysis of simple, single phase ac series and parallel circuits-apparent power, active power, reactive power and power factor-concept of complex power-impedance and power triangle.

Resonance in series and parallel circuits-Q factor-half power frequencies and bandwidth of resonant circuits. **(10)**

NETWORK THEOREMS

Superposition theorem-Thevenin's theorem-Norton's theorem-Maximum power transfer theorem-Reciprocitytheorem-applicationto AC and DC circuits. **(9)**

COUPLED CIRCUITS

Self and mutual inductance-coefficient of coupling-dot convention-analysis of simple coupled circuits-ideal transformer-conductively coupled circuits-analysis of single tuned circuits involving mutual inductance. **(9)**

THREE PHASE CIRCUITS

Three phase star and delta connections-phase sequence-line and phase quantities-analysis of three phase circuits with star and delta connected balanced loads-phasor diagram representation-two wattmeter method of power measurement-reactive power measurement. **(8)**

Total: 45

TEXT BOOKS

1. Joseph A. Edminister and Mahmood Nahvi, “Electric Circuits”, Schaum’s Series, Tata McGraw-Hill, Edition 2004, New Delhi.

2. Sudhakar A. and Shyammohan S.P., “Circuits and Networks: Analysis and Synthesis”, Tata McGraw-Hill, Edition 2004, New Delhi.

REFERENCE BOOKS

1. Paranjothi S.R., “Electric Circuit Analysis”, New Age International (P) Ltd, Edition, New Delhi 2000.

2. William H.Hayt Jr, Jack E. Kemmerly, and Steven M.Durbin, “Engineering Circuit Analysis”, Tata McGraw-Hill, New Delhi, 2002.

3. Gupta B.R, “Fundamentals of Electric Circuits”, S.Chand & Company (Pvt) Ltd, New Delhi, 2002.

09EE33 DC MACHINES AND TRANSFORMERS

ASSESSMENT: THEORY

OBJECTIVE

To understand the fundamentals of energy conversion, generation of D.C. voltage and to study the construction, working principle, characteristics and testing of D.C. machines and transformers.

EXPECTED OUTCOME

The students will understand energy conversion principles, study the characteristics and applications of D.C. machines and transformers.

ELECTRIC MACHINERY FUNDAMENTALS

Field energy and mechanical force – Forces and torque – Energy conversion via electric field – principles of electromechanical energy conversion – single and multiple excited systems – armature winding –types. **(6)**

D.C. MACHINES

DC Machines – construction – DC Generators – principle of operation-EMF equation- types - magnetization characteristics – process of voltage build up – no load and load characteristics –armature reaction-commutation- parallel operation – applications. DC Motors- principle of operation – Back EMF and torque equations – Types of DC Motors – Circuit model – electrical and mechanical characteristics-. Brushless dc motor-applications. **(12)**

SPEED CONTROL AND TESTING OF D.C. MACHINES

Starting methods – Speed control methods -.starters –braking- Testing of DC motors – losses and efficiency – direct, indirect and semi-direct testing – separation of losses by single motor and auxiliary motor methods. **(8)**

TRANSFORMERS

Transformers – types and general features of construction of single phase and three phase transformers – principle of operation – EMF equation – transformation ratio – phasor diagram – equivalent

circuit – open circuit and short circuit tests – Sumpner's test - regulation – efficiency – All day efficiency. **(10)**

THREE PHASE TRANSFORMERS

Polarity test – parallel operation of single phase and three phase transformers – OFF load and ON load tap changing – three phase connections – Scott connection – inrush current - harmonics in transformers – cooling – autotransformer – instrument transformers. **(9)**

Total: 45

TEXT BOOK

1. Nagrath I.J., and Kothari D.P., "Electrical Machines", Tata McGraw Hill, 2004.

REFERENCE BOOKS

1. Clayton A.E., and Hancock N.N., "Performance and Design of D.C. Machines" Pitman and Sons, 1963.

2. Say M.G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors, New Delhi, 1983.

3. Langsdorf A.S, "Theory of DC Machinery", McGraw Hill Publishers, New Delhi, 2000.

4. Mukherjee P.K.S. and Chakraborthi S., "Electrical Machines", Dhanpat Rai and Sons, New Delhi, 1990.

5. R.K.Rajput, "Electrical Machines", Laxmi Publications (P) Ltd, New Delhi, 2003.

6. Vincent Del Toro, "Electrical Machines and Power Systems", Prentice Hall of India, 1988.

09EE34 SOLID STATE DEVICES

ASSESSMENT: THEORY

OBJECTIVE

To enable the students to understand the basics of semiconductor materials and the knowledge about working and applications of transistors.

EXPECTED OUTCOME

The students will be exposed to the major applications of diode, BJT, FET and related analysis.

SEMICONDUCTOR MATERIALS

Energy band theory of crystals-insulators, semiconductors and conductors- intrinsic semiconductors - extrinsic semiconductors - mobility and conductivity - Hall Effect and its application- drift and diffusion currents - potential within a graded semiconductor. **(9)**

SEMICONDUCTOR DIODES

PN Junction-biasing- PN junction diode- diode equation–VI Characteristics-temperature effects-junction breakdown-transition and diffusion capacitance-diode switching times-piecewise linear model-small signal equivalent circuit-Zener diode-Schottky barrier diode-Solar cell-Photo diode-LED. **(9)**

BIPOLAR JUNCTION TRANSISTORS

Transistor operation-current components-CC,CE,CB configuration–transistor characteristics-leakage currents and breakdown voltages–types of biasing–bias stability–bias compensation techniques-DC,AC load lines and operating point-transistor as a switch–transistor switching characteristics-BJT active load circuit-Uni Junction Transistor and its applications. **(9)**

FIELD EFFECT TRANSISTORS

JFET, MOSFET: construction and operation –VI characteristics –types of biasing-load lines–FET as a voltage variable resistor-basic MOSFET application-MOSFET active load circuit. **(9)**

BJT AND FET AMPLIFIERS

Basic BJT amplifiers - small signal low frequency parameters and equivalent circuit – T model – hybrid model- small signal analysis of amplifiers - multistage amplifiers-amplifier frequency response - frequency response of BJT.

JFET, MOSFET: Basic amplifiers- small signal model-small signal analysis of amplifiers – multistage amplifiers-frequency response of FET. **(9)**

Theory : 45
Tutorial : 15
Total : 60

TEXTBOOK

1. Millman J. and Halkias C.C., “Electronic Devices and Circuits”, Tata McGraw-Hill, New Delhi, 1992.

REFERENCE BOOKS

1. Donald.A Neaman, “Electronic Circuits Analysis and Design”, Tata McGraw-Hill, New Delhi, Third Edition , 2007.

2. Boylestead R.L., and Louis Nashelsky, “Electronic Devices and Circuits”, Pearson/Prentice Hall, Ninth Edition,2006.

3. Allen Mottershead, “Electronic Devices and Circuits: An Introduction”, Prentice-Hall of India, New Delhi, 2000.

4. Salivahanan, “Electronic Devices and Circuits”, Tata McGraw-Hill, New Delhi, Reprint 2006.

09EE36 LINEAR INTEGRATED CIRCUITS

ASSESSMENT: THEORY

OBJECTIVE

To make the students understand the basic principle of operational amplifiers, its applications and design.

EXPECTED OUTCOME

This course will pave the way to design amplifiers, comparators, converters and different types of filters using IC 741, power supply using IC 723, any application circuits with IC 555 Timer and PLL.

INTEGRATED CIRCUIT TECHNOLOGY

Silicon semiconductor technology –wafer processing, oxidation, epitaxy, deposition, ion implantation and diffusion and silicon gate process – basic CMOS processing technology – n-well , p– well process, twin – tub process and silicon on insulator - circuit elements – resistors, capacitors and thin film transistors. **(9)**

INTRODUCTION TO OPERATIONAL AMPLIFIER

Functional block diagram – characteristics of an ideal op-amp – analysis of typical op-amp – equivalent circuit – open loop gain – CMRR – input bias and off set currents – input and output off set voltages – off set compensation techniques – frequency response characteristics – noise –stability – limitation - frequency compensation – slew rate. **(9)**

LINEAR APPLICATIONS OF OP- AMP

DC- AC Amplifiers – voltage follower – summing, scaling and averaging amplifier – inverting and non inverting amplifier – differential amplifier – instrumentation amplifier – voltage to current and current to voltage converters – integrator and differentiator – practical considerations – active filters – design of low pass, high pass, band pass and band stop Butterworth filters - narrow band pass and notch filters – oscillators. **(9)**

COMPARATORS AND CONVERTERS

Comparator- zero crossing detector – regenerative comparator – sample and hold circuit – voltage to frequency and frequency to Voltage converters – precision rectifiers – peak detectors – clipper and clamper – logarithmic and exponential amplifier – multiplier and divider – wave form generators. **(9)**

OTHER LINEAR ICs AND APPLICATIONS

Voltage regulators – IC 723 – current limiting and current boosting – fixed and adjustable three terminal regulators – SMPS - PLL and applications – IC 555 timer and applications – voltage controlled oscillators -IC 566-D/A converters – A/D converters – ADC / DAC specifications. **(9)**

Total: 45

TEXT BOOK

1. Ramakant A.Gayakward, “Op-Amps and Linear Integrated Circuits”, IV Edition, Prentice Hall of India, New Delhi, 2003.

REFERENCE BOOKS

1. Roy Choudhury D. and Shail Jain., “Linear Integrated Circuits”, III Edition, New Age 2007.

2. Sergio Franco, “Design with Operational Amplifiers and Analog and Integrated Circuits”, Second Edition Tata McGraw Hill Publishing Co., New Delhi, 1997.

3. Michael Jacob J.,“Analog Integrated Circuits and Applications”, First Edition, Prentice Hall of India, New Delhi, 2000.

4. Coughlin F.R. and Driscoll F.F., “Operational Amplifiers and Linear Integrated Circuits”, IV Edition, Prentice Hall of India, New Delhi, 1997.

5. Sidney Soclof,” Application of Analog Integrated Circuits”, Prentice Hall of India, 1990.

09FY21 MATHEMATICS – II

(Common to first semester B.E., /B.Tech. all branches)

ASSESSEMNT: THEORY

OBJECTIVE

The objective is to develop the basic Mathematical problem solving skills in the areas of Theory of Equations, Difference Calculus, Vector Calculus, Fourier Series and Laplace Transforms for Engineering students that are imperative for effective understanding of Engineering subjects. The topics introduced will serve as basic tools for specialized studies in many Engineering fields.

EXPECTED OUTCOME

At the end of this course the students will be familiar in applying the ideas of theory of equations Difference calculus, vector calculus, Laplace Transform and Fourier series for solving for Engineering problems.

THEORY OF EQUATIONS

Relation between the roots and the coefficients-Symmetric functions of the roots -Transformation of equations-Reciprocal equations-Solution of algebraic and transcendental equations by Newton-Raphson method-polynomial equations by Graeffe's root squaring method. **(9)**

DIFFERENCE CALCULUS

Finite differences-operators and their interrelations-Interpolations-Newton's and Lagrange's method, Numerical differentiation based on Newton's formula, Numerical integration-Trapezoidal and Simpson's 1/3 rule–Solutions of finite difference equations with constant coefficients. **(9)**

VECTOR CALCULUS

Vector differentiation-gradient-divergence-curl-physical interpretation and identities. Vector integration–line–surface and volume integrals. Gauss, Stoke's and Green's theorems (without proof)-applications. **(9)**

LAPLACE TRANSFORMS

Transform of standard functions-Transform of unit step, dirac delta, error and periodic functions-Initial and final value theorems-Inverse transforms and their properties-Convolution theorem-Applications to ordinary differential equations and integral equations. **(9)**

FOURIER SERIES

Dirichlet's conditions-Full range series-Half range series-Complex form of series-Parseval's identity –Harmonica analysis. **(9)**

Theory : 45
Tutorial : 15
Total: 60

TEXT BOOKS

1. Kandasamy. P. *et al*., "Engineering Mathematics for first year B.E/ B.Tech", (Volume I & II) (Eight fully Revised Edition) S.Chand & Co – (2008).

2. Kandasamy . P., *et al*., "Numerical methods. ", S.Chand & Co - (2008).

3. Veerarajan .T, "Engineering Mathematics" (III Semester) (Third Edition) Tata.McGraw – Hill Publishing Company Ltd– (2008).

REFERENCES

1. Erwin Kreyszig, "Advanced Engineering Mathematics",(Eight Edition) John Wiley & Sons Pvt Ltd., - (2007).

2. Grewal B.S., "Higher Engineering Mathematics", (Forith Edition), Khanna Publishers – (2007).

09EE32 ELECTROMAGNETIC FIELDS

ASSESSMENT: THEORY

OBJECTIVE

To impart knowledge and understanding the basic concepts of static electric and magnetic fields.

EXPECTED OUTCOME

Upon completion of this course, students will be able to apply the laws of electrostatics and electromagnetics in the study of electrical machine theory and power line parameter calculations, understand the relation between the fields under time varying situations and acquire knowledge about the propagation of uniform plane waves in different medias.

ELECTROSTATICS

Types of charge distributions – Coulomb's law – electric field intensity of point, line and sheet of charges – electric flux density – Gauss's law and its applications – divergence theorem – Poisson's and Laplace equations – electric potentials – potential gradient. **(9)**

CONDUCTORS AND DIELECTRICS

Conductor properties - Current and current density – continuity of current – nature of dielectric material – electric dipole – Potential and field due to an electric dipole - polarization – boundary conditions for perfect dielectric materials - capacitance – determination of capacitance for different configurations – electrostatic energy storage and energy density. **(10)**

MAGNETOSTATICS

Biot Savart's law and its applications– Ampere's circuital law and its applications – Stoke's theorem – magnetic flux and flux density – scalar and vector magnetic potential. **(8)**

MAGNETIC FORCE AND INDUCTANCE

Force on moving charge –force between different current elements –force and torque on a closed circuit – magnetization - magnetic boundary conditions – Inductance – Inductance of Solenoids, Toroids, Transmission lines & Cables- Mutual Inductance – Magneto-static energy storage and energy density – Lifting force of a magnet.**(9)**

TIME VARYING FIELDS AND ELECTROMAGNETIC WAVES

Faraday's law –Stationary and motional emfs - conduction and displacement current densities – Maxwell's equation in differential and integral forms.

Electromagnetic wave equations - uniform plane waves – wave motion in free space and in conducting medium – propagation of plane waves in lossy and in perfect dielectrics– Poynting vector and Poynting's theorem. **(9)**

Theory: 45

Tutorial: 15

Total: 60

TEXT BOOK

1. Hayt W.H., and John A. Buck, "Engineering Electromagnetics", Tata McGraw Hill, New Delhi, 2006.

REFERENCE BOOKS

1. John D.Kraus and Daniel A. Fleisch, "Electromagnetics with Applications" V Edition, Tata McGraw Hill, 1999.

2. Ashutosh Pramanik, "Electromagnetism – Theory and Applications", Prentice Hall of India, New Delhi,2003.

3. Gangadhar K.A., "Field Theory", Khanna Publishers, Delhi, 2004.

4. Joseph A.Edminister, "Theory and Problems of Electromagnetics", Schaum's Outline Series, Tata McGraw Hill Inc., 2004.

5. Rao N.N., "Elements of Engineering Electromagnetics", Prentice Hall of India, New Delhi, 2003.

6.Matthew N.O.Sadiku, "Elements of electromagnetics", Oxford university Press, Chennai, 2007.

09EE43 ELECTRONIC CIRCUITS

ASSESSMENT: THEORY

OBJECTIVE

To enable the students to understand the operation of DC power supplies, power amplifiers, feedback amplifiers, oscillators, wave shaping circuits and multivibrators.

EXPECTED OUTCOME

The students will understand the working of DC power supplies, power amplifiers, feedback amplifiers, oscillators, wave shaping circuits and multivibrators and their analysis and design.

DC POWER SUPPLIES

Single phase rectifiers Half-Wave, full-wave and bridge rectifiers –ripple factor – rectification efficiency – TUF – PIV – regulation –Filters inductor, capacitor, L-section and filters – ripple factor – Regulators series and shunt type – protection circuits –three-phase rectifiers – ripple factor and DC output voltage. **(9)**

POWER AMPLIFIERS

Amplifier types – class-A power amplifiers – direct coupled and transformer coupled configuration – power dissipation – efficiency -push-pull configuration – class-B push-pull power amplifier – efficiency – power dissipation – power output - class AB power amplifier –complementary symmetry operation –class C amplifiers single tuned and double tuned amplifiers – amplifier distortion – determination of distortion – power transistors power BJTs, power MOSFETs. **(9)**

FEEDBACK AMPLIFIERS AND OSCILLATORS

Feedback concepts – ideal feedback topologies – Advantages and disadvantages of negative feedback – analysis of voltage and current feedback amplifier circuits – stability of the feedback circuit – Oscillators Barkhausen criterion – RC phase shift, Wien bridge, Hartley and Colpit's Oscillators – Frequency Stability-crystal Oscillator. **(9)**

WAVE SHAPING CIRCUITS

Linear wave shaping – high-pass RC circuit – low pass RC circuit – response to sinusoidal , step , pulse , square wave and ramp inputs –differentiator and integrator – pulse transformers – equivalent circuit – rise-time response – applications –clipping and clamping circuits – comparators. **(9)**

MULTIVIBRATORS AND TIME-BASE GENERATORS

Astable and monostable multivibrators – collector coupled configuration – fixed biased bistable multivibrator – general features of a time base signal – methods of generating a time base signal - exponential sweep circuit- transistor constant current sweep –Miller and Bootstrap voltage time-base generators – current time-base generator – triggered transistor blocking oscillator (base timing). **(9)**

Total: 45

TEXT BOOK

1. Jacob Millman, Christos C Halkias, Satyabrata Jit, “Electronic Devices and Circuits”, Tata McGraw-Hill, Second Edition, 2007.

REFERENCE BOOKS

1. Jacob Millman and Herbert Taub, “Pulse, Digital and switching Waveforms”, Tata McGraw-Hill, New Delhi,2000.

2. Millman J. and C.C.Halkias, “Integrated Electronics: Analog and Digital Circuits and Systems”, McGraw-Hill, New Delhi, 1992.

3. Robert L. Boylstead and Louis Nashelsky, “Electronic Devices and Circuit Theory”, Prentice-Hall of India, New Delhi, 1997.

4. Salivahanan, “Electron Devices and Electronic Circuits”, Tata McGraw-Hill, New Delhi, 2004.

5. Allen Mottershed, “Electronic Devices and Circuits An Introduction”, Prentice-Hall of India, New Delhi, 2001.

09EE44 MEASUREMENTS AND INSTRUMENTATION

ASSESSMENT: THEORY

OBJECTIVE

The students can acquire knowledge about the usage of measuring instruments, measurement of non electrical quantities, types of transducers and recorders.

EXPECTED OUTCOME

The learners can handle the measuring equipments, instrument transformers, sophisticated instruments like digital storage oscilloscope, harmonic analyzer and spectrum analyzer in the laboratory. The students will be able to select a transducer for any specific application.

MEASUREMENTS OF ELECTRICAL QUANTITIES

Measurement of Voltage and Current – PMMC Instruments – Moving Iron Instruments – Dynamometer Type Wattmeter – Use of Instrument Transformers – Induction Type Energy Meter – Errors in Energy Meter – Testing of Energy Meter by Phantom Loading. Measurement of R, L and C – Wheatstone, Kelvin, Maxwell, Anderson and Schering Bridges. **(10)**

GALVONAMETER, MAGNETIC MEASUREMENTS AND SPECIAL INSTRUMENTS

Flux Meter – Determination of BH Curve and Hysteresis Loop of Ring and Bar Specimens (Double Bar Method Only) – Iron Loss Measurement by Magnetic Squares Maximum Demand Indicator – Electrodynamometer Power Factor Meter – Weston Frequency Meter – synchro scope – Megger. **(9)**

ELECTRONIC MEASURING INSTRUMENTS

Analog CRO, Digital Storage Oscilloscope – Bistable Storage Oscilloscopes-Fast Storage Oscilloscopes –Multichannel Storage Oscilloscope.Signal Generator – Function Generator – DVM – Digital Multi-Meter – Digital Frequency Meter – Spectrum Analyzer – Distortion Factor Meter – Q Meter – Harmonic Analyzer. **(10)**

TRANSDUCERS, SIGNAL CONDITIONING and RECORDERS

Functional Elements of an Instrumentation System –– Active and Passive Transducers – Resistive Potentiometer – Strain Gauges – LVDT – Digital Displacement Transducer – Thermistor – Electromagnetic Flow Meter –Capacitive Transducers – Piezoelectric Transducer – Hall Effect Transducer.Measurement of Non Electrical Quantities-Linear Displacement-Rotary Displacement-Torque-Linear Velocity-Angular Velocity-Vibration. **(10)**

DATA ACQUISITION, TELEMETRY and DISPLAY DEVICES

Block Diagram of Data Acquisition System-Methods of Telemetry – Land Line Telemetry – RF Telemetry – Multiplexing – Time Division Multiplexing – Frequency Division Multiplexing, Recorders – Galvanometer Type Recorders – Potentiometer Recorders – X-Y Recorder – Magnetic Tape Recorder – Digital Plotters and Printers – LED, LCD, Dot Matrix Displays. **(6)**

Total: 45

TEXT BOOK

1. Sawhney A.K., “A Course in Electrical and Electronic Measurements”, Dhanpat Rai and Sons, New Delhi, 2004.

REFERENCE BOOKS

1. Ernest O.Doeblin, “Measurement Systems – Applications and Design”, McGraw Hill, 2001.

2. Kalsi H.S., “Electronic Instrumentation”, Tata McGraw Hill Co., 2002.

3. Cooper A.D., and Helfrik A.D., “Modern Electronic Instrumentation and Measurement Techniques”, Prentice Hall of India, New Delhi, 2001.

4. Ramabhadran S., “Electrical Measurements and Instruments”, Khanna Publishers, New Delhi, 1993.

5. Moorthy, D.V.S., “Transducers and Instrumentation”, Prentice Hall of India Pvt. Ltd., 1995.

6.Singh S.K.,”Industrial Instrumentation and Control”, Tata McGraw Hill Publishers, New Delhi, 2003, II Edition.

09EE45 DIGITAL INTEGRATED CIRCUITS

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the fundamental concepts of digital electronic circuits and make them learn the design procedure of digital system using integrated circuits.

EXPECTED OUTCOME

The learner will be able to design any combinational circuit using logic gates, multiplexers and decoders, synthesize and analyze synchronous and asynchronous sequential circuits and test the digital circuits for fault diagnosis.

NUMBER SYSTEM & DIGITAL LOGIC FAMILIES

Number systems - conversion methods-number representations - computer codes - BCD, Gray code - error detection and correction codes - parity codes- hamming codes- Boolean algebra – basic postulates, theorems.

Digital IC characteristics, Logic Families – TTL, ECL, MOS and CMOS families – comparison of performances – speed, fan-in, fan-out, propagation delay, power dissipation and noise margin. **(9)**

COMBINATIONAL LOGIC CIRCUITS

Switching functions – canonical forms – sum of products and product of sums – simplification – Quine McCluskey algorithm – designing combinational logic circuits using logic gates – adders – subtractors - BCD adders and subtractors – decoders – encoders – multiplexers – demultiplexers – parity generators and checkers – design of combinational circuits using multiplexers and decoders. **(9)**

SEQUENTIAL LOGIC CIRCUITS Flip Flops – ripple counters – synchronous counters – shift registers - ring counters – Johnson's counter - frequency counter – Digital clock. Mealy and Moore Machines – state table – state diagram - state reduction – state assignment –fundamental mode – pulse mode – mixed operating mode – synthesis and analysis of synchronous sequential circuits – asynchronous sequential circuits . **(9)**

MEMORY DEVICES AND PLDs

Memory parameters – general memory operation - ROM – architecture – timing – PROM - EPROM - EEPROM - Flash memories – RAM – SRAM – DRAM – architecture – read and write cycles – refreshing – magnetic disc data storage and optical disc storage - Programmable logic devices - PLA - PAL – GAL – FPGA - CPLD - programming PLDs – simple design exercises. **(9)**

DIGITAL SYSTEM TESTING

Combinational logic hazards – fault detection and redundancy – testing for single stuck faults – bridging faults – functional testing – design for testability – built in self test – automatic test pattern generation – IDDQ test. **(9)**

Theory: 45
Tutorial : 15
Total : 60

TEXT BOOK

1. Morris Mano, “Digital Design”, III Edition, Prentice Hall of India Ltd., 2002.

REFERENCE BOOKS

1. Ronald J.Tocci, “Digital Systems – Principles and Applications”, Sixth Edition, Prentice Hall of India Ltd., 1999.

2. John M.Yarbrough,”Digital Logic Applications and Design”, PWS, 2001.

3. Miron Abramovici, Melvin A. Brever and Arthur D. Friedman, “Digital Systems Testing and Testable Design”, Jaico Publication House, 2000.

4. Palmer J.E., “Introduction to Digital Systems”, Schaum’s Outline Series,Tata McGraw Hill, New Delhi, 1996.

5. Richard F.Tinder, “Engineering Digital Systems Design”, Harcourt India Pvt. Ltd., New Delhi, 2001.

6.John P.Uyemura, “A First Course in Digital Systems Design – An Integrated Approach”, Brooks / Cole Publishing Company, 1999.

09CE31 MATHEMATICS III

ASSESSMENT: THEORY

OBJECTIVE

The objective is to incorporate the ideas of complex variables, partial differential equations and its applications and Fourier transforms that are imperative for effective understanding of Engineering subjects. The topics introduced will serve as basic tools for specialized studies in many engineering fields.

EXPECTED OUTCOME

The students will be familiar in applying complex variable ideas to solve electrical problems, partial differential equation ideas in modeling and solving electrical problems and Fourier transform ideas to analyze and solve communication oriented problem.

COMPLEX DIFFERENTIATION

Analytic functions–Definitions and properties–Cauchy Riemann equations in cartesian and polar coordinates-construction of analytic functions– Conformal mappings–Bilinear Transformation -the mappings of the form w= z+a, az, 1/z, z^2, e^z, sinz, cosz, -Simple problems. **(9)**

COMPLEX INTEGRATION

Cauchy's integral theorem-Integral formula-Taylor's and Laurent's series (without proof)-Types of singularities, Poles and residues-Cauchy's residue theorem-Applications-Contour integration using circular and semicircular contours. **(9)**

PARTIAL DIFFERENTIAL EQUATIONS

Formation by elimination of arbitrary constants and functions-solution by direct method-solution of first order non-linear PDE-standard types- Lagrange's linear equation-Linear higher order homogeneous PDE with constant coefficients. **(9)**

FOURIER TRANSFORMS

Fourier integral theorem (without proof)-Infinite Fourier transform-infinite Fourier sine and cosine transforms-properties and problems-Convolution theorem-Parseval's identity-Finite Fourier sine and cosine Transforms- properties and problems. **(9)**

BOUNDARY VALUE PROBLEMS

Vibration of strings-one dimensional wave equations, one dimensional heat flow- unsteady state and steady state -Two dimensional heat flow steady state in Cartesian coordinates-Separation of variables-Fourier series solution. **(9)**

Theory: 45
Tutorial: 15
Total: 60

TEXT BOOKS

1. Kandasamy P., "Engineering Mathematics", Volume – II & III S.Chand &Co., 2004.

2. Veerarajan T., "Engineering Mathematics", Third Edition, Fifth Reprint, Tata Mc Graw – Hill Publishing Company Ltd, 2008.

3. Venkataraman M.K., "Engineering Mathematics III", Revised and Enlarged Fourteenth Edition, The National Publishing Company, 2008.

4. Venkataraman M.K., "Engineering Mathematics III-A", (Eleventh Edition), The National Publishing Company , 2008.

REFERENCE BOOKS

1. Erwin Kreyszig, "Advanced Engineering Mathematics", (Eighth Edition) John Wiley & Sons (Asia) Private Limited., - 2008.

2. Grewal, B.S., "Higher Engineering Mathematics", (Fortith Edition) Khanna Publishers, 2007.

09EE35 NETWORK ANALYSIS AND SYNTHESIS

ASSESSMENT – THEORY

OBJECTIVE

To introduce to the students the basics of network topology and circuit transients, to make the students learn about analysis and synthesis of one port and two port networks and to study the filters and attenuators.

EXPECTED OUTCOME

At the end of the semester a learner will be able to analyze any complex network using basic circuit concepts, evaluate the transient and steady-state behavior of electric circuits and synthesize an electrical network.

NETWORK TOPOLOGY

Basic definitions of a network graph - oriented graph – sub graph - planar graph - path and circuit - tree and its properties - cut sets - incidence matrix - circuit matrix - cut set matrix - fundamental circuit or tie set matrix - fundamental cut - set matrix.

Network analysis using graph theory: Formation of network equations - network equilibrium equations on the basis of loop analysis - network equilibrium equations on the basis of node analysis - application to dc networks. **(9)**

CIRCUIT TRANSIENTS

Transient concepts - differential equations and initial conditions in RLC networks - transient response of simple RL, RC, and RLC series and parallel circuits to step and sinusoidal inputs using Laplace transform method - natural frequency and damping factor - response of circuits to non - sinusoidal periodic inputs and pulses. **(9)**

NETWORK FUNCTIONS AND TWO PORT NETWORKS

Concept of complex frequency - network functions - driving point and transfer functions and their properties - poles and zeros and their significance - time domain behavior from pole - zero plot - two port

networks - Z, Y, ABCD, and h parameters - condition for reciprocity and symmetry - parameter conversion - interconnection of two port networks – analysis of typical two port networks - input and output impedances of terminated two port networks - image impedances. **(9)**

FREQUENCY DOMAIN ANALYSIS AND SYNTHESIS OF NETWORKS

Frequency domain network function - magnitude and phase plots - immittance loci of RLC networks - standard form of open loop transfer function - Bode plots of standard factors of open loop transfer function - Bode plots of simple functions - Hurwitz polynomials - positive real functions - frequency response of reactive one ports - synthesis of reactive one ports - synthesis of RL and RC one - port networks. **(9)**

FILTERS AND ATTENUATORS

Introduction - propagation constant - decibel and neper - classification of filters - filter networks - equations of filter networks - low pass, high pass, band pass, and band elimination filters - limitations of constant k filters - m - derived filters - composite filter. Attenuators: T type, ð type, lattice, bridged T, and L type attenuators. **(9)**

Theory : 45
Tutorial : 15
Total : 60

TEXT BOOK

1. Roy. D.Choudhury, “Networks and Systems”, New Age Publications (Academic), New Delhi, 2005.

REFERENCE BOOKS

1. Sudhakar, A. Shyammohan S Palli, “Circuits and Networks: Analysis and Synthesis”, Tata McGraw Hill Publishing Co. Ltd., 2008.

2. Gupta, B.R., “Fundamentals of Electric Circuits”, S.Chand & Company (Pvt) Ltd, New Delhi, 1998.

3. Jagan N.C., and Lakshminarayana C., “Network Theory”, BS Publications, Hyderabad, 2001.

09EE51 SYNCHRONOUS MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To study the construction and principle of operation of alternators and synchronous motors, learn the methods of regulation and the parallel operation of alternators and to introduce the concepts of generalized machine theory.

EXPECTED OUTCOME

The students will have an in-depth knowledge of construction and operation of alternators and synchronous motors. They will be able to obtain the regulation of alternators and performance characteristics of synchronous motors and apply the concepts of generalized machine theory to rotating electrical machines modeling.

CONSTRUCTION AND WORKING OF ALTERNATORS

Types and general constructional features - principle of operation – methods of excitation – induced EMF - armature reaction - Concept of synchronous reactance - Phasor diagrams. **(9)**

VOLTAGE REGULATION

Regulation by direct load test - Predetermination of regulation by EMF, MMF, Potier and ASA methods.

Two reaction theory of salient pole machines - Determination of direct and quadrature axis reactances by slip test. **(9)**

PARALLEL OPERATION OF ALTERNATORS

Need for synchronizing – synchronizing methods - synchronizing power - synchronizing torque – maximum power output - motoring and generating conditions - synchronous machines on infinite bus bars - parallel operation of two alternators - effect of unequal voltages - distribution of load - effect of change in excitation - effect of change in steam supply - Power - angle characteristics. **(9)**

SYNCHRONOUS MOTORS

Synchronous motors - principle of operation - starting methods of synchronous motor –Equations for power input and power developed-maximum value of power input and power developed-V curves and inverted V curves and their determination - O curves - hunting - natural frequency of oscillations - damper windings - synchronous condenser - Permanent magnet synchronous motor – reluctance motor – Hysteresis motor. **(9)**

GENERALISED MACHINE THEORY

Generalized machine theory – diagrammatic representation of generalized machine – formation of EMF equation – expression of power and torque – representation and general equations of DC machine, synchronous machine and induction machine. **(9)**

Total: 45

TEXT BOOKS

1. Nagarath I.J., and Kothari D.P., “Electrical Machines”, II Edition, Tata McGraw Hill, New Delhi, 2004.

2. Say M.G., “The Performance and Design of Alternating Current Machines”, CBS Publishers and Distributors, New Delhi, 1993.

REFERENCE BOOKS

1. Vincent Del Toro, “Electrical Machines and Power Systems”, Prentice Hall of India, 1988.

2. Sen S.K., “Rotating Electrical Machinery”, Khanna Publishers, New Delhi, 1984.

3. Mukherjee P.K.G. and Chakraborthi S., “Electrical Machines”, DhanpatRai and Sons, New Delhi, 1990.

4. Paul. C. Krause, “Analysis of Electric machinery”, McGraw Hill Publishers, 1985.

5. Murugeshkumar K., “Induction and Synchronous Machines”, Vikas Publishing House Pvt. Ltd., 2003.

6.Bimbra P.S., “Generalized Theory of Electrical Machines”, Khanna Publishers, New Delhi, 2001.

09EE53 - CONTROL ENGINEERING

ASSESMENT: THEORY

OBJECTIVES

To introduce the basic concepts of physical systems, modeling and an in-depth analysis of system dynamics in time-domain and frequency domain using classical techniques and state-space models.

EXPECTED OUTCOME

The learner will be able to model all types of physical systems and to analyze their transient and steady state behavior, design controllers in both time domain and frequency domain to meet the required specifications and analyze the given system in state-space using different canonical forms.

FEED BACK SYSTEMS

Concept of control system – physical system – linear systems and their properties - transfer function - mathematical modeling of electrical and mechanical systems – analogous systems – open loop and closed loop systems –- effect of feedback on system sensitivity - block diagram representation – block diagram algebra – signal flow graphs and their properties – Mason's gain formula.

Control system components: potentiometer, tacho-generator, synchros, AC and DC servo motors – gear trains. **(9)**

TIME RESPONSE ANALYSIS

Standard test signals – time domain study of first order and second order feedback control systems – time domain specifications – steady state and dynamic errors – error coefficients – P, PI and PID controllers – Routh-Hurwitz criterion - Root locus. **(9)**

FREQUENCY RESPONSE ANALYSIS

Introduction - Bode plot – Polar plot – Nyquist criterion – Frequency response specifications - estimation for second order systems - correlation between time domain and frequency domain specifications - gain and phase margins. **(9)**

INTRODUCTION TO DESIGN

Concepts of stability – absolute stability and relative stability – gain adjustment - closed loop frequency response – introduction to M and N circles - Nichol's chart.

Design problem – network compensation using lead, lag and lead-lag networks – design using Bode plot. **(9)**

STATE SPACE ANALYSIS

State, state variables and state model – representation using physical, phase and canonical variables – diagonalization – transfer function from state model - state transition matrix – solution to state model - concepts of controllability and observability. **(9)**

Theory : 45
Tutorial : 15
Total : 60

TEXT BOOKS

1. Nagrath J. and Gopal M., "Control Systems Engineering", IV Edition, New Age International, New Delhi, 2006.

2. Katsuhiko Ogata, "Modern Control Engineering", V Edition, Prentice Hall of India Private Ltd., New Delhi, 2008.

REFERENCE BOOKS

1. Gopal M., "Control Systems – Principles and Design",Third Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

2. Benjamin C. Kuo, "Automatic Control Systems", Eighth Edition, Prentice Hall of India Private Limited, New Delhi, 2002

3. Norman S. Nise, "Control Systems Engineering", Fourth Edition, John Wiley and Sons (Asia) Pvt. Ltd, Singapore, 2004.

4. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Tenth Edition, Pearson Prentice Hall, NJ, 2008.

09EE54 - MICROPROCESSORS AND COMPUTER ARCHITECTURE

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the concepts of microprocessors, fundamentals of computer architecture, the parallel processing concepts and pentium processor architecture and make them learn the assembly language programming techniques.

EXPECTED OUTCOME

The students will be able to understand the microprocessor architecture and to program in assembly language.

INTEL 8086 MICROPROCESSOR

8086 Architecture – Internal operation – interrupts- Maximum and Minimum mode – System bus timing - addressing modes - instruction formats – instruction set - Assembly language programming – programming Examples. **(9)**

MICROPROCESSOR INTERFACING TECHNIQUES

Logic devices for interfacing: Tristate devices – Buffers – Decoders – Encoders – Latches- Memory interfacing concepts: Memory map and address decoding – Programmable peripheral interface 8255 – Programmable communication interface 8251 – DMA controller 8257 –Programmable Interrupt controller 8259. **(9)**

PENTIUM PROCESSOR

Pentium architecture – RISC concepts – Bus operation – Pentium superscalar architecture – pipelining – branch prediction – Instruction and data caches – floating point - protected mode operation. **(9)**

PROCESSOR DESIGN

Parallel processing – Parallel computer structures – architectural classification schemes- Instruction level parallel processing – Scalar to Superscalar processor organization - pipeline processors – Fundamentals of pipeline processing – pipelined processor design.

Control design: Program control – control memory – instruction sequencing – instruction interpretation – address sequencer – micro programmed control. **(10)**

MEMORY AND I/O SYSTEMS

Memory hierarchy – Latency and bandwidth – Main memory - virtual memory – demand paging – memory protection – page table architectures - cache memory – computer system buses – interaction of I/O devices and memory hierarchy. **(8)**

Total : 45

TEXT BOOKS

1. Yu-Cheng Liu and Glenn A.Gibson ,"Microcomputer Systems: The 8086/8088 Family architecture , Programming , and Design ", III Edition, Prentice Hall of India, 2000.

2. John Paul Shen, Mikko H.Lipasti, "Modern Processor Design – Fundamentals of Superscalar Processors", Tata McGraw Hill, 2005.

REFERENCE BOOKS

1. John P.Hayes, "Computer Architecture and Organization", III Edition, McGraw Hill, 1998.

2. M.Morris Mano, "Computer System Architecture", III Edition, Prentice Hall of India, 1996.

3. Hwang and Briggs, "Computer Architecture and Parallel Processing", McGraw Hill Book Company, 1995.

4. James L. Antonakos, "An Introduction to the Intel family of microprocessors", Pearson Education, Asia , III Edition, 2001.

09PE46 NUMERICAL METHODS AND C PROGRAMMING

ASSESSMENT: THEORY

OBJECTIVE

To train the students to find solutions for problems using numerical computations and to develop computer programs for complex engineering problems in C language.

EXPECTED OUTCOME

At the end of the course the learners will be able to determine solutions of systems represented by complex mathematical models using numerical methods and develop application software for any kind of engineering problems using the programming language C.

NUMERICAL METHODS

Solution of linear simultaneous equations: Gauss elimination method – Gauss-Jordan method – Crout's method – Gauss-Siedal method. Newton-Raphson method.

Solution of Differential equations: Taylor series method – Picard's method – modified Euler's method – fourth-order Range-Kutta method – Milne's predictor-corrector method – solution to partial differential equations. **(9)**

C FUNDAMENTALS

Structure of C program – character set – identifiers – data types – constants – variables and variable declaration – arithmetic, relational, logical and bitwise operators – operator hierarchy – expressions – statements and blocks – basic input-output functions – header files and C preprocessor. **(9)**

CONTROL STRUCTURES AND FUNCTIONS

Conditional and looping structures – break and continue statements – functions – storage classes – recursion. **(9)**

ARRAYS AND POINTERS

Defining single and multi-dimensional arrays – processing arrays – passing arrays to functions – pointer declaration – pointers and

addresses – pointers and functions – pointers and arrays – character arrays - basic string operations. **(9)**

STRUCTURES

Structure definition – member access – unions – *typedef* and *enum* – structures and pointers – structures and functions – self referentialstructures. **(9)**

Theory : 45

Tutorial : 15

Total : 60

TEXT BOOKS

1. Kandasamy,P., Thilagavathi,K., Gunavathy K., “Numerical Methods”, Volume IV, S. Chand and Company Ltd., New Delhi, 2001.

2. Byron S. Gottfried, “Programming with C”, Schaum’s Outline Series, McGraw Hill Publications, New Delhi, 2008.

REFERENCE BOOKS

1. Venkatraman M. K., “Engineering Mathematics”, National Publishing Co., 1998.

2. Grewal B. S., “Higher Engineering Mathematics”, Khanna Publishers,New Delhi, 2002.

3. Brain W. Kernighan and Dennis M. Ritchie, “The C Programming Language”, Second Edition, Prentice Hall Software Series, 1988.

09EE52 INDUCTION MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To make the students understand the principle, performance characteristics and various methods of speed control of three phase induction motor, single phase induction motor and special machines.

EXPECTED OUTCOME

The learners will be able to select suitable motor for any specific application and practical implementation of speed control methods for various motors can be realized.

THEORY OF THREE PHASE INDUCTION MACHINES

Three phase induction motor: Principle of operation – rotating magnetic field – construction - squirrel cage and slip ring motors – phasor diagram – slip, emf, current, power, torque, torque-slip curves. Power stages - losses and efficiency. Induction Generators: Principle of operation – self and external excitation. **(9)**

TESTING AND PERFORMANCE PREDICTION

Equivalent circuit - determination of equivalent circuit parameters – calculation of performance by equivalent circuit, circle diagram– harmonics – cogging, crawling and noise production in cage induction motors – high torque cage machines – double cage motor and equivalent circuit. **(9)**

STARTING AND SPEED CONTROL OF 3 PHASE INDUCTION MOTORS

Starting of cage and slip ring induction motors - speed control pole changing change of supply voltage, frequency, rotor resistance, injected EMF methods – and slip power recovery scheme, electric braking. **(9)**

SINGLE PHASE INDUCTION MOTORS

Principle of operation of single - phase induction motor – double revolving field theory - equivalent circuit – determination of equivalent circuit parameters and performance characteristics – methods of starting

– capacitor start, capacitor start and run, shaded pole and repulsion motors – universal motor. **(9)**

SPECIAL MACHINES

Switched Reluctance Motor-Reluctance motor-Stepper motor - DC and AC Servo motor - Synchros - Linear motors and Levitation motors - Linear Induction motor – Linear synchronous motors – PCB motors. (Qualitative treatment only). **(9)**

Total: 45

TEXT BOOKS

1. Say M.G., “The Performance and Design of Alternating Current Machines”, CBS Publishers and Distributors, New Delhi, 1993.

2. Nagarath I.J. & Kothari D.P, “Electric Machines”, Tata McGraw Hill, Third Edition, 2004.

REFERENCE BOOKS

1. Fitzgerald A.E. & Kingsley: “Electrical Machinery”, Tata McGraw Hill.,Sixth Edition, 2003.

2. Langsdorf A.S., “Theory of AC Machinery”, McGraw Hill.6th Edition,1959.

3. Chapman S.J, “Electric Machinery Fundamentals”, McGraw Hill., Second Edition, 1991.

4. Vincent Del Toro, “Electrical Machines & Power Systems”, Prentice Hall, Second Edition, 2003.

5. Puchestein, Lloyd & Conrad, “Alternating Current Machines”, Asia Publishing House, 1962.

6. Cyrill. G. Veinott, “Fractional and Sub fractional Horse Power Electric Motors”,Mc Graw Hill Publishers, 1996.

09EE55 - MICROCONTROLLER BASED SYSTEM DESIGN

ASSESSMENT: THEORY

OBJECTIVE

To teach the students the architecture, hardware design concepts, programming aspects of 8051 microcontroller and the architectural features of advanced microcontrollers.

EXPECTED OUTCOME

The students will be able to design and implement the microcontroller based systems on their own.

THE 8051 MICROCONTROLLER

Introduction to Microprocessor, Microcontrollers and Embedded Processors – Intel 8051 microcontroller architecture – Internal Memory – I/O Ports – Reset and Clock circuits – Counters and Timers – Serial communication - Interrupts. **(9)**

PROGRAMMING 8051 in ASSEMBLY and C

8051 Addressing modes – Instruction set – Programming 8051 Timer/Counter – Serial communication – Interrupts – Machine cycle and Bus timings – Programming examples. **(9)**

INTERFACING EXTERNAL MEMORY and I/O DEVICES

Memory mapped I/O – Memory address decoding –External RAM and ROM – Expanding I/O with 8255 Programmable peripheral device – Keyboard interfacing – Numeric 7 segment and LCD interfacing – Handling multiple interrupts. **(9)**

INTERFACING PERIPHERAL DEVICES

ADC, DAC and Sensor Interfaces – RTC Interface – Interfacing relays and opto isolators – Stepper motor interface – DC motor interface – Pulse width modulation – Device programmer – Emulators – Development tools. **(9)**

ENHANCED MICROCONTROLLER FEATURES

Salient features of 8096 Microcontroller – Motorola 68HC11 – PIC 18 series – ARM 7 processor – Serial I/O Bus Standards: RS232C-Inter Integrated Circuit (I2C) controllers - USB Controllers – CAN controllers. **(9)**

Case Study: Industrial Control Applications using microcontroller.

Total : 45

TEXT BOOKS

1. Muhammad Ali Mazidi, Gillispie Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education, 2004.

2. Myke Predko, "Programming and Customizing the 8051 Microcontroller",Tata McGraw Hill, New Delhi, 2004.

REFERENCE BOOKS

1. Kenneth J Ayala, "The 8051 Microcontoller Architecture, Programming and Application", Penram International Publishing Co.(India), 1996.

2. John B. Peatman," Design with PIC microcontrollers", Pearson Education Singapore ,1998.

3. Jonathan W.Valavano, "Embedded Micro Computer System: Real Time Interfacing", Brooks/Coole, USA, 2000.

4. Andrew Sloss, Dominic Symes, and Chris Wright, "ARM System Developer's Guide: Designing and Optimizing System", The Morgan Kaufmann Series, 2004.

09EE62 POWER ELECTRONICS

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the different modern power semiconductor devices, various topologies and operation of power electronic circuits such as ac to dc, dc to dc, ac to ac and dc to ac converters.

EXPECTED OUTCOME

The students will have thorough understanding of various power semiconductor devices and the operations of different converters using them.

POWER SEMICONDUCTOR DEVICES

Need for power conversion – Power Semiconductor Switches - Idealized Characteristics-Power diodes – Thyristors – Diac – Triac – GTOs – Power transistors: Power BJTs – Power MOSFETs – IGBTs – MCT – IGCT- IPMs -comparison of power semiconductor switches - steady state and dynamic characteristics – switching and conduction losses-protection circuits – series and parallel connection-Heat dissipation - heat sink/loss calculation-data sheets/manufacturers.**(11)**

AC-DC CONVERTERS

Introduction – phase angle control – single phase and three phase half and fully controlled converters – dual converters – estimation of performance parameters for continuous current operation – device selection for ac-dc converters – effects of load and source inductances – control circuit-driver circuit – sensing circuits-current and voltage sensors, opto couplers circuits – cosine wave crossing control – ramp comparator approach – synchronization and isolation – microprocessor based implementation. **(10)**

DC-DC CONVERTERS

Principle of chopper operation – control strategies – step down chopper – step up chopper – single, two and four quadrant operation –

Estimation of average load voltage and load current for continuous

current operation –– device selection for dc-dc converters- control circuit – microprocessor based implementation – magnetic considerations.

Switched mode regulators – buck regulator – boost regulator – buck-boost regulator – cuk regulator –comparison of regulators. **(7)**

AC-AC CONVERTERS

AC voltage Controllers – principle of ON-OFF control – single phase and three phase voltage controllers Estimation of RMS load voltage, RMS load current and input power factor

Cycloconverters: single phase and three phase cyclo converters – output voltage equation – device selection for ac-ac converters- control circuit. **(7)**

DC-AC CONVERTERS

Principle of operation – single phase series inverter – parallel inverter – voltage source inverters and current source inverters- single phase bridge inverter – three phase bridge inverter –– voltage control of inverters- device selection for dc-ac converters – harmonic reduction –– introduction to multilevel inverters. - EMI considerations. Generation of control signals for inverters – microprocessor, based implementation.

Applications: UPS – SMPS – HF induction heating – switch mode welding –-electronic lamp ballast. **(10)**

Theory : 45
Tutorial : 15
Total : 60

TEXT BOOKS

1. Rashid M.H., "Power Electronics: Circuits, Devices and Applications", IV Edition, Pearson Education Asia, New Delhi 2007.

2. Ned Mohan, M.Undeland and William P.Robinson, "Power Electronics – Converters, Applications and Design", II Edition, John Wiley and Bros., 2005, New York.

REFERENCE BOOKS

1. Jagannathan V., “Introduction to Power Electronics” Prentice Hall of India Private Ltd.,New Delhi, 2004.

2. Singh M.D., and K.B. Khanchandani, “Power Electronics”, Second Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2007.

3. Joseph Vithayathil, “Power Electronics Principles and Applications”, McGraw Hill, 1995.

4. Dubey G.K., etal,“Thyristorised Power Controllers” New Age Publishers, Second Edition, Chennai, 2004.

5. Moorthi V.R.,“Power Electronics” Oxford University Press, New Delhi, 2005.

6. Andrej M.Trzynadlowski,“Introduction to Modern Power Electronics” John Wiley & Sons,Inc. Newyork, 1998.

7. Jai.P.Agrawal,“Power Electronic Systems –Theory and Design” Pearson Education Asia, New Delhi 2001.

8. M.H.Rashid, “Power Electronics Hand Book”, Academic Press, New York 2001.

9. Dewan S.B. and Straughen A., “Power Semiconductor Circuits”, John Wiley and sons, Inc. New York, 1984.

10.Sen P.C.,“Modern Power Electronics”, Wheeler Publishing, New Delhi,2002.

11.Umanand L., “Power Electronics – Essentials and Applications” Wiley India Pvt. Limited. New Delhi, 2009.

09EE63 TRANSMISSION AND DISTRIBUTION SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To introduce the essentials of interconnected electric power systems. To give a comprehensive overview of the terminology, electrical concepts, design considerations, construction practices, operational aspects of transmission and distribution systems in particular.

EXPECTED OUTCOME

Upon completion of the course the students will be able to model a transmission line, analyze the performance of power transmission systems, study the need of different mechanical structures for transmission and distribution systems, to know the tariff calculations for consumers and grid tariff calculations and the latest trends in substation automation.

INTRODUCTION

Transmission : Power Transmission by AC and DC systems – Comparison of Copper Coefficiencies of various systems .

Line Parameters : Resistance of conductors – skin effect – inductance of a conductor due to internal and external flux –– inductance and capacitance of single-phase two-wire line, three phase lines with symmetrical and unsymmetrical spacing, bundled conductor lines and double circuit three phase lines –effect of earth on line capacitance.**(9)**

LINE PERFORMANCE AND CORONA

Regulation and efficiency: short lines – medium lines represented by nominal T and P methods – long lines – rigorous solution – ABCD constants – Ferranti effect.

Phenomenon of corona – disruptive critical voltage – visual critical voltage – corona loss – radio interference. **(9)**

INSULATORS AND MECHANICAL DESIGN OF OVERHEAD LINES

Insulator materials – insulator types – voltage distribution over insulator string – methods of improving string efficiency – insulator failure – testing of insulators.

Line supports – types of steel towers – cross arms – span, conductor configuration, spacing and clearances – sag and tension calculations- effect of wind, temperature and ice – support at different levels – stringing chart – conductor vibration. **(9)**

UNDERGROUND CABLES

Comparison between overhead line and underground cable for transmission – types of cables – types of insulating materials – insulation resistance – potential gradient – grading of cables – capacitance of single and three core cables – faults and fault location by loop test – cable installation – current rating of cables–operating problems with underground cables. **(9)**

DISTRIBUTION SYSTEMS AND SUBSTATIONS

AC distribution - Radial and ring main systems - ring main distributors with interconnectors – methods of solving AC distribution systems. Tariff calculations: two part tariff - Grid Tariff.

Substation - types of substations – layout and location of substations – busbar arrangements – Introduction to substation automation protocols. **(9)**

Total: 45

TEXT BOOK

1. Wadhwa C.L., “Electrical Power Systems”, New Age International, 2007.

REFERENCE BOOKS

1. Luces M.Fual Keribeery, Watter Coffer, “Electrical Power Distribution and Transmission”, Pearson Education, 1996.

2. Nagrath J. and Kothari D.P., “Power Systems Engineering”, Tata McGraw Hill, 2007.

3. Dr. S.L.Uppal, “Electrical Power”, Khanna Publishers, 1980.

4. Sony M.L., Gupta P.V., Bhatnagar V.S., and A.Chakraborti, “A Text Book on Power Systems Engineering”, Dhanpat Rai and Co., Delhi, 1997-98.

09EE56 VLSI DESIGN

ASSESSMENT: THEORY

OBJECTIVE

To understand the design aspects of VLSI circuits using CMOS devices and programmable logic devices and to familiarize VHDL language for modeling combinational and sequential circuits.

EXPECTED OUTCOME

The students can model combinational circuits, sequential circuits and computational elements for a digital system using VHDL language.

MOS AND CMOS CIRCUITS

Electrical properties of MOS and BiCMOS circuits - nMOS inverter – pull-up to pull-down ratio – BiCMOS inverter – latch-up in CMOS circuits - stick diagrams – design rules and layout – sheet resistance – capacitive loads – inverter delays – propagation delays – wiring capacitances. **(9)**

SUB SYSTEM DESIGN

Switch logic – gate logic – combinational logic – structured design – clocked sequential circuits – bus drivers – power dissipation for CMOS and BiCMOS circuits – current limitations. **(9)**

DESIGN OF COMPUTATIONAL ELEMENTS

Four bit shifter – ALU design – adders – adder enhancement techniques – multipliers – storage / memory elements – forming arrays of cells. **(9)**

HARDWARE MODELING USING VHDL

Introduction to VHDL - design flow – data types - operators - functions and procedures – behavioral modeling - structural modeling - time dimension and simulation – synthesis.

Combinational logic design using VHDL: Multiplexers – demultiplexers – adders / subtractors – comparators.

Sequential logic design using VHDL: Flip-Flops – synchronous and asynchronous counters – Finite State Machines. **(9)**

PROGRAMMABLE LOGIC DEVICES

Programmable Logic Arrays (PLAs) – Programmable Array Logic Devices (PALs) – Complex Programmable Logic Devices (CPLDs) - 22V10 PAL Device – Altera MAX 7000 – Field Programmable Gate Arrays (FPGAs) – Altera Flex 10K, Xilinx XC4000 FPGA family architectures – Xilinx Spartan series FPGAs - Using CAD Tools to implement circuits in CPLDs and FPGAs. **(9)**

Total: 45

TEXT BOOKS

1. Dauglas A. Pucknell, Kamran Eshraghian, “Basic VLSI Design”, III Edition, Prentice Hall of India, 2001.

2. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw Hill, Singapore, 2000.

REFERENCE BOOKS

1. Neil H. E. Weste and Kamran Eshragian, “Principles of CMOS VLSI Design: A Systems Perspective”, II Edition, Pearson Education Asia Pvt. Ltd., 2004.

2. Douglas L. Perry, “VHDL Programming by Example”, IV Edition, Tata McGraw Hill, NewDelhi, 2002.

3. Wayne Wolf, “Modern VLSI Design”, III Edition, Pearson Education Asia Pvt. Ltd., 2003.

4. John F.Wakerly, “Digital Design Principles and Practices”, III Edition, Pearson Education Asia Pvt. Ltd., 2003.

09EE65 DATA COMMUNICATION NETWORKS

ASSESSMENT: THEORY

OBJECTIVE

The objective of this course is to introduce to the students the tools and techniques of networking, queuing models for performance analysis, broadband networks and Network Security.

EXPECTED OUTCOME

Learning this course will enable the students to have an exposure to the techniques used for transmission and dissemination of information.

TOOLS AND TECHNIQUES

Protocol layering – Wired and Wireless Networks - system design – multiple access – switching – the OSI model – concepts of the telephone network – internet – ATM networks – Introduction to LAN, WAN, MAN, Bluetooth, Cellular Networks**.** **(8)**

POINT TO POINT PROTOCOLS

Physical layer – analog and digital transmission Modulation and DeModulation – spread spectrum communication.

Data link layer- error control – ARQ retransmission strategies – framing – traffic management – classes – scheduling - pricing. **(10)**

ROUTING

Routing protocol requirements – distance vector – link state – choosing link costs – flooding – optimal routing –– shortest path routing. **(9)**

FLOW CONTROL AND DELAY MODELS

Flow control – window flow control – rate control schemes – queuing models – Little's theorem – the M/M/1, M/M/n Queuing models – network of queues. **(9)**

TCP/IP AND BROADBAND NETWORKS

TCP congestion control – QoS – IP addressing – IP routing – broadband ISDN- VSAT– network security- Introduction to cryptography – RSA algorithms-Public key cryptography. **(9)**

Total : 45

TEXT BOOKS

1. Keshav S., “An Engineering Approach to Computer Networking”, Addision Wesley,1999.

2. Behrouz. A. Forouzan, “Data Communication and Networking”, IV Edition, Tata McGraw Hill, 2008.

REFERENCE BOOKS

1. Tanenbaum A.S., “Computer Networks”,II Edition, Prentice Hall of India, New Delhi, 2003.

2. Dimitri Bertzekas and Robert Gallager,”Data Networks”, II Edition,Prentice Hall of India”,2000.

3. William Stallings, “Data and Computer Communications”, V Edition, Prentice Hall of India, New Delhi, 2005.

09EE66 DIGITAL SIGNAL PROCESSING

ASSESSMENT: THEORY

OBJECTIVE

To impart to the students the fundamental concepts of digital signal processing and algorithms, design and realize digital filters using different methodologies, and to familiarize the architecture of digital signal processors.

EXPECTED OUTCOME

The students can solve problems in signal processing, design and realize digital filters theoretically and in digital signal processors. This subject will be a platform to learn other signal and image processing concepts.

DISCRETE TIME SIGNALS AND SYSTEMS

Discrete time signals – classification – sampling – aliasing – discrete time systems - classification – linearity – time invariance – causality – stability – convolution – correlation – analysis of discrete time systems - Z-Transform and its properties - Inverse Z-Transform - solution of difference equations using Z-Transform. **(9)**

FOURIER ANALYSIS OF DISCRETE TIME SIGNALS

Discrete Fourier Transform (DFT) - Properties - IDFT - Discrete-Time Linear System Analysis by DFT – Fast Fourier Transform (FFT) – Properties - Radix-2 Decimation in Time FFT – Radix-2 Decimation in Frequency FFT - IDFT. **(9)**

DIGITAL FILTERS

Types - Butterworth filters - Chebyshev filters - IIR filters - characteristics - IIR filter design by Impulse Invariance Method - Bilinear Transformation Method - FIR filters - characteristics - design of FIR filters by frequency sampling – FIR filters using window functions. **(9)**

IMPLEMENTATION OF DISCRETE TIME SYSTEMS

Realization of IIR filters – direct form realization – cascade form – parallel form – realization of FIR filters – transversal structure - linear

phase realization – poly phase realization – quantization noise –quantization errors – quantization errors in computation of DFT and FFT algorithms. **(9)**

DIGITAL SIGNAL PROCESSOR AND APPLICATIONS

Digital Motor Control Drivers – Requirements - Architecture of TMS320LF2407 DSP Controller – Peripherals – PWM Generator - Applications of DSP in Electrical Appliances, Motor Control, Power Supply Inverters, Robotics and Automotive Control. **(9)**

Total: 45

TEXT BOOKS

1. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing Principles Algorithm and Application", III Edition, Prentice Hall of India, 2005.

2. Ashok Ambardar, "Analog and Digital Signal Processing", II Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.

REFERENCE BOOKS

1. Ramesh Babu P., "Digital Signal Processing", IV Edition, Scitech Publications (India) Pvt. Ltd., Chennai, 2007.

2. Mitra Sanjit K., "Digital Signal Processing: A Computer Based Approach", Tata McGraw Hill, New Delhi, 2006.

3. Monsoon H. Hayes, " Digital Signal Processing", Schaum's Outline Series, Tata McGraw Hill, New Delhi, 2004.

4. TMS320LF2407 Technical Reference Manual.

5. Hamid A. Toliyat, Steven Campbell, "DSP Based Electromechanical Motor Control", CRC Press, NewYork, 2004.

09EE72 POWER SYSTEM ANALYSIS

ASSESSMENT: THEORY

OBJECTIVE

To learn the power system modeling and algorithms for the analysis of electrical power systems, recent developments power flow analysis and to study the dynamics of operation and control of power systems under normal and abnormal conditions.

EXPECTED OUTCOME

The students will learn power system planning, operation and control. They are also trained to model large scale power systems, solve the load flow problems using efficient numerical methods, analyze the power system transients and faults, study the dynamics of power systems and know about the task of maintaining a reliable electric power system.

REPRESENTATION OF POWER SYSTEM COMPONENTS

Single line diagram – per unit quantities – per unit impedance / reactance diagrams – Complex Power –Representation of Loads – equivalent circuit of transformer with off - nominal tap ratio - Bus admittance matrix – formulation of Y_{bus} - Formation of Z_{bus} using step-by-step building algorithm. **(9)**

LOAD FLOW STUDIES

Load flow equations and methods of solutions - Gauss-Seidel method for load flow studies – Newton-Raphson method for load flow studies – Fast Decoupled load flow method – load flow computations in large systems. **(9)**

FAULT CALCULATIONS

Balanced and unbalanced faults – types of faults – symmetrical faults – consideration of prefault load current – symmetrical components – sequence impedances and sequence networks for synchronous machines, transmission lines, transformers –formation of sequence networks – unsymmetrical fault analysis - single line to ground fault, line to line fault, double line to ground fault. **(9)**

POWER SYSTEM TRANSIENTS

Circuit closing transients – sudden symmetrical short circuit of alternator – recovery transients due to removal of short circuit – travelling waves on transmission lines – wave equations – surge impedance – equivalent circuit for traveling wave studies – forked line – arcing grounds –capacitance switching – current chopping – lightning phenomenon. **(9)**

POWER SYSTEM STABILITY

Steady state and transient state stability of power systems –stability limits – swing equation for single machine infinite bus system – solution of swing equation by modified Euler –equal area criterion and its applications – methods of improving transient stability – Installation of Automatic Voltage regulators. **(9)**

Theory: 45
Tutorial: 15
Total: 60

TEXT BOOK

1. Kothari D.P., I.J.Nagrath, “Modern Power System Analysis”, Tata McGraw Hill, 2007.

REFERENCE BOOKS

1. C.L.Wadhwa, “Electrical Power Systems”, New Age International (P) Ltd., 2007.
2. John J. Grainger, W.D.Stevenson, “Elements of Power System Analysis”,Tata McGraw Hill, 2003.
3. Gupta B.R., “Power System Analysis and Design”, III Edition, Wheeler Publishers, 2003.
4. Hadi Saadat, “Power System Analysis”, Tata McGraw Hill, Third Edition,Reprint, 2004
5. Weedy B.M., “Electric Power Systems”, John Wiley, New York, 1987.

09EE73 ELECTRIC DRIVES AND CONTROL

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the fundamental concept of electrical drives, principle of operation and control of DC drives, AC drives, special drives and their applications.

EXPECTED OUTCOME

The students will have the knowledge and understanding of the drive systems, the fundamental characteristics of various types of motors and their starting, braking and speed control by solid state control and control of drives using microcontroller/DSP controller, neural networks and fuzzy techniques.

INTRODUCTION TO ELECTRICAL DRIVES

History and development of drive systems- comparisons-concept of electric drive –block diagram representation – advantages-classification-AC and DC drives-requirements of a good adjustable speed drive – principle factors affecting the choice of drive – speed-torque characteristics of drive motor and load – joint speed-torque characteristics – selection of power rating for drive motor based on thermal overloading and load variation factors – load equalization – starting – braking and reversing for various types of drive motors. **(9)**

DC DRIVES

Introduction-speed control of DC motors – Ward-Leonard scheme and its draw backs –solid state control-advantages-performance parameters- converter fed DC drives – single phase and three phase drives-performance characteristics – single, two and four quadrant operation.

Chopper fed DC drives – chopper fed control of separately excited DC motor and series DC motor – performance characteristics – supply harmonics-power factor and effect of ripple on motor performance.**(10)**

AC DRIVES

Methods of speed control of three phase induction motor – solid-state control schemes – AC voltage controllers – DC link inverters – cyclo converters.

Rotor control: Rotor resistance control– slip power recovery scheme- static Sherbius drive-static Kramer drive – modified Kramer drive. Introduction to vector control – harmonic distortion due to static converters.

Synchronous motor drives: Speed control of three phase synchronous motor – true synchronous and self controlled modes.**(10)**

SPECIAL DRIVES

DC servo drives - principle of operation - AC servo drives - principle of operation - Principle and control Stepper motor drives- comparison between servo drive and stepper drive - Brushless DC motor drives–introduction to PLC based drives-energy efficient drives-switched reluctance motor drives – solar and battery powered drives. **(8)**

DIGITAL CONTROL AND DRIVE APPLICATIONS

Digital techniques in speed control – advantages and limitations – control of electric drives using micro controllers and DSP processors – Introduction to fuzzy logic and neural network application in electric drives – selection of drive and control schemes for steel industry-textile industry-mining-paper industry-cement mills-machine tools-control system for elevators and cranes. **(8)**

Theory: 45
Tutorial: 15
Total: 60

TEXT BOOKS

1. Dubey G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, New Delhi, Edition, 2006.

2. Bose B K, “Modern Power Electronics and AC Drives”, Pearson Education (Singapore) Pvt. Ltd, New Delhi, 2006

REFERENCE BOOKS

1. Dubey G.K., “Power Semiconductor Controlled Drives” John Wiley and Sons, New York, 1999.

2. Vedam Subramaniam, “Electrical Drives and Applications”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.

3. Ion Boldea and Nasar S A, “Electric Drives”, CRC Press LLC, New York, 1999.

4. Pillai S.K., “A First Course on Electrical Drives”, II Edition, New Age International Publishers, 2004.

5. Sen P.C., “Thyristor DC Drives”, John Wiley and Sons, New York, 1981.

6. Murphy J.M.D., “Thyristor Control of AC Motor”, Paragon Press, London, 1978.

7. Berde M.S., “Electric Motor Drives”, Khanna Publishers, New Delhi 1997.

09PE56 ELECTRIC MACHINES AND CONTROLS LABORATORY

ASSESSMENT: PRACTICAL

OBJECTIVE

To train the students conduct direct and indirect tests on DC and AC machines and determine their performance curves, the transfer function models of DC machines and evaluate their performance.

EXPECTED OUTCOME

The learners will be able to analyze the performance of DC and AC machines using different tests and verify the theory of operations.

LIST OF EXPERIMENTS

1. Swinburne's Test
2. Load Test on DC Shunt Generator
3. Load Test on DC Shunt Motor
4. Transfer function of D.C. generator.
5. Transfer function of armature controlled D.C. motor.
6. Load Test on Single Phase Two Winding Transformer
7. Open Circuit and Short Circuit Tests on Single Phase Two Winding Transformer
8. Predetermination of Regulation of 3-phase Alternator by EMF and MMF methods
9. Load test on three-phase squirrel cage induction motor.
10. Load test on single-phase capacitor start induction motor.
11. Determination of V and inverted V curves of synchronous motors.
12. Predetermination of performance characteristics of three phase squirrel cage induction motor by equivalent circuit method and circle diagram method.

09EE61 DESIGN OF ELECTRICAL MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To provide knowledge on the design aspects of electrical machines and introduce computer aided machine design.

EXPECTED OUTCOME

The students will have a good understanding on the design and applications of electrical machines and will be able to analyze their performance.

INTRODUCTION

Principle, limitations and recent trends of machine design - Magnetic leakage calculations- heating and cooling of electrical machine - heat dissipation - temperature rise - time curve - methods of ventilation.**(12)**

DC MACHINES

Output equation - choice of specific loadings - choice of poles and speed - design of armature – design of field system- yoke design – design of inter poles – commutator and brush design. **(9)**

SYNCHRONOUS MACHINES

Specifications –types- rating and dimensions - specific loadings-main dimensions - design of stator –yoke design-rotor design of salient pole and turbo alternators-design of damper windings- cooling of alternators. **(9)**

INDUCTION MOTORS

Three phase induction motors-standard specifications - output equation - specific loadings - main dimensions-design of stator - rotor design – calculations of equivalent circuit parameters.

Single phase induction motor - output equation - specific loadings - main dimensions - design of main and auxiliary winding - capacitor design - equivalent circuit parameters – torque - efficiency. **(9)**

TRANSFORMERS

Standard specifications - output equation – design of core, windings, tank and cooling tubes.

Calculation of circuit parameters - magnetizing current - losses and efficiency - temperature rise and regulation from design data- design of inductors. **(9)**

NOTE: A term paper on computer aided design and analysis of electrical machines must be submitted using MATLAB.

TEXT BOOKS

1. Sawhney A.K., " A Course in Electrical Machine Design", Dhanpat Rai & Sons, New Delhi, 2000.

2. Upadhyay K.G., "Conventional and Computer Aided Design of Electrical Machines", Galgotia Publications Pvt. Ltd, New Delhi, 2004.

REFERENCE BOOKS

1. Say M.G., "The Performance and Design of Alternating Current Machines", CBS Publishers and Distributors, New Delhi, 1993.

2. Sen S.K., "Principles of Electrical Machine Design with Computer Programs", Oxford and IBH Publishing Company, 1987.

3. Kuhlmann J.H, "Design of Electrical Operators", John Wiley, 1957.

4. Veinott C.G., "Theory and Design of Small Induction Motors", McGraw Hill, 1959.

5. Jimme. J. Cathey. "Electric Machines -Analysis and Design Applying MATLAB",Mc – Graw Hill Publishers – 2001.

6. Shanmugasundaram A. etal,. "Electrical Machine Design Data Book", John Wiley, India, 1979.

09EE81 - EMBEDDED SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To expose the students to the tools used in the design of embedded systems, real time concepts and techniques for the development of a complete embedded system.

EXPECTED OUTCOME

Learning this course on Embedded Systems will provide the students the required skills to design a complete real time embedded system.

INTRODUCTION

Embedded Systems evolution trends – Embedded system design process – micro controller architecture –PIC 16 series- Program and Data memory – CPU registers – Instruction set – I/O ports – External Interrupts – Timer 0 - RB0/INT – Timer1 – Compare and Capture mode – Timer 2 – PWM outputs – ADC- SCI - UART - SPI – PSP - I^2C operation. **(10)**

REAL TIME OPERATING SYSTEMS (RTOS)

Basic real time concepts- Real time design issues - The Shared data problem – Software architectures – Real time specification - real time kernel – inter task communication and synchronization – real time memory management. **(9)**

SYSTEM PERFORMANCE, ANALYSIS AND OPTIMIZATION

Response time calculation – interrupt latency – time loading and its measurement –scheduling – reducing response times and time loading – analysis of memory requirements – reducing memory loading – input – output performance. **(8)**

DEBUGGING TECHNIQUES AND DEVELOPMENT TOOLS

Faults, failures, bugs and effects- reliability – testing – fault tolerance- host and target machines – linker/locators for embedded software – getting embedded software in to target system - Debugging

strategies, Simulators-Logic Analyzers – In Circuit Debugger and In Circuit Emulator. **(8)**

EMBEDDED SYSTEM APPLICATIONS

Networks for embedded systems – Elevator controller – Telephone PBX – Personal digital assistants – Set top Boxes - Real time systems as complex systems – real time databases – real time image processing - An example: The tank monitoring system. **(10)**

Case Study : Embedded Automobile Control System.

Total : 45

TEXT BOOKS

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computer Systems Design”, Morgan Kaufman Publishers, 2004.

2. John. B. Peatman, “Design with PIC Microcontrollers”, Pearson Education, 2004.

REFERENCE BOOKS

1. Philip A.Laplante, “Real Time Systems Design and Analysis: An Engineers Handbook”, II Edition, Prentice Hall of India, New Delhi, 2000.

2. David E Simon, “An embedded software primer”, Pearson Education Asia, 2001

3. Raymond J.A. Bhur and Donald L.Bialey, “An Introduction to Real Time Systems: From Design to Networking with C/C++”, Prentice Hall Inc., New Jersey, 1999.

4. Krishna C.M. and Kang G.Shin, “Real Time Systems”, McGraw Hill, New Delhi, 1997.

09PE65 ELECTRONICS AND MICROPROCESSOR LABORATORY

ASSESSMENT: PRACTICAL

OBJECTIVE

To inculcate the students the skills pertaining to the design of any electronic circuit with linear and digital ICs for the given design specifications, to make the students acquire assembly language programming skills in 8085 processor and to impart the student the knowledge of power electronic converter-based systems.

EXPECTED OUTCOME

The learners will have the real time understanding of designing any circuit for the given requirements and have clear concepts of power electronic converter based systems. Students will be able to write assembly language and understand techniques for interfacing I/O devices to the microprocessor.

LIST OF EXPERIMENTS

1. Adders, Subtractors, Serial adder, Parallel adder and ALU.
2. Square wave Oscillator, Crystal Oscillator using Digital ICs.
3. Multiplexer, Demultiplexer, Encoder and Decoder
4. Applications of Operational Amplifier.
5. IC 555 Timer Applications.
6. RC Phase Shift Oscillator.
7. Waveform Generators (Square, Triangle and Ramp).
8. Study of Single Phase Fully Controlled Converter.
9. AC Phase Control Using SCR.
10. Study of Parallel Inverter.
11. Programming 8085 microprocessors involving arithmetic operations.
12. Traffic Light Controller Interface.

09EE82 PROTECTION AND SWITCHGEAR

ASSESSMENT: THEORY

OBJECTIVE

To offer a detailed understanding of the types of relays, circuit breakers and other protective devices used in power system.

EXPECTED OUTCOME

The learners will be able to use the theoretical background for practical implementation of the protection of power system components.

PROTECTIVE RELAYS

Basic requirements of protective relaying – Functional characteristics of relay-Definitions-Classification of relays – relay terms – non-directional and directional over current relays – distance relays – Reactance relay-Mho relay-universal torque equation-Connection for phase fault relays – differential relays. **(8)**

CIRCUIT BREAKERS

Elementary principle of arc extinction – re-striking - rate of rise of re-striking and recovery voltage – Arc-interruption theories-Bulk oil – minimum oil – air blast – vacuum – SF6 circuit breakers – rating – speed of operation – selection and testing of circuit breakers – fuses – HRC fuses. **(9)**

APPARATUS PROTECTION

Protective relays for protection of generators – transformers – bus and line including parallel feeders – effect of current and potential transformers on the performance of relays. **(9)**

PROTECTION AGAINST OVERVOLTAGES

Voltage surge – causes of over voltages – switching, insulation failure, arcing grounds and resonance – lightning – methods of protection – surge diverter – surge absorber – groundings – Resonant grounding, Peterson coil, Methods of Neutral grounding. **(9)**

STATIC RELAYS

Amplitude, phase and hybrid comparator schemes – block diagram representation of static relay for transformer protection- Static over current relay- Static directional relay-Static comparator scheme for differential protection- Static Distance relay.

Microprocessor based relay - Block diagram representation of over current and impedance relays. **(10)**

Total : 45

TEXT BOOKS

1. Ravindranath B., and Chander M., “Power System Protection and Switchgear”, Wiley Eastern, 1977.

2. Wadhwa C.L., “Electrical Power Systems”, VI Edition, New Age International Pvt. Ltd., 2005.

REFERENCE BOOKS

1. Madhavarao T.S., “Power System Protection – Static Relays”, Tata McGraw Hill, 1979.

2. Sunil S. Rao, “Switch Gear and Protection”, Khanna Publishers, 1994.

3. Soni M.L., Gupta P.V., and Bhatnagar U.S., “A Course in Electrical Power” Dhanpat Rai and Sons, 2003.

4. “Indian Electricity Rules - 1956. As Amended Up to date”, Allahabad Law Agency, Allahabad.

5. Badri Ram and Vishwakarma D.N., “Power System Protection and Switchgear”, Tata McGraw Hill, 1994.

6. Paithankar Y.G. and Bhide S.R., “Fundamentals of Power System Protection” Prentice Hall of India, 2004.

09EE83 GENERATION AND UTILISATION OF ELECTRIC POWER

ASSESSMENT: THEORY

OBJECTIVE

To impart the knowledge about various means of power generation and utilization of electrical energy in various electrical systems and appliances.

EXPECTED OUTCOME

The students will be familiar on different types of electric drives, electric traction systems, various lamps, illuminators design schemes, optimizing the design of electrical utilities and energy saving aspects.

ELECTRICAL POWER GENERATION

Load and load duration curves – load demand – diversity and plant factors – size and number of units – hydro electric power plants - large, medium and small head plants – choice of turbines – plant lay out – pumped storage plants.

Steam plants – layout – Diesel and gas turbine stations – nuclear power plants.

Introduction to Distributed Generation - Power generation from fossil fuels – solar – wind – tidal – ocean thermal - geothermal – biogas(Qualitative treatment only). **(12)**

ELECTRIC TRACTION

Traction motors-starting –control- series parallel- multiple unit control - braking – speed – time curves –mechanics of train movement- tractive effort for acceleration – power and energy output from driving axles – specific energy output and consumption – train resistance –– comparison of DC and AC traction- systems of railways electrification - aircraft electrical systems. **(9)**

HEATING AND WELDING

Advantages of electric heating – resistance heating – induction and arc furnaces – high frequency eddy current heating – dielectric

heating –power and voltage calculation – electric oven heating – electric iron – welding generators – resistance and arc welding – air conditioning and refrigeration. **(8)**

ILLUMINATION

Laws of illumination – calculation of illumination – street lighting and flood lighting – MSCP – sources of illumination – incandescent, vapour, discharge and arc lamps, carbon filament, tungsten filament lamp, gas filled tungsten lamps, neon lamps, CFL lamps, design of lighting schemes – design of outdoor lightings. **(8)**

ELECTROLYSIS

Fundamentals of electroplating -faradays laws of electrolysis – applications of electrolytic process – electro plating- refining- production of metals- electro forming – electro typing-anodizing- current and energy efficiency – power supplies – types of rectifiers. **(8)**

Total : 45

TEXT BOOKS

1. Wadhwa C.L., " Utilisation of Electrical Energy ", New Age Publishers, Madras 2006.

2. Rai G.D., "Non-Conventional Energy Sources", Khanna Publishers, 1993.

REFERENCE BOOKS

1. Suryanarayana N.V., "Utilisation of Electric Power",Wiley Eastern Limited, Madras 1994.

2. Soni M.L., Gupta P.V., Bhatnagar U.S., and Chakrabarti A., "A Text Book on Power System Engineering", Dhanpat Rai and Co, Delhi,2004.

3. Deshpande M.V., " Elements of Electrical Power Station Design", Pitman 1989

4. Rakesh Das Begamudre, "Energy Conversion Systems", New Age Publishers, New Delhi 2000.

5. Dr.S.L.Uppal , " Electric Power", Khanna publishers, New Delhi ,1980

6. Garg G.C., " Utilisation of Electric Power and Electric Traction , " Khanna Publishers, New Delhi, 1995.

09ER01 ADVANCED TOPICS IN POWER ELECTRONICS

ASSESSMENT: THEORY

OBJECTIVE

To provide a theoretical and practical background in advanced power electronic devices and circuits, with the engineering analysis, design, and laboratory skills. To study the principles of power conditioners, FACTs and Custom Power frequency control, circuit design considerations, and applications of power electronics.

EXPECTED OUTCOME

The students can understand the concepts of resonant converters with a theoretical and practical background with the engineering analysis, design. They can attain through knowledge in the FACTs and Custom Power frequency control, circuit design considerations, and applications.

RESONANT CONVERTERS

Zero voltage and zero current switching – classification of resonant converters – basic resonant circuit concepts – load resonant converters – resonant switch converters – zero voltage switching, clamped voltage topologies – resonant DC link inverters and zero voltage switching – high frequency link integral half cycle converters – applications in SMPS and lighting. **(9)**

IMPROVED UTILITY INTERFACE

Generation of current harmonics – current harmonics and power factor – harmonic standards and recommended practices – need for improved utility interface – improved single phase utility interface – improved three phase utility interface – EMI and RFI. **(9)**

POWER CONDITIONERS

Power line disturbances - noise and Surge reduction - power conditioners other than UPS – uninterruptable power supply - design of static UPS - filter design. **(9)**

FACTS AND CUSTOM POWER

Introduction – principles of reactive power control in load and transmission line compensation – series and shunt reactive power compensation – concepts of Flexible AC Transmission Systems (FACTS) – static var compensators (SVC) – thyristor controlled reactor – thyristor switched capacitor – solid state power control – static condensers – controllable series compensation – thyristor controlled phase - angle regulator and unified power flow control – modeling and methods of analysis of SVC and FACTS controllers – system control and protection – harmonics and filters – simulation and study of SVC and FACTS under dynamic conditions. **(9)**

EMERGING DEVICES AND CIRCUITS

Power junction field effect transistors – field controlled thyristors – JFET based devices Vs other power devices – MOS controlled thyristors – power integrated circuits – new semiconductor materials for power devices. **(9)**

Total : 45

TEXT BOOK

1. Ned Mohan, et.al, “Power Electronics Converters, Applications and Design”, Second Edition, John Wiley and Sons, New York, 1995.

REFERENCE BOOKS

1. Miller T.J.E., “Reactive Power Control Systems”, John Wiley, 1982.

2. Mathew R.M., “Static Compensation for Reactive Power Control”, Context Publication, Winnipeg, 1984.

3. James W. Clark, “AC Power Conditioners – Design and Applications”, Academic Press ,Inc, California,1990

4. Sen P.C., “Modern Power Electronics”, Wheeler Publishing, New Delhi, 1998.

09ER02 AUTOMOTIVE ELECTRONICS - EMBEDDED SOFTWARE DEVELOPER

ASSESSMENT: THEORY

OBJECTIVE

To Provide Automotive Electronics related domain exposure to establish a learning platform for Embedded system development environment in the application of engineering aspects in the development life cycle of projects for automobiles

AUTOMOBILE ELECTRICALS AND ELECTRONICS

Basic Electrical Components in an automobile - Starting system (Battery, Ignition Switch, Solenoid, Starter, Neutral Safety Switch), Charging system (Alternator Drive Belt, Battery, Alternator, Voltage Regulator), Fuses. Overview of Vehicle Electronic system - Driver - Vehicle - Environment system (Control and monitoring systems, Electronic systems of the vehicle and the environment) ECUs and vehicle subsystems - Electronic systems of Powertrain subsystem, Electronic systems of Chassis subsystem, Electronic systems of Body subsystems (Comfort and Passive safety), Multimedia subsystems. Automobile sensors and actuators, Engine management system, Vehicle safety systems, Environmental legislation (Pollution Norms - Euro / Bharat standards). **(9)**

AUTOMOTIVE EMBEDDED SOFTWARE DEVELOPMENT
INTRODUCTION TO EMBEDDED SYSTEMS

Embedded Systems definition, Components of Embedded systems, Microprocessor - Classification of Microprocessors (based on architecture, based on performance), Microcontrollers, Memory, Peripherals.

Introduction to an embedded board (TMS470 based / ARM9 based) for hands on lab sessions (RISC processor based with standard peripherals / interfaces and I/Os). **(6)**

OPERATING SYSTEM IN EMBEDDED ENVIRONMENT

Introduction to OS - General Purpose OS, RTOS -, Kernel - Pre-emptive & Non pre-emptive, Scheduler, Interrupt - Interrupt latency and Context Switch Latency-, Board Support package, Task - Multi-tasking, Task synchronization, Inter-task communication, Features of a typical embedded RTOS (µC/OS-II). **(6)**

INTEGRATED DEVELOPMENT ENVIRONMENT IN EMBEDDED ENVIRONMENT

Integrated Development Environment (Introduction to IDE, Getting Started, Hardware / Software Configuration (Boot Service, Host – Target Interaction), Booting (IDE-Interaction, target-Agent), Reconfiguration, Managing IDE, Target Servers, Agents, Cross – Development, debugging), Introduction to an IDE for the lab board – RTOS, PC based debugger. **(8)**

EMBEDDED SYSTEM IN AUTOMOTIVE CONTEXT

Embedded systems in typical modern automobile - Distributed systems, Embedded components a) Engine Management system - Diesel / Gasoline system, Components, System architecture (H/W, S/W) b) Vehicle safety systems, c) Body electronics systems, d) Infotainment systems – Navigation, Car radio. **(4)**

EMBEDDED SYSTEM COMMUNICATION PROTOCOLS

Introduction to Control networking, Communication protocols in embedded systems - SPI, I^2C, USB, -Vehicle communication protocols – Introduction to CAN, LIN, FLEXRAY, MOST, KWP 2000 - Details of CAN. **(4)**

AUTOMOTIVE APPLICATION DEVELOPMENT: FUNCTIONAL DESIGN, AUTO-CODE GENERATION

Introduction to Modeling and Simulation,
ASCET, Labcar, INCA (Setup 1 definition support by RBEI) or
Matlab, Simulink, Labview (Setup 2),
Autocode generation for a given automotive control application (e.g. Throttle valve control, PID simulation). **(8)**

Total : 45

REFERENCE BOOKS

1. Robert Bosch, “Bosch Automotive Handbook”, Bentley Publishers, Sixth Edition, 2004.

2. Joerg Schaeuffele, Thomas Zurawka, “Automotive Software Engineering - Principles, Processes, Methods and Tools, SAE International, 2005.

3. Jean J. Labrosse, “µC/OS-II Real Time Kernel”, CMP Books, 2002.

09ER03 COMPUTER AIDED DESIGN OF ROTATING MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To introduce the concepts of computer aided analysis and design techniques for rotating machines and to develop computer programs for the design of AC and DC machines and performance calculations.

EXPECTED OUTCOME

The learners will be able to design electrical machines using computer programs and learn the optimization techniques.

INTRODUCTION

Orientation of engineering design problems to computers – design by analysis / approaches – simulation of non-linearity – stator winding for three phase and single phase induction motors – computer programs. **(10)**

THREE-PHASE INDUCTION MOTOR

Standard specifications – constructional features – specific electric and magnetic loadings – output coefficient – main dimensions – computer programs. **(10)**

DESIGN OF STATOR AND ROTOR

Core design – leakage reactance – rotor winding design – equivalent resistances – computer programs. **(7)**

PERFORMANCE CALCULATIONS

Calculation from design data – Carter's coefficient – no load current – equivalent circuit parameters – torque – efficiency and temperature rise – computer programs. **(8)**

SINGLE PHASE INDUCTION MOTORS

Main dimensions – auxiliary winding and capacitor design – equivalent circuit parameters – torque, efficiency and temperature rise calculations using design data – computer programs.

Introduction to optimization techniques as applied to rotating machine design. **(10)**

NOTE:

A term paper in computer aided design of a part in the three-phase or single-phase induction motors should be completed during the course work for internal assessment.

Total : 45

TEXT BOOKS

1. Upadhyay K.G., "Conventional and Computer Aided Design of Electrical Machines", Galgotia Publications Pvt. Ltd, New Delhi, 2004

2. Sen S.K., "Principle of Electrical Machine Design with Computer Programs", Oxford and IBH Publishing Company, 1987.

REFERENCE BOOKS

1. Say M.G., "Performance and Design of A.C. Machines",CBS Publications and Distributors, New Delhi, 1993.

2. Kuhlmann J.H., "Design of Electrical Apparatus", John Wiley, India, 1957.

3. Veinott C.G., "Theory and Design of Small Induction Motors", McGraw Hill, 1996.

4. Shanmugasundharam etal., "Electrical Machine Design Data Book", John Wiley, India, 1979.

5. Ramamoorthy M., "Computer Aided Design of Electrical Equipment", Affiliated East-West Press India, 1987.

09ER04 COMPUTER NUMERICAL CONTROL

ASSESSMENT: THEORY

OBJECTIVE

To impart the knowledge on numerical control of machine tools through computer aided part programming with feedback systems and cutting tools to process the components.

EXPECTED OUTCOME

The students will be able to understand the selection of drives for the CNC machines, usability of suitable feedback devices and control circuits by preparing part program to manufacture different components.

DESIGN FEATURES OF CNC SYSTEMS

Basic concepts of computer numerical control – advantages and limitations– Design feature of CNC machine tools - CNC machine control and operation - elements of CNC machine tools – applications – co-ordinate systems – types of CNC systems – analog and digital – absolute and incremental systems – open loop and closed loop systems – new developments in CNC systems. **(9)**

CNC DRIVES AND CONTROLS

Information flow in CNC systems – Types of input media – NC tape and tape coding procedures – decoding – tape formatting types - associated electronics for various formats – data conversion– Drive systems for CNC machines – DC motors, stepper motors, Hydraulic actuators - AC servo drives – Comparative features. **(9)**

FEEDBACK DEVICES AND APPLICATIONS

Feedback devices – absolute and incremental type rotary encoders – Synchro resolvers - shaft encoders and linear optical encoders –inductosyn – moiré fringe digitizer – laser interferometer - digital differential analyzer – linear and circular interpolation using differential analyzer – complete interpolator – transducer placement, measuring schemes using these feedback devices. **(9)**

CNC TOOLING

Automatic Tool Changer – Types of ATC and tool magazine – characteristics of tool magazines – ATC operation – machining centers - adaptive control systems – ACC and ACO types - various operating modes of a CNC machine – Programmable Logic Controllers. **(9)**

CNC PROGRAMMING

Manual CNC Programming – Computer aided part programming - program verification aids – data processing unit - DNC system – CAD / CAM / CIM - manufacturing cell - FMS. **(9)**

Total: 45

TEXT BOOK

1. Yoram Koran, “Computer Control of Manufacturing Systems”, McGraw Hill Book Company, New York, 2000.

REFERENCE BOOKS

1. Yoram Koran and Joseph Benuri, “Numerical Control of Machine Tools”, Khanna Publishers, New Delhi, 2002.

2. Martin S.J., “Numerical Control of Machine Tools”, ELBS Publications, 1990.

3. Mikell P.Groover, “Automation, Production Systems and Computer-Integrated Manufacturing”, Prentice Hall of India, 2001.

4. Mikell P.Groover and Emory W.Zimmers, “CAD/CAM: Computer-Aided Design and Manufacturing”, Prentice Hall of India, 2001.

09ER05 DATABASE MANAGEMENT SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To provide basics of database technology with data models, to introduce current trends in this field with the knowledge of internal storage structures and to have an introductory knowledge about query processing techniques.

EXPECTED OUTCOME

At the end of the semester the learners will be able to develop application software to handle all type of database management systems.

INTRODUCTION

Introduction – Purpose of Database systems – View of data – Data models – DB languages – DBA – Database users – Overall system structure. **(9)**

ENTITY RELATIONSHIP MODEL

ER model – Basic concepts – Mapping constraints – Keys – ER Diagram – Design – Reduction to tables. **(9)**

RELATIONAL MODEL

Relational model – Structure – Relational algebra – Tuple relational calculus – Extended operations – Modification of the database – Views – SQL—basic structure – Set operations – Aggregate functions – Null values – Nested subqueries – Derived relations – Views – Modification — Embedded SQL . **(9)**

DESIGN AND ANALYSIS OF DB

Integrity constraints – Domain constraints – Referential integrity – Assertions – Triggers – Functional dependencies – Relational database design – Decomposition – Normalization using functional, multi-valued, join dependencies – Domain key normal form – Alternative approaches.**(9)**

OBJECT OREIENTED AND DISTRIBUTED DBS

Object oriented databases – Data model – Languages – Object relational databases –Parallel databases – Introduction – Interquery – Intraquery , Intraoperation – Interoperation parallelism– Distributed databases – Distributed data storage – Dead lock handling. **(9)**

Total: 45

TEXT BOOK

1. Abraham Silberschatz , Henry.F. Korth and S. Sudarshan. "Database System Concepts", III Edition , McGraw Hill , 1997.

REFERENCE BOOKS

1. Elmasri R. and Navathe S.B., "Fundamentals of Database Systems", Addison Wesley Publication, 2000.

2. Raghu Ramakrishnan and Johannes Gehrky, "Database Management System", McGraw Hill, 2000.

3. Bipin C.Desai , "An Introduction to Database Systems", West Publishing Company, 1994.

09ER06 DATA STRUCTURES AND ALGORITHMS

ASSESSMENT: THEORY

OBJECTIVE

The students will be detailed about the optimal design of an algorithm and selection of algorithms to solve the given problem. They are also trained to model the given problem through graphs and find an optimal solution for the same through performance analysis of algorithms designed.

EXPECTED OUTCOME

At the end of the course students should have a good understanding of the fundamental data structures used in computer science, have a good understanding of how several fundamental algorithms work to analyze the space and time efficiency of most algorithms and should be able to design new algorithms or modify existing ones for new applications and reason about the efficiency of the result.

INTRODUCTION AND BASIC DATA STRUCTURES

Problem solving Techniques and Examples - Abstract Data Type (ADT) - The List ADT – Arrays:- Array of structures – Polynomial representation – Multidimensional Arrays – Sparse Matrices – Transpose and Multiplication of Sparse Matrices - Stacks and Queues: Implementation and Applications. **(9)**

ADVANCED DATA STRUCTURES

Trees: Binary Tree - Tree Traversals - Binary Search Trees - AVL Trees – Splay Trees – B Trees – Red Black Trees. **(9)**

GRAPHS ALGORITHMS

Elementary Graph Algorithms - Minimum Spanning Trees – Topological Sorting - Single-source Shortest Paths - All Pairs Shortest Paths. **(9)**

SORTING AND HASHING

Insertion Sort – Shell Sort – Heap Sort – Merge Sort – Quick Sort – Radix Sort – External Sort - Analysis of Sorting Algorithms - Hashing :- Hash Functions - Separate Chaining - Open Addressing - Rehashing - Extendible Hashing. **(9)**

ALGORITHM DESIGN TECHNIQUES

The role of Algorithms in computing - Getting Started - Growth of functions. Introduction to algorithms design: Divide and Conquer - Dynamic Programming - Greedy Algorithm - Backtracking - Branch and Bound - Randomized Algorithms – Introduction to NP Problems. **(9)**

Total : 45

TEXT BOOKS

1. Weiss M.A., “Data Structures and Algorithm Analysis in C++”, Third Edition, Pearson Education, 2007.

2. Thomas H Cormen, Charles E Leiserson and Ronald L Rivest, “Introduction to Algorithms”, Second Edition, Prentice Hall of India, 2002.

REFERENCE BOOKS

1. Dromey R.G., “How to Solve it by Computers”, Pearson Education Asia, 2005.

2. Robert L Kruse, Clovis L Tando and Bruce P Leung, “Data Structures and Program Design in C”, Second Edition, Prentice Hall of India.

3. Jean Paul Trembley,Paul G Sorenson,“An Introduction to Data Structures with Applications”, Second Edition, Tata McGraw Hill, 2007.

09ER07 DESIGN OF SMALL MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To facilitate the students to have in depth knowledge in the design of important machines like servo motors, reluctance motors, universal motors, permanent magnet motors and synchros.

EXPECTED OUTCOME

The students are expected to have a good understanding on the design of fractional horse power machines.

DC MACHINES

Design of motors and generators – servomotors. **(9)**

PERMANENT MAGNET MACHINES

Use of ceramic (ferrite) permanent magnet – design and applications. **(9)**

SYNCHRONOUS MOTORS

Design of reluctance type, permanent magnet type and excited type – hysteresis motors. **(9)**

INDUCTION MOTORS

Design of small three-phase induction motors, single-phase induction motors, shaded pole and split phase universal motors. **(9)**

SPECIAL MOTORS

Two-phase servomotors – asynchronous tacho generators – their use as accelerometers – synchros – selsyn – switched reluctance motor. **(9)**

Total: 45

TEXT BOOK

1. C.G.Veinott, "Theory and Design of Small Induction Motors", McGraw Hill, 2000.

REFERENCE BOOKS

1. Yermolin N.P., “Small Electrical Machines”, Rajkamal Prakasham Pvt. Ltd., Delhi.
2. Spreadbury P.G., “Fractional Horsepower Electrical Motors”, Sir Issac Pitman and Sons 1957.
3. Shanmugasundaram, Ganagadharan G. and Palani R., “Electrical Data Book”, John Wiley, India, 1979.
4. Miller T.J.E., “Electronic Control of Switched Reluctance Machines”, New Publication 2001.

09ER08 - DIGITAL CONTROL SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To digitize the continuous-time controllers, to design controllers in discrete-time domain, to implement them using digital system such as microcontrollers, personal computers, etc and to analyze the systems and controllers in discrete-time state-space.

EXPECTED OUTCOME

At the end of the semester the learners will be able to analyze systems in discrete-time domain, determine the stability of the system in discrete-time domain and apply discrete-time state-space methods in system analysis.

INTRODUCTION

Basic concepts of digital control systems – block diagram - analog to digital and digital to analog conversion – sampling and hold devices – multiplexing - sampling and sampling theorems. **(9)**

Z TRANSFORM

Definition and evaluation – basic properties – inverse Z transform – pulse transfer function – starred Laplace transform - applications.**(9)**

MAPPING BETWEEN Z PLANE AND S PLANE

Representation of poles and zeros in the Z plane – relation between Z plane and S plane – mapping - correspondence between pole location in the Z plane and system time response – analysis of simple loop containing a discrete time controller. **(9)**

STABILITY ANALYSIS AND DESIGN

Jury's stability test - discrete root locus – frequency response methods – bilinear transformation — LMI techniques - design using root locus and Bode plot- discrete Nyquist stability criterion. **(9)**

DISCRETE STATE SPACE ANALYSIS

Introduction – state space representation of discrete systems – canonical forms – state transition matrix – solving discrete time state equations.**(9)**

Total : 45

TEXT BOOKS

1. Katsuhiko Ogata, “Discrete-Time Control Systems”, II Edition, Pearson Education Asia, Singapore, 2001.

2. Benjamin C. Kuo, “Digital Control Systems”, II Edition, Oxford University Press, 2004.

REFERENCE BOOKS

1. Gene F. Franklin J. David Powell and Michael Workman, “DigitalControl of Dynamic Systems”, Third Edition, Addison Wesley Longman, 2000.

09ER09 DIGITAL IMAGE PROCESSING

ASSESSMENT: THEORY

OBJECTIVE

To study the image fundamentals, mathematical transforms and image processing techniques necessary for image processing.

EXPECTED OUTCOME

The students will have fundamental knowledge of image processing techniques to carryout projects in image processing and machine vision.

DIGITAL IMAGE FUNDAMENTALS AND TRANSFORMS

Elements of visual perception - image sampling and quantization - relationship between pixels - geometric transformations - Discrete Fourier Transform - Properties of 2D Fourier Transform – FFT - Walsh, Hadamard and Discrete Cosine Transforms - Haar, Slant and Karhunen Loeve Transforms. **(9)**

IMAGE ENHANCEMENT TECHNIQUES

Spatial domain methods: Basic grey level Transformation - histogram equalization – image subtraction - image averaging - Spatial filtering: Smoothing and sharpening - Laplacian filters - Frequency domain filters: Smoothing and sharpening - homomorphic filtering. **(9)**

IMAGE RESTORATION

Model of image degradation / restoration process - noise models - inverse filtering – least mean square filtering - constrained least square filtering - blind image restoration – pseudo inverse - singular value decomposition. **(9)**

IMAGE SEGEMENTATION AND REPRESENTATION

Edge detection - thresholding - region based segmentation - basic morphological operations - Boundary representation: chain codes - polygonal approximation - boundary segments - Boundary descriptors: Fourier descriptors - regional descriptors. **(9)**

IMAGE COMPRESSION

Lossless compression: Variable length coding - LZW coding – Bit plane coding – Predictive coding - DPCM. Lossy Compression: Transform coding – Wavelet coding - Basics of Image compression standards: JPEG and MPEG. Basics of vector quantization. **(9)**

Total: 45

TEXT BOOK

1. Rafael C. Gonzalez, Richard E. Woods,"Digital Image Processing", III Edition, Prentice Hall of India, 2008.

REFERENCE BOOKS

1. William K Pratt, "Digital Image Processing", John Wiley Publications, NewYork, 2001.

2. Milan Sonka, Vaclav Hlavac, Roger Boyle, "Image Processing Analysis and Machine Vision", Brooks Cole Publishing Company, USA, 2001.

3. Arthur R.Weeks, "Fundamentals of Electronic Image Processing", Prentice Hall of India, 2003.

4. Jayaraman S., Esakkirajan S., Veerakumar T., " Digital Image Processing", Tata McGraw Hill, New Delhi, 2009.

09ER10 DIGITAL PROTECTION OF POWER SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

The students can acquire knowledge about various techniques used in digital protection of power systems.

EXPECTED OUTCOME

The students will be able to understand the various algorithms, DSP based protection and AI based protection systems.

INTRODUCTION TO COMPUTER RELAYING AND PROTECTIVE RELAYING ALGORITHMS

Development of computer relaying – historical background – computer relay operation – sample and hold circuits – converters – filters – different algorithms used for protection of power systems. **(9)**

TRANSMISSION LINE RELAYING

Sources of error – relaying as parameter estimation – different distance relay techniques – protection of series compensated line. **(9)**

PROTECTION OF TRANSFORMERS, MACHINES AND BUSES

Power transformer algorithms – generator protection – motor protection – digital bus protection. **(9)**

HARDWARE ORGANISATION

The nature of hardware issues – computer for relaying – supplementary equipment – redundancy and backup – servicing – training – maintenance. **(9)**

NEW RELAYING PRINCIPLES

Travelling waves due to faults - travelling wave distance relay – travelling wave differential relays – adaptive relaying – fault location algorithms – DSP based relay – AI based relaying techniques. **(9)**

Total: 45

TEXT BOOKS

1. Singh L.P., “Digital Protection – Protective Relaying from Electro Mechanical to Microprocessor”, New Age International Private Ltd., New Delhi, Chennai etc., 1994.

2. Madhava Rao T.S., “Power System Protection”, Tata McGraw Hill, New Delhi, 1989.

REFERENCE BOOKS

1. Arun G. Phadke and James S. Thorp, “Computer Relaying for Power Systems”, John Wiley and Sons Inc., New York, 1988.

2. Patra S.P., Basu S.K. and Choudri S., “Power System Protection”, Oxford and IBH Publishing Co., 1983.

3. Sunil S.Rao, “Switchgear and Protection”, Khanna Publishers, Delhi, 1994.

4. Badri Ram and D.N.Vishwakarma, “Power System Protection and Switchgear”, Tata McGraw Hill, New Delhi, 1994.

09ER11 ELECTRONIC PRODUCT DESIGN

ASSESSMENT: THEORY

OBJECTIVE

This subject provides a framework for developing electronic instrumentation, from hand-held devices to consoles. It offers practical design solutions for Printed Circuit Board fabrication, describes the interactions and priorities encountered in design solutions.

EXPECTED OUTCOME

The students will be able to integrate engineering principles with real applications from a systems perspective and fabricate printed circuit boards intended for projects in industries.

ERGONOMICS

Concept of a product – phases of development of an electronic product – pre-study phases, study phase, design, engineering, trial production phases, ergonomics for electronic equipments – definition – anthropometry – ergonomic requirements – ergonomics in industrial electronic equipments. **(9)**

ELECTRONIC COMPONENTS AND NOISE

Electronic components: Resistors, capacitors and inductors - types and characteristics – discrete and integrated circuit packages.

Noise in electronic equipments: Types and sources of electrical noise supply line transients, EMI, ESD and ground noises – radiated and conducted noise – wiring and noise coupling paths – partitioning – grounding – shielding – filtering. **(9)**

ENCLOSURES AND CABLES

Enclosure requirement – materials and various standards – classes of enclosures – signal, power and compensating cables – various types of board connectors. **(9)**

PRINTED CIRCUIT BOARD TECHNOLOGY

Printed Circuit Board materials and standards – manufacturing techniques – general design guidelines for PCBs – design guidelines

for analog, digital and power electronic circuit PCBs – Multilayer PCBs – soldering techniques – automation in PCB design and manufacturing – Introduction to SMD technology. **(9)**

INSTRUMENT TESTING

Types of testing – testing against EMI – environmental and mechanical testing – manufacturing cycle – automatic test equipments – quality and reliability. **(9)**

Total: 45

TEXT BOOKS

1. Kim R.Fowler, "Electronic Instrument Design", Oxford University Press, NewYork, 1996.

2. Walter C.Bosshart, "Printed Circuit Boards: Design and Technology", Tata McGraw Hill, New Delhi, 2005.

REFERENCE BOOKS

1. Anand M.S.,"Electronic Instruments and Instrumentation Technology", Prentice Hall of India, 2004.

2. John R Barnes, "Robust Electronic Design Reference Book", Volumes I and II, Kluwer Academic Publishers, NewYork, 2004.

3. Ott H.W., "Noise Reduction Techniques in Electronic System", John Wiley & Sons, NewYork, 1988.

4. Bruce R Archambeault, "PCB Design for Real-World EMI Control", Kluwer Academic Publishers, NewYork, 2002.

5. Mourad Samiha and Zorian Yervant, "Principles of Testing Electronic Systems", John Wiley & Sons, NewYork, 2000.

09ER12 FLEXIBLE AC TRANSMISSION SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To teach the students FACTS technology, which have come into widescale operation and offers further opportunities to improve the control of transmission systems under deregulated environment.

EXPECTED OUTCOME

On completion of this subject, the students would be able to understand modeling, study the operation of various FACTS controllers, their impact on AC transmission system and realize the need for reactive power compensation in AC transmission system.

INTRODUCTION

Reactive power control in electrical power transmission lines - Uncompensated transmission line - series compensation – Basic concepts of static VAR Compensator (SVC) – Thyristor Switched Series capacitor (TCSC) – Unified power flow controller (UPFC). **(9)**

STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS

Voltage control by SVC – Advantages of slope in dynamic characteristics – influence of SVC on system voltage – Design of SVC voltage regulator – Applications: Enhancement of transient stability – steady state power transfer – Enhancement of power system damping – prevention of voltage instability. **(9)**

THYRISTOR CONTROLLED SERIES CAPACITOR (TCSC) AND APPLICATIONS

Operation of the TCSC – Different modes of operation – Modeling of TCSC – Variable reactance model – Modeling for stability studies. Applications: Improvement of the system stability limit – Enhancement of system damping – Voltage collapse prevention. **(9)**

EMERGING FACTS CONTROLLERS

Static Synchronous Compensator (STATCOM) – Principle of operation – V-I Characteristics – Unified Power Flow Controller (UPFC)

– Principle of operation – Modes of Operation – Applications – Modeling of UPFC for Power Flow Studies. **(9)**

CO-ORDINATION OF FACTS CONTROLLERS

Controller interactions – SVC – SVC interaction – Co-ordination of multiple controllers using linear control techniques – Control coordination using genetic algorithms. **(9)**

Total: 45

TEXT BOOK

1. Mohan MathurR,RajivKVarma, "Thyristor-Based Facts Controllers for Electrical Transmission Systems," IEEE press and John Wiley & Sons, Inc., 2002, Reprint 2009.

REFERENCE BOOKS

1. John A.T., "Flexible A.C. Transmission Systems", Institution of Electrical and Electronic Engineers (IEEE), 1999.

2. Narain G. Hingorani and Laszlo Gyugyi, "Understanding FACTS," Wiley-IEEE Press, 1999.

3. Padiyar K.R., "Facts Controllers In Power Transmission and Distribution", New Age International, 2007.

09ER13 HIGH SPEED NETWORKS

ASSESSMENT: THEORY

OBJECTIVE

To introduce to the students the concept of Quality of Service, ATM networks , DSL, performance analysis using queuing models, Issues and protocols for routing and traffic management.

EXPECTED OUTCOME

Students will gain knowledge on the various high speed networks and learn about the analytical models for networks.

INTRODUCTION TO QoS

Introduction – need for speed and quality service – protocol and network fundamentals – packet switching and frame relay networks. **(6)**

ATM AND DSL

High-speed networks - ATM - ATM protocol architecture - ATM logical connections - ATM cells - digital subscriber link (DSL) - asymmetric DSL (ADSL) - high bit rate DSL (HDSL) - VHDSL - symmetric DSL (SDSL) - rate adaptive DSL (RADSL) - high speed LAN - fast Ethernet - gigabit internet - ATM LAN. **(10)**

PERFORMANCE ANALYSIS

Performance modeling and estimation - queuing analysis - queuing models - single server queues - multi server queues - self similarity - self similar data traffic modeling and estimation of self similar data traffic. **(11)**

TRAFFIC MANAGEMENT

Traffic management - link level flow and error control - link control mechanisms - ARQ performance - transport level traffic control - transmission control protocol (TCP) over ATM - real time transport protocol. **(9)**

ROUTING

Internet routing - overview of graph theory - least cost path - concept of graph theory - shortest path length determination - routing protocols - routing for high speed and multimedia traffic. **(9)**

Total : 45

TEXT BOOKS

1. William Stallings, “High Speed Networks – TCP/IP and ATM Design Principles”, Prentice Hall of India, 2008.

2. Dimitri Bertsekas and Robert Gallager, “Data Networks”, II Edition, Prentice Hall of India, 2000.

REFERENCE BOOKS

1. Tere Parnell, “Building High Speed Networks”, Tata McGraw Hill, 2000.

2. Keshav S., “An Engineering Approach to Computer Networking”, Addison Wesley, 1999.

09ER14 HIGH VOLTAGE TRANSMISSION SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To introduce the concepts, advantages and limitations of EHVAC and HVDC transmissions, modeling, analysis and operation of EHVAC and HVDC systems and to study the origin of over voltage in EHV systems and EHV cables and their protections.

EXPECTED OUTCOME

The learners will be able to appreciate the advantages and understand the limitations of High Voltage (HV) transmission systems. They will have an exposure on the cables used in HV transmission systems and learn the operational features of EHVAC and HVDC systems.

EHV AC AND HVDC TRANSMISSION – INTRODUCTION

Introduction to EHV AC and HVDC transmission – comparison between HVAC and HVDC overhead and underground transmission scheme – standard transmission voltages – factors concerning choice of HVAC and HVDC transmission – block diagram of HVAC and HVDC transmission schemes. **(6)**

EHV LINE CONDUCTORS

Properties of bundled conductors – inductance and capacitance of EHV lines – surface voltage gradient on single, double and more than three conductor bundles – corona effects – power loss – increase in radius of conductor – charge voltage diagram – qualitative study of corona pulses, their generation and properties. **(8)**

EHV AC SYSTEMS

Properties of EHV AC transmission at power frequency – generalized constants – power circle diagram and its use – voltage control using compensators – high phase order transmission. **(8)**

HVDC SYSTEMS

Review of rectification and inversion process – constant current and constant excitation angle modes of operations – analysis of DC transmission systems – harmonics on AC and DC sides and filters for their suppression – multi terminal DC transmission systems – parallel operation of AC and DC transmission systems – modern developments in HVDC transmission. **(12)**

OVER VOLTAGES & EHV CABLES

Over voltage in EHV systems, origin and types – ferro resonance over voltage – switching surges - reduction of switching surges - reduction of switching surges on EHV systems – introduction to EHV cable transmission – electrical characteristics of EHV cables – properties of cable insulation materials – EHV insulators – characteristics and pollution performance – protection of HVAC and HVDC systems. **(11)**

Total : 45

TEXT BOOKS

1. Rao S., "EHV AC and HVDC Transmission Engineering and Practice", I Edition, Khanna Publishers, Delhi, 1990.

2. Rakesh Das Begamudre, "EHV Transmission Engineering", Wiley Eastern Limited, 1990.

REFERENCE BOOKS

1. Miller T.J.E., "Reactive Power Control in Electric Systems". John Wiley and Sons, New York, 1980.

2. Dubey G.K., S.R.Doraida, Joshi A., and R.H.K.Sinha, "Thyristorised Power Controllers", Wiley Eastern Limited, 1992.

3. Adamson C., and Hingorani N.G., "HVDC Power Transmission", Garrowy Limited, England, 1960.

4. Kimbark E.W., "Direct Current Transmission – Volume I", Wiley Interscience, 1971.

09ER15 JAVA PROGRAMMING

ASSESSMENT: THEORY

OBJECTIVE

To introduce the basic concepts of Java programming technique, train the learners to handle the syntax and logical errors using exception and to familiarize the graphic user interface (GUI) programming technique.

EXPECTED OUTCOME

At the end of the semester the learners will be able to design GUI based applications in Java by handling errors and exceptions effectively and to design DBMS using JDBC.

INTRODUCTION

Introduction to java - advantages of java - java development environment - JVM - data types - variables - arrays - arithmetic operators - bit wise operators - relational and logical operators - operator precedence.

Conditional and looping structures - Class fundamentals - declaring objects - object reference variables - methods - constructors - *finalize* method - *this* key word - garbage collection - access control - command line argument. **(9)**

INHERITANCE AND EXCEPTION

Inheritance - *super* key word - multilevel hierarchy - method overloading and overriding - *final* key word - abstract classes - packages and interfaces - visibility control.

Exception handling - types - uncaught exceptions - using try, catch, throw, throws and finally - creating and using exception subclasses.**(9)**

THREADS

Threads - multi threaded programming - java thread model - thread class and runnable interface - creating multiple treads - priorities - synchronization.

String handling - I/O basics - streams - reading and writing files - serialization. **(9)**

APPLETS

Applet fundamentals - need for browsers - applet classes - simple programs using applets - event handling - delegation event model - event classes - listener interfaces - adapter classes. **(9)**

AWT

AWT classes - window fundamentals – layout managers - introduction to JDBC – networking. **(9)**

Total: 45

TEXT BOOK

1. Patrick Naughton and Herbert Schildt, “Java 2 - The Complete Reference”, Third Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1999.

REFERENCES

1. Bruce Eckel, “Thinking in Java”, Prentice Hall PTR, Upper Saddle River, New Jersey, 1998.

2. Patrick Noughton, “The Java Hand Book”, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

3. Deitel H.M., Deitel P.L, “JAVA – How to Program”, Prentice Hall of India, 1997.

4. Cay S., Horstmann and Geary Cornell, “Core Java2 – Volume I - Fundamentals”, Sun Micro Systems Press, Fifth Indian Reprint, 2001.

5. Cay S., Horstmann and Geary Cornell, “Core Java2 – Volume II –Advanced Features”, Sun Micro Systems Press, First Indian Reprint, 2000.

6. Dr. Styaraj Pantham, “Pure JFC Swing”, Tech Media Publishers, 1999.

09ER16 LINEAR AND NONLINEAR SYSTEMS THEORY

ASSESSMENT: THEORY

OBJECTIVE

To introduce the state-space concept, modeling of physical system in state-space, design controllers in state-space and also to introduce the concepts of nonlinearity, analysis of nonlinear systems.

EXPECTED OUTCOME

At the end of the course the learner will be able to model physical system in different types of state models, convert one model state model in to another state model, determine transfer function model from state model and find solution of state model. Further, they will be able to plot the phase portraits of nonlinear systems, analyze nonlinear systems using describing function methods and analyze the satiability of linear and nonlinear systems using Liapunov stability theorem.

STATE-SPACE ANALYSIS

Overview of classical control systems – advantages of state model - concepts of state, state variables and state model – state model for linear time-invariant continuous time systems – transfer function from state model – state transition matrix – properties - solution of state equations. **(9)**

DESIGN OF CONTROL SYSTEMS IN STATE-SPACE

Linear transformation – invariance of state model – concept of controllability and observability – controllable and observable canonical forms – Kalman and Gilbert tests – pole-placement by state feedback – Ackermann's formula – full order and minimum-order state observers.**(9)**

PHASE-PLANE ANALYSIS

Nonlinear systems – common physical nonlinearities – jump resonance – phase plane and phase portraits – singular points – types – construction of phase trajectories: analytical, isoclines, delta methods – limit cycle oscillations – stability analysis. **(9)**

DESCRIBING FUNCTION METHOD

Basic concepts – derivation of describing functions for saturation, dead-zone, backlash, ideal relay, relay with dead-zone, relay with saturation, relay with hysteresis – stability analysis by describing function.**(9)**

LIAPUNOV STABILITY ANALYSIS

Concepts of definiteness of sign – quadratic forms – Liapunov theorems on the stability and instability of nonlinear systems – asymptotic stability of linear systems by the second method of Liapunov – Krasovskki's theorem on the global asymptotic stability of nonlinear systems – variable-gradient method for generating Liapunov functions. **(9)**

Total : 45

TEXT BOOK

1. Nagrath J., and Gopal M., "Control Systems Engineering", Fourth Edition, New Age International, New Delhi, 2006.

REFERENCE BOOKS

1. John E. Gibson , "Nonlinear Automatic Control", McGraw-Hill Book Company, Inc, 1963.
2. Hassan K. Khalil, "Nonlinear Systems", Third Edition, Prentice Hall, 2001.
3. Shankar Sastry, "Nonlinear Systems", First Edition, Springer, 1999.

09ER17 MECHATRONICS

ASSESSMENT: THEORY

OBJECTIVE

To impart a blend of skills in mechanical engineering, electronics and computing to comprehend the mechatronics system design.

EXPECTED OUTCOME

The students will be introduced to a concurrent approach in the design of mechatronics system involving different disciplines to achieve more reliable and flexible systems.

INTRODUCTION

Definition of mechatronics - scope of mechatronics - key issues - integrated design in mechatronics - key elements - design process - simulation and block diagrams - mechanical translation systems - mechanical rotational systems - electro mechanical coupling – fluid systems. **(10)**

SMART SENSORS, TRANSDUCERS AND MOTION ACTUATORS

Sensors for measurement of motion, position, force, torque and flow – Tactile sensors – ultrasonic sensors – range sensor – electric position sensor – magnetostrictive transducer – fiber optic devices – Actuators – direct current motor - electric linear actuators – electric rotary actuators – permanent magnet stepper motor – fluid power actuation – piezo electric actuator. **(9)**

HARDWARE COMPONENTS

Binary logic – logic gates – relay logic – PC and PLC – transducer signal conditioning and devices for data conversion – programmable timers – counters – signals, systems and controls. **(8)**

FLEXIBLE AUTOMATION

Microprocessors and microcomputers in automation – real time interfacing – data acquisition – I/O process – computer interfacing – PLC programming – assembly automation – feeding elements – programmable interface adapter. **(9)**

ADVANCED APPLICATION

Sensors for condition monitoring – control in automated manufacturing – AI and Fuzzy logic in mechatronics – micro sensors – robotics and numerical control – programming – manipulator configuration. **(9)**

Total : 45

TEXT BOOKS

1. Devdas Shelty and Richand A. Kolk, “Mechatronics System Design”, PWS Publishing Company, BOSTON, USA, 1997.

2. Bolton W., “Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering”, Pearson Education, Addison Wesley, Second Edition, 2001.

REFERENCE BOOKS

1. HMT Ltd., “Mechatronics”, TMH, New Delhi, 1998.

2. David W.Pessan, “Industrial Automation – Circuit Design and Components”, John Wiley and Sons, Singapore, 1990.

3. Lawrence J.Kamm, “Understanding Electro-Mechanical Engineering An Introduction to Mechatronics”, PHI, 2000.

4. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, 2002 (Indian reprint).

09ER18 MEDICAL ELECTRONICS

ASSESSMENT: THEORY

OBJECTIVE

To teach the students the concepts of medical electronic equipments and applications.

EXPECTED OUTCOME

Upon completion of this course, students are expected to know about the physiology and anatomy of human system, analyze the cardiac, respiratory and neuro problems and to know about the medical equipment maintenance and management.

BIO-POTENTIAL ELECTRODES

Electrode electrolyte interface, resting and action potentials, polarisation and non- polarisable electrodes, calomel electrode, needle electrode, microelectrode biological amplifiers, lead systems and recording systems. **(9)**

CARDIAC SYSTEM

ECG sources - normal and abnormal waveforms, cardiac pacemaker-external pacemaker, implantable pacemaker, different types of pacemakers, fibrillation, defibrillator, AC defibrillator, DC defibrillator, arrhythmia monitor. **(9)**

NEUROLOGICAL SYSTEM AND SKELETAL SYSTEM

EEG - wave characteristics, frequency bands, spontaneous and evoked response. Recording and analysis of EMG waveforms, muscle and nerve stimulation, fatigue characteristics. **(9)**

RESPIRATORY MEASUREMENT AND VENTILATOR

Spirometer, Heart-Lung Machine, Oxygenators, Pnemograph, Artificial Respirator – IPR type, functioning. – Ventilators , Dialysis Machine – Blood Gas Analyser – Po_2, Pco_2, measurements. **(9)**

THERAPHATIC AND MONITORING INSTRUMENTS

Electromagnetic and ultrasonic blood flowmeter, equipments of physiotheraphy – Transcutaneous Electric Nerve Stimulator(TENS) -

ultrasonic theraphy- extra corporial shockwave lithotripsy- diathermy – audiometers – continous patient monitoring system – Medical Equipment Maintenance and Management. **(9)**

NOTE: A Term paper is to be submitted about a current topic in this field.

Total : 45

TEXT BOOK

1. Khandpur R.S, “HandBook of Biomedical Instrumentation”, Tata McGraw-Hill, New Delhi, 2004.

REFERENCE BOOKS

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, NewYork, 1998.

2. Leslie Cromwell, “Biomedical Instrumentation and Measurement”, Prentice Hall of India, New Delhi, 1997.

3. Joseph J.carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, John Wiley and sons, NewYork, 1997.

4. Prof. Venkataram S.K., “Biomedical Electronics and Instrumentation”, Galgotia Publications Pvt. Ltd., 2000.

09ER19 MODELING AND ANALYSIS OF ELECTRICAL MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To understand the dynamics of operation of electrical machines under normal and abnormal conditions.

EXPECTED OUTCOME

On completion of this course, the students can develop dynamic models and perform analyses of electrical machines.

PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION

Magnetic circuits – stored magnetic energy, co-energy – force and torque – singly and doubly excited system – MMF pattern for DC and AC machines – calculation of air gap mmf and per phase machine inductance using physical machine data. **(9)**

DC MACHINES

Voltage and torque equations – dynamic characteristics of permanent magnet and shunt DC motors – state equations – solution of dynamic characteristics by Laplace transformation. **(9)**

REFERENCE FRAME THEORY

Static and rotating reference frames – transformation of variables – reference frames – transformation between reference frames – transformation of a balanced set – balanced steady state phasor and voltage equations – variables observed from several frames of reference. **(9)**

INDUCTION MACHINES

Voltage and torque equations in machine variables – transformation in arbitrary reference frame – voltage and torque equation in reference frame variables – analysis of steady state operation – free acceleration characteristics – dynamic performance for load variations – computer simulation. **(9)**

SYNCHRONOUS MACHINES

Voltage and torque equation in machine variables – transformation in rotor reference frame (Park's equation) – voltage and torque equation in reference frame variables – analysis of steady state – dynamic performance for load variations – computer simulation. **(9)**

Total: 45

TEXT BOOKS

1. Paul C.Krause, Oleg Wasyzczuk, Scott D.Sudhoff, "Analysis of Electrical machinery and drive systems", IEEE Press, Second Edition, 2005.

2. Krishnan R., "Electrical Motor Drives, Modelling, Analysis and Control", Prentice Hall of India, 2002.

REFERENCE BOOKS

1. Fitzgerald A.E., Charles Kingsley, Jr. and Stephen D.Umans, "Electric Machinery", Tata McGraw Hill, Fifth Edition 1992.

2. Subramanyam V., "Thyristor Control of Electric Drives", Tata McGraw Hill Publishing Company Limited, New Delhi 1998.

09ER20 MODELING AND SIMULATION

ASSESSMENT: THEORY

OBJECTIVE

To expose the students to the fundamental modeling techniques, probability concepts, and to introduce the petri-net modeling tool.

EXPECTED OUTCOME

Learning this subject will make the student competent enough to model and analyze the performance of a system

SYSTEM AND SYSTEM ENVIRONMENT

Concept of a system-continuous and discrete systems - models of a system - modeling approaches - advantages and disadvantages of simulation systems – system dynamics – analysis of simulation output. **(6)**

PROBABILITY CONCEPTS IN SIMULATION

Random number generation - mid square-mid product method - constant multiplier method-additive congruential method - linear congruential method - test for random numbers - the Chi square test – the Kolmogrov - Srimov test – Runs test-Gaps test-Random variable generation-Distributions - exponential, Poisson, Uniform, Weibull - Empirical distribution-Normal distribution – building on empirical distribution – rejection method. **(12)**

STATE SPACE BASED MODELS

Markovian-Non Markovian models - Discrete and Continuous time Markov Chains - Markov reward models - Semi Markov models - Markov regenerative models. **(10)**

NON STATE SPACE METHODS

Performance models - queueing models - task precedence graphs - Dependability models-Reliability graphs - Fault trees. **(9)**

PETRI NET MODELS

Finite State Automata – Petri nets-Stochastic Petri nets – Stochastic Reward nets - Coloured Petri nets **(8)**

Term Paper: A Case study using any of the above modeling techniques

Total : 45

TEXT BOOKS

1. Geoffrey Gordon, “System Simulation”, Prentice Hall of India Second Edition, 2009

2. Trivedi K.S.,“Probability and Statistics with Reliability Queueing and Computer Science Applications”, II Edition, John Wiley and Sons, Newyork, 2001.

REFERENCE BOOKS

1. Gotrifed B. S., “Elements of Stochastic Process Simulation”, Prentice Hall 1984

2. Arson J.S., Banks J.C., and Nelson B.L., “Discrete Event System Simulation”, Prentice Hall of India, 1996.

3. Ajmone Marsan M., Kartson D., Conte G., and Donatelli S., “Modelling with generalized stochastic Petri nets”, Wiley, NewYork 1995

4. Donald Gross, J.F.Shortle, Thompson J.M., Harris C.M.,”Fundamentals of Queueing Theory” John Wiley, Fouth Edition, 2009.

09ER21 NEURAL NETWORKS AND FUZZY SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To offer a detailed understanding of the constituent methodologies expounded in neural networks and fuzzy logic to solve real time problems.

EXPECTED OUTCOME

The learners will be able to use neural network and fuzzy logic to achieve optimal solution for the given problem.

FUNDAMENTALS OF NEURAL NETWORKS

Introduction to Artificial Neural Networks – Biological Neural Networks –differences – fundamental models of Artificial Neural Networks – Mc Culloch Pitts Neuron model – Architecture – Learning Rules – Activation Functions – Hebb Network - Perception Network – Adaline and Madaline Networks and Associate memory Networks – Architecture, Algorithm and Applications. **(9)**

UNSUPERVISED LEARNING AND OTHER NEURAL NETWORKS

Hop field Network – Back propagation Network – Radial Basis function Network – Kohonen's Network – LVQ – Max Network - Hamming Network – Energy functions - Counter Propagation Network – Adaptive Resonance Theory – Neocognitron - Boltzmann machine – Architecture, Algorithm and Applications. **(9)**

FUNDAMETALS OF FUZZY LOGIC

Crisp set – Vagueness – Uncertainty and Imprecision – Fuzziness – Fuzzy set theory – Properties and Operations on Classical and Fuzzy sets – Crisp and Fuzzy Relations – Fuzzy Tolerance and Equivalence Relations – Membership Functions – Features – Fuzzification – Membership value assignments – Linguistic Variable – Fuzzy Truth Qualifier – Measure of Fuzziness. **(9)**

FUZZY MODELS AND CONVERSION

Introduction to Fuzzy Model – Fuzzy Logic Control – Structure of Fuzzy Logic Control – Fuzzification Models – Knowledge base – Rule base – Inference Engine – Fuzzy to Crisp Conversion – Lambda cuts for Fuzzy sets and Relations – Defuzzification Methods. **(9)**

APPLICATIONS OF NEURAL NETWORKS AND FUZZY LOGIC

Applications of Neural Networks : Pattern Recognition – Image Compression – Communication – Control Systems – Neuro Controller – Applications of Fuzzy Logic: Fuzzy Pattern Recognition -Fuzzy Image Compression – Fuzzy Logic Controllers – Introduction to Neuro-Fuzzy Control. **(9)**

Total: 45

TEXT BOOKS

1. Laurene Fausett, “Fundamentals of Neural Networks – Architecture, Algorithms and Applications”, Prentice Hall, 2008.

2. Timothy J.Ross, “Fuzzy Logic with Engineering Applications”, McGraw Hill Inc., 1997.

REFERENCE BOOKS

1. James A.Freeman and David Skapura, “Neural Networks Algorithms, Applications and Programming Techniques”, Addison Wesley, 2000.

2. Jacek M.Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, Delhi, 1997.

3. George J.Klir and Bo Yuan, “Fuzzy Sets and Fuzzy Logic – Theory and Applications”, Prentice Hall of India, New Delhi, 2000.

4. Chin - Teng. Lin and C.S.George Lee, “Neural Fuzzy Systems – A Neuro Fuzzy Synergism to Intelligent Systems”, Prentice Hall International Inc.

09ER22 PHYSICAL DESIGN OF VLSI CIRCUITS

ASSESMENT: THEORY

OBJECTIVE

To study the layout rules, methodologies and clocking strategies in the design of VLSI circuits and to study the placement and routing algorithms for optimal design of VLSI circuits.

EXPECTED OUTCOME:

The students will be familiar with physical design methodologies of VLSI circuits and analyze their performance.

INTRODUCTION TO VLSI TECHNOLOGY

Layout rules – circuit abstraction - cell generation using programmable logic array, transistor chaining, Wein Berger arrays and gate matrices – layout of standard cells, gate arrays and sea of gates - Field Programmable Gate Arrays (FPGAs) – layout methodologies – packaging - computational complexity - algorithmic paradigms. **(9)**

PLACEMENT USING TOP-DOWN APPROACH

Partitioning: Approximation of hyper graphs with graphs - Kernighan-Lin Heuristic ratiocut - partition with capacity and I/O constraints - floor planning - rectangular dual floor planning - hierarchial approach - simulated annealing - floor plan sizing – placement - cost function – force directed method - placement by simulated annealing - partitioning placement - module placement on a resistive network - regular placement – linear placement. **(9)**

ROUTING USING TOP-DOWN APPROACH

Fundamentals: Maze running – line searching - Steiner trees - Global Routing: Sequential approaches - hierarchial approaches - multicommodity flow based techniques - randomized routing - one step approach - integer linear programming - Detailed routing: Channel routing – switch box routing - routing in FPGA - array based FPGA - row based FPGAs. **(9)**

PERFORMANCE ISSUES IN CIRCUIT LAYOUT

Delay Models: Gate Delay Models - Models for interconnected Delay - Delay in RC trees - Timing Driven Placement - Zero Stack Algorithm - Weight based placement - Linear Programming Approach - Timing Driven Routing - Delay Minimization - Clock Skew Problem -Buffered Clock Trees – Minimization - Constrained via Minimization - Unconstrained via Minimization - Other issues in Minimization. **(9)**

SINGLE LAYER ROUTING, CELL GENERATION AND COMPACTION

Planar Subnet Problem (PSP) - Single layer global routing - Single layer detailed routing - Wire length and bend minimization technique - Over The Cell (OTC) Routing - Multiple Chip Modules (MCM) - Programmable Logic Arrays - Transistor Chaining - Wein Burger Arrays - Gate matrix layout -1D compaction - 2D compaction. **(9)**

Total: 45

TEXT BOOK

1. Sarafzadeh, C.K.Wong, “An Introduction to VLSI Physical Design”, McGraw Hill, NewYork, 1995.

REFERENCE BOOKS

1. Sadiq M.Sait, Habib Youssef, “VLSI Physical Design Automation, Theory and Practice”, World Scientific Publishing Company, Singapore, 2009.

2. Bryan T. Preas, Michael Lorenzetti, “Physical Design and Automation of VLSI Systems”, The Benjamin-Cummins Publishers Company, Netherlands, 1998.

3. Naveed A.Sherwani, “Algorithm for VLSI Physical Design Automation”, Third Edition, Springer Publishers, NewYork, 1998.

4. Ban Wong, Anurag Mittal, Yu Cao, Greg Starr, “Nano CMOS Circuit and Physical Design”, John Wiley & Sons, NewYork, 2004.

09ER23 POWER QUALITY

ASSESSMENT: THEORY

OBJECTIVE

Introduction and analysis of power quality and harmonic phenomena in electric power systems: characteristics and definitions, voltage sags, electrical transients, harmonics, mitigation techniques, standards of power quality and harmonics.

EXPECTED OUTCOME

The students will have thorough understanding of the concept of utility distribution and industrial electric power quality phenomena. They are proficient in the analysis of power quality disturbances: voltage sags, motor starting, transient phenomena, and harmonics. They are fully trained in designing and evaluating the solutions to mitigate power quality disturbances.

INTRODUCTION TO POWER QUALITY

Power Quality definition – Need for power quality – sensitive loads – Non linear loads – inter connected power systems – Deregulation – Power quality characteristics – types of power quality problems – Transients-Impulsive, Oscillatory - Voltage Variations-Short, Long Duration-Voltage Imbalance-Waveform Distortions: - DC Offset, Harmonics, Notching, Noise - Power Frequency Variations. Sources of power quality problems – Effects of power quality problems – Responsibilities of the suppliers and user of electrical power – power quality standards- Computer Business Equipment Manufacturers Associations (CBEMA) curve. **(6)**

SHORT INTERRUPTIONS AND LONG INTERRUPTIONS

Introduction – Origin of short interruptions : Voltage magnitude events due to re-closing, Voltage during the interruption – Monitoring of short interruptions –Influence on induction motors, Synchronous motors, Adjustable speed drives, Electronic equipments – Single phase tripping : Voltage during fault and post fault period, Current during fault period – Prediction of short Interruptions.

Definition – Failure, Outage, Interruption – Origin of interruptions – Causes of long interruptions – Principles of regulating the voltage – Voltage regulating devices, Applications : Utility side, End-User side –Reliability evaluation – Cost of interruptions. **(9)**

VOLTAGE SAG AND TRANSIENTS

Introduction – Definition – Magnitude, Duration – Causes of Voltage Sag – Three Phase Unbalance – Phase angle jumps – Load influence on voltage sags on Adjustable speed drives, Power electronics loads, Sensitive loads - Stochastic assessment of voltage sags - Overview of mitigation methods. Definition – Power system transient model – Principles of over voltage protection - Types and causes of transients – Devices for over voltage protection - Capacitor switching transients –Lightning transients – Transients from load switching. **(9)**

HARMONICS, WIRING AND GROUNDING

Sources – Definitions and terms – standards and measures – Impacts – Voltage Distortion - Current Distortion - Examples and case studies – Harmonics on power systems devices – Transformers – Capacitor banks – Calculation of Harmonic Voltage and Currents in Single Phase And Three Phase Converters - Current Harmonics in Converters with Inductive/Capacitive Filters. AC motor – cables – Guidelines for harmonics voltage and current limitation. IEEE and IEC standards. Definitions and terms – Reasons for grounding – National Electrical Code (NEC) grounding requirements – Utility Power system grounding – End-User power system grounding – Wiring and grounding problems. **(11)**

POWER QUALITY MONITORING AND SOLUTIONS

Introduction – Power quality monitoring : Need for power quality monitoring, Evolution of power quality monitoring, Deregulation effect on power quality monitoring – Power factor improvement – Brief introduction to power quality measurement equipments and power conditioning equipments – Planning, Conducting and Analyzing power quality survey – Mitigation and control techniques - Active Filters for Harmonic Reduction. **(10)**

Total: 45

TEXT BOOK

1. Roger. C., Dugan, Mark. F., McGranagham, Surya santoso, H Wayne Beaty, " Electrical Power Systems Quality", McGraw Hill, 2003.

REFERENCE BOOKS

1. Barry W. Kennedy, "Power Quality Primer" MC Graw Hill Publications, New York.

2. Sankaran C., " Power Quality" CRC Press, 2002, New York.

3. Heydt G.T., "Electric Power Quality", Second Edition.West Lafayette, IN,Stars in a Circle Publications,1994.

4. Bollen M.H.J., "Understanding Power Quality Problems: Voltage Sags and Interruptions", NewYork: IEEE Press, 1990.

5. Arrillaga J., Watson N.R., Chen S., Power Systems Quality Assessment New York Wiley, 1999.

6. Soares Book on Grounding and Bonding, Ninth Edition, Richardson, TX: International Association of Electrical Inspectors, 2004

7. NEC 2005 HandBook, M.W. Early, Editor, Massachusetts, National Fire Protection Association, 2005.

8. Handbook of Power Signatures: Second Edition Revised and Expanded, Dranetz – BMI, 2000.

9. Arrillaga J., Watson N.R., Chen S., "Power System Quality Assessment", John Wibey&Sons 2000, New York.

10.Derek.A.Paice, "Power Electronic Converter Harmonics", IEEE Industrial Application Society, IEEE Press, New York 1996.

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

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

09ER24 POWER SYSTEM CONTROL

ASSESSMENT: THEORY

OBJECTIVE

To familiarize various control actions to be implemented to meet the variations of system load, to understand and model real and reactive power controls, to get an overview of economic dispatch and to have an introductory knowledge in recent trends of power system controls.

EXPECTED OUTCOME

The students will be able to understand control of real power and reactive power by frequency and voltage control respective, learn computer control of power systems and learn economic dispatch control techniques.

INTRODUCTION

Need for voltage and frequency regulation in power system - system load characteristics - basic P-f and Q-v control loops - cross coupling between control loops - plant level and system level controls - recent trends of real-time control of power systems. **(5)**

REAL POWER AND FREQUENCY CONTROL

Fundamentals of speed governing mechanisms and modeling – speed – load characteristics - regulation of two synchronous machines in parallel – control areas –LFC control of a single area – static and dynamic analysis of uncontrolled and controlled cases - multi-area systems – two area system modeling - static analysis -uncontrolled case - tie line with frequency bias control of two-area and multi-area system – steady state instabilities. **(15)**

REACTIVE POWER – VOLTAGE CONTROL

Typical excitation system – modeling – static and dynamic analysis – stability compensation - effect of generator loading - static shunt capacitor/reactor VAR compensator, synchronous condenser, tap-changing transformer - static VAR system - modeling – system level voltage control. **(8)**

COMPUTER CONTROL OF POWER SYSTEMS

Energy control center functions – system hardware configuration SCADA system – functional aspects – security monitoring and control system states and their transition - various controls for secure operation. **(10)**

ECONOMIC DISPATCH CONTROL

Incremental cost curve – co-ordination equations with loss and without losses, solution by iteration method. (No derivation of loss coefficients). Base point and participation factors. Economic controller added to LFC control. **(7)**

Total: 45

TEXT BOOKS

1. Olle I.Elgerd, “Electric Energy and System Theory – An Introduction”, Tata McGraw Hill Publishing Company, New Delhi. 1983.

2. Kirchmayer .L.K. “Economic operation of power system”, John Wiley & Sons, 1953.

REFERENCE BOOKS

1. Allen J.Wood, Bruce F.Woolenbarg, “Power Generation Operation and Control”, John Wiley and Sons, 1984.

2. Mahalanbis, A.K., Kothari, D.P and Ahson, S.I., “Computer Aided PowerSystem Analysis and Control”, Tata McGraw Hill Publishing Company, New Delhi, 1990.

3. Kundur, “Power System Stability and Control”, McGraw-Hill Pub.Co., 1994.

09ER25 POWER SYSTEM ECONOMICS

ASSESSMENT: THEORY

OBJECTIVE

To provide a comprehensive up-to-date economics frame work for understanding the critical issues associated with power system.

EXPECTED OUTCOME

The learners will be able to formulate the objective function with constraints for conventional power generation systems and manage the available power to meet the load variations through optimal load sharing.

INTRODUCTION

Operational problems of power system – review of economic dispatch and loss formula calculations. **(9)**

OPTIMAL POWER FLOW

Formulation of OPF problem – cost minimization – loss minimization – solution using NLP methods – successive LP methods. **(9)**

HYDRO THERMAL COORDINATION

Long range and short range hydro scheduling – A gradient approach – hydro units in series – pumped storage hydro plants – solution method used in iteration and dynamic programming. **(9)**

UNIT COMMITMENT

Constraints in unit commitment – thermal unit constraints – hydro constraints – solution methods – priority list methods – dynamic programming solution. **(9)**

MAINTENANCE SCHEDULING

Preparation of maintenance schedules for generating units – turbines – boilers – taking into account forced outages and normal outages – optimal maintenance – scheduling - using mathematical programming. **(9)**

Total: 45

TEXT BOOK

1. Kirchmayer L.K., “Economic Operation of Power Systems”, John Wiley and Sons Inc., New York, 1953.

REFERENCE BOOKS

1. Allen J. Wood and Bruce F.Wollenberg, “Power Generation, Operation and Control”, John Wiley and Sons, New York and Singapore, 1984.

2. Murthy P.S.R., “Power System Operation and Control”, Tata McGraw Hill, New Delhi, 1984.

3. Kirchmayer L.K., “Economic Control of Interconnected Systems”, John Wiley and Sons, New York, 1959.

4. Elgerd O.I., “Electric Energy System Theory An Introduction”, Tata McGraw Hill, New Delhi, 1971.

5. Berger A.R., “Power System Analysis”, Prentice Hall, New Jersey, 1986.

6. Mahalanabis A.K., Kothari D.P., and Ahson S.I., “Computer Aided Power System Analysis and Control”, Tata McGraw Hill, New Delhi, 1990.

09ER26 PROGRAMMABLE LOGIC CONTROLLERS

ASSESSMENT: THEORY

OBJECTIVE

To study the hardware features and internal operations of PLC and to know the PLC communication facilities used in Automation.

EXPECTED OUTCOME

The learners will be able to carryout PLC installation, programming and maintenance in real time Industrial applications.

INTRODUCTION

Programmable controller –need for PLC – modular PLC and fixed PLC – block diagram of PLC – input and output modules – power supply – types of PLC system. **(9)**

HARDWARE DESIGN

CPU – processor's function – processor's operating system – processor ports – interfacing PC to PLC – processor operating modes – PLC system memory and application memory – input modules – output modules – module selection – PLC internal operation and signal processing – input and output processing – timing consideration. **(9)**

PROGRAMMING OF PLC SYSTEM

System functions – sequence control – ladder logic – programming sequences – limitation of ladder programming – logic instruction sets – standard PLC functions – special function relays - timers – counters – shift registers – data handling instructions – arithmetic instructions – data manipulation – program subroutines – programming examples. **(9)**

PLC COMMUNICATION AND AUTOMATION

Introduction to PLC Networking – Networking Standards – Protocols – Field Bus – Process Bus and Ethernet - communication between several PLCs – Distributed Control System (DCS) – Architecture - DCS system integration with PLC and computers - communication in DCS – Introduction to SCADA – Comparison between SCADA and DCS – data highways – redundancy concepts – Manufacturing Automation Protocol (MAP) – Technical Office Protocol (TOP). **(9)**

APPLICATIONS AND PLC MAINTENANCE

PLC as robot controller and FMS – PLC to factory automation – PLC in process control – PLC maintenance – internal PLC faults – faults external to PLC – programmed error – watch dogs – safety – hardware safety circuits – troubleshooting. **(9)**

Total: 45

TEXT BOOK

1. Ian G.Warnock, “Programmable Controllers Operation and Application”, Prentice Hall International, UK, 1992.

REFERENCE BOOKS

1. Gary Dunning, “Introduction to Programmable Logic Controllers”, International Thomson Publishing Company, USA, 1998.

2. John W. Webb and Ronald A.Reis, “Programmable Logic Controllers – Principles and Applications”, III Edition, Prentice Hall Inc., New Jersey, 1995.

3. Hughes T., “Programmable Logic Controllers”, ISA Press, 1994.

4. Krishnakant , “Computer Based Industrial Control”, Prentice Hall of India, 1997.

5. Lukcas M.P., “Distributed Control Systems”, Van Nostrand Reinhold Co., New York, 1986.

09ER27 REAL TIME SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To introduce the real time system concepts, the real time programming languages, and performance evaluation of real time systems.

EXPECTED OUTCOME

Students studying this course will gain proficiency in designing a real time system for critical applications.

INTRODUCTION

Introduction - issues in real time computing - structure of a real time system - task classes - performance measures for real time systems - estimating program run times – task assignment and scheduling - classical uniprocessor scheduling algorithms – uniprocessor scheduling of IRIS tasks - tasks assignment - mode changes - fault tolerant scheduling. **(9)**

PROGRAMMING LANGUAGES AND TOOLS

Language features - desired language characteristics - data typing - control structures - facilitating hierarchical decomposition - package - run-time error handling - overloading and generics - multitasking - low level programming - task scheduling - timing specifications - programming environments - run-time support – code generation. **(9)**

REAL TIME DATABASES

Real time database - basic definition - real time Vs general-purpose database – main memory databases - transaction priorities - transaction aborts - concurrency control issues - disk scheduling algorithms - two-phase approach to improve predictability - maintaining serialization consistency - databases for hard real time systems. **(9)**

COMMUNICATION

Real time communication - communications media - network topologies - protocols – buffering data – synchronization – dead lock –

mail boxes and semaphores - fault tolerance techniques - fault types - fault detection - fault error containment - redundancy – data diversity - reversal checks - integrated handling. **(9)**

EVALUATION TECHNIQUES

Reliability evaluation techniques - reliability models for hardware redundancy – software error models – response time calculation – interrupt latency – time loading and its measurement – reducing response times – analysis of memory requirements – reducing memory loading. **(9)**

Total : 45

TEXT BOOK

1. Krishna C.M., Kang G. Shin, “Real Time Systems”, McGraw-Hill International Edition, 1997.

REFERENCE BOOKS

1. Philip A. Laplante, “Real Time Systems Design and Analysis – An Engineers Handbook”, Second Edition - IEEE Press, IEEE Computer Society Press, 2001.

2. Stuart Bennett, “Real Time Computer Control - An Introduction”, Second Edition, Pearson Education, 2005.

3. Peter D Lawrence, “Real Time Micro Computer System Design -An Introduction”, McGraw-Hill, 1988.

4. Allworth S.T. and Zobel R.N., “Introduction to Real Time Software Design”, Macmillan, Second Edition, 1987.

09ER28 RENEWABLE ENERGY SOURCES AND POWER GENERATION

ASSESSMENT: THEORY

OBJECTIVE

To promote the importance of the renewable energy sources and its need to meet growing demand.

EXPECTED OUTCOME

The students will be trained to know about various renewable energy resources and their importance in meeting the energy demand, optimizing the design of electrical utilities and energy saving aspects.

INTRODUCTION

Trends in energy consumption – World energy scenario – energy sources and their availability – conventional and renewable sources – need to develop new energy technologies. **(8)**

ENERGY CONVERSION

Solar Thermal Electric Conversion - Principle of solar thermal power generation – Low and medium temperature systems – Sterling cycle solar thermal power generation – Brayton cycle – tower concept – cost effectiveness.

Photovoltaic Energy Conversion: Solar radiation and measurement – Solar cells and their characterization – influence of insolation and temperature. PV arrays – electrical storage with batteries – charge controllers.

MHD Energy Conversion: Principle of magneto hydrodynamic (MHD) power generation – types of MHD systems – advantages. **(10)**

POWER CONDITIONING SCHEMES

DC power conditioning converters – Maximum power point tracking algorithms – AC power conditioners – line commutated thyristor inverters – Synchronized operation with grid supply – stand-alone inverters. Applications - Water pumping, refrigeration, street lighting, audio-visual equipments – economic analysis of PV systems. **(10)**

WIND ENERGY SYSTEMS

Basic principle of wind energy conversion – nature of wind – power in the wind – Site selection considerations - components of Wind Energy Conversion System (WECS) – Classification of WECS – Generating Systems – Schemes of electrical generation - generator control – load control – Energy storage - Interconnected. **(9)**

ENERGY FROM OCEANS AND MISCELLANEOUS SOURCES

Ocean thermal energy conversion – methods of ocean thermal electric power generation – energy from tides – ocean waves – mini and micro hydel power generation – hybrid systems.

Principle of operation of solar ponds – types of solar ponds – extraction of thermal energy – electrical power generation from solar pond – Desalination and industrial process heating. **(8)**

Total : 45

TEXT BOOK

1. Rai G.D., "Non-Conventional Energy Sources", Khanna Publishers, 2004.

REFERENCE BOOKS

1. Bhadra S.N., Kastha D., Banerjee S., "Wind Electrical Systems", Oxford University Press, 2005.

2. Sutton, "Direct Energy conversion", McGraw Hill, 1996.

3. Rai G.D., "Solar Energy Utilization", Khanna Publishers, IV Edition, 2002.

4. Daniel Hunt V., "Wind Power – A Hand Book of WECS Systems", Van Nostrand and Co., New York, 1981.

5. Rakosh Das Begamudre, "Energy Conversion Systems", New Age Publishers, New Delhi, 2000.

09ER29 RESOURCE MANAGEMENT TECHNIQUES

ASSESSMENT: THEORY

OBJECTIVE

To provide an introduction to resource management techniques, linear programming and game theory based solutions, inventory control techniques and algorithms for nontraditional optimization.

EXPECTED OUTCOME

Various resource management concepts learnt by students through the study of this subject will provide them the exposure to the underlying techniques of optimal resource usage.

LINEAR PROGRAMMING

Linear programming formulation – graphical solution – simplex method – two phase method – big M method – primal and dual problems – degeneracy – unbounded solution – infeasible solution – transportation methods – assignment models – traveling salesmen problem. **(9)**

SEQUENCING AND GAME THEORY

Johnson's rule – processing 'n' jobs through 'm' machines – game theory – two person zero sum games – pure strategies and saddle points – mixed strategies – solution of games by dominance – graphical solution – linear programming model in game theory. **(9)**

PROJECT MANAGEMENT AND INVENTORY CONTROL

Definition of a project – Fulkerson's rule – PERT Network construction – critical path identification – CPM crashing – resource scheduling – inventory control functions – EOQ models for purchase manufacturing (with/without shortages) – Dynamic order quantity – ABC analysis – re-order level. **(9)**

SYSTEM SIMULATION AND QUEUEING THEORY

Systems concepts – types of systems and models – system simulation procedure – Monte Carlo simulation method (simple problems) – introduction to simulation languages (continuous/discrete) – queueing model – Kendall notations – single channel, multi-channel service models for infinite population (No derivations - only problems).**(9)**

NON-TRADITIONAL OPTIMIZATION ALGORITHMS

Genetic algorithms – working principles – difference between GA and traditional methods – similarities between GA and optimization methods – simulated annealing – global optimization – simple simulation procedure for the above. **(9)**

Total : 45

TEXT BOOKS

1. Ravindren, Phillips and Solberg, “Operations Research Principle and Practice”, John Wiley and Sons, 2000.

2. Dharani Venkatakrishnan S., “Operations Research”, Keerthi Publishing House (P) Ltd., 1998.

REFERENCE BOOKS

1. Kalyanmoy Deb, “Optimization for Engineering Design – Algorithm and Examples”, Prentice Hall of India, 2000.

2. Hamdy A.Taha, “Operations Reasearch – An Introduction”, Prentice Hall of India, 2000.

3. Hillier.F and Leberman.G, “Operations Research - An Introduction”, Tata McGraw Hill, 2000.

09ER30 RESTRUCTURED POWER SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To impart the students the latest advancements in power system industry around the world other than India. The subject covers the restructuring and deregulation of the power utility industry to meet the technological and regulatory changes under globalization.

EXPECTED OUTCOME

On completion of this course, the students will understand the world electricity market scenario in structured environment, the trading concepts, electricity pricing under deregulated environment and compare that with existing Indian systems. They will also be trained to model the restructured power system.

OVERVIEW OF KEY ISSUES IN ELECTRIC UTILITIES RESTRUCTURING

Restructuring Models: PoolCo Model, Bilateral Contracts Model, Hybrid Model - Independent System Operator (ISO): The Role of ISO - Power Exchange(PX): Market Clearing Price(MCP) - Market operations: Day-ahead and Hour-Ahead Markets, Elastic and Inelastic Markets - Market Power - Stranded costs - Transmission Pricing: Contract Path Method, The MW-Mile Method - Congestion Pricing: Congestion Pricing Methods, Transmission Rights - Management of Inter-Zonal/Intra Zonal Congestion: Solution procedure, Formulation of Inter-Zonal Congestion Sub problem, Formulation of Intra-Zonal Congestion Sub problem. **(9)**

ELECTRIC UTILITY MARKETS IN THE UNITED STATES:

California Markets: ISO, Generation, Power Exchange, Scheduling Co-ordinator, UDCs, Retailers and Customers, Day-ahead and Hour-Ahead Markets, Block forwards Market, Transmission Congestion Contracts(TCCs) - New York Market: Market operations - PJM interconnection - Ercot ISO - New England ISO - Midwest ISO: MISO's Functions, Transmission Management, Transmission System Security, Congestion Management, Ancillary Services Coordination, Maintenance Schedule Coordination - Summary of functions of U.S. ISOs. **(9)**

OASIS: OPEN ACCESS SAME-TIME INFORMATION SYSTEM

FERC order 889 - Structure of OASIS: Functionality and Architecture of OASIS - Implementation of OASIS Phases: Phase 1, Phase 1-A, Phase 2 - Posting of information: Types of information available on OASIS, Information requirement of OASIS, Users of OASIS - Transfer Capability on OASIS: Definitions, Transfer Capability Issues, ATC calculation, TTC calculation, TRM calculation, CBM calculation - Transmission Services - Methodologies to calculate ATC - Experiences with OASIS in some Restructuring Models: PJM OASIS, ERCOT OASIS.**(9)**

ELECTRIC ENERGY TRADING

Essence of Electric Energy Trading - Energy Trading Framework: The Qualifying factors - Derivative Instruments of Energy Trading: Forward Contracts, Futures Contracts, Options, Swaps, Applications of Derivatives in Electric Energy Trading - PortFolio Management: Effect of Positions on Risk Management - Energy Trading Hubs - Brokers in Electricity Trading - Green Power Trading. **(9)**

ELECTRICITY PRICING - VOLATILITY, RISK AND FORECASTING

Electricity Price Volatility: Factors in Volatility, Measuring Volatility - Electricity Price Indices: Case Study for Volatility of Prices in California, Basis Risk - Challenges to Electricity Pricing: Pricing Models, Reliable Forward Curves - Construction of Forward Price Curves: Time frame for Price Curves, Types of Forward Price Curves – Short-term Price Forecasting: Factors Impacting Electricity Price, Forecasting Methods, Analyzing Forecasting Errors. **(9)**

Total: 45

REFERENCE BOOKS

1. Stagg G.W., A.H.El.Abiad “Computer Methods in Power System Analysis”, McGraw Hill, 1968.

2. M.K. Jain, N.D.Rao, G.J.Berg, “Improved Area Interchange Control Method for use with any Numerical Technique”, I.E.E.E. P.E.S Winter Power Meeting 1974.

3. J.P.Britton, “Improved Area Interchange Control for Newton’s method Load Flows”, Paper 69 TP 124-PWR presented at IEEE Winter Power Meeting, New York, Jan 26-31, 1969.

4. Tinney W.F. and Meyer W.S., “Solution of Large Sparse System by Ordered Triangular Factorization” IEEE Trans. on Automatic Control, Vol : AC-18, pp:333-346, Aug 1973.

5. Zollenkopf K., “Bi-Factorization : Basic Computational Algorithm and Programming Techniques; pp:75-96 ; Book on “Large Sparse Set of Linear Systems” Editor: J.K.Rerd, Academic Press, 1971.

09ER31 ROBOTICS AND CONTROL

ASSESSMENT: THEORY

OBJECTIVE

To study the development of robot mechanisms, the basic principles expounded in the design, analysis and synthesis of robotic system.

EXPECTED OUTCOME

The learners will be able to conduct research activities in computer vision, machine intelligence and related areas of robotic system.

INTRODUCTION

Evolution of robotics - Laws of robotics – types - robot anatomy – specification of robot -– resolution, repeatability and precision movement. Introduction to robot arm kinematics and dynamics – planning of manipulator trajectories. **(9)**

ROBOTIC DRIVES AND CONTROL

Hydraulic, Electric and Pneumatic drives – linear and rotary actuators – end-effectors – types. Control of robot manipulator. Variable structure control – non-linear decoupled and feedback control – PD control scheme – effect of external disturbance – PID control scheme – resolved motion control - computed torque control, force control of robotic manipulators. Hybrid position / force control and adaptive control. **(9)**

ROBOTIC SENSORS

Sensors in robotics- status sensors, environmental sensors, quality control sensors, safety sensors and work cell control sensors. Classification of robotic sensors – non optical and optical position sensors – velocity sensors – proximity sensors – contact and non contact type – touch and slip sensors – force and torque sensors – selection of right sensors. **(9)**

ROBOTIC VISION SYSTEMS

Architecture of robotic vision system – stationary and moving camera – image acquisition - image representation – image processing and image

segmentation. Object location – pick and place – object identification – visual inspection – visual guidance – role of embedded system in robotic vision. **(9)**

ROBOTIC APPLICATIONS

Industrial applications – future scope of robotics - multiple robots – safety in robotics – robot intelligence and task planning – artificial intelligence – application of AI and knowledge based expert systems in robotics. Methods of robot programming. **(9)**

Total : 45

TEXT BOOK

1. Fu, K.S., Gonzalez RC., and Lee C.S.G., "Robotics Control, Sensing Vision and Intelligence", Mc Graw Hill, 1987.

REFERNCE BOOKS

1. Kozyrey, Yu. "Industrial Robotics", MIR Publishers Mascow, 1985.

2. Deb. S.R, "Robotics Technology and Flexible Machine Design", Tata McGraw Hill, 2005.

3. Mikell. P. Groover, Michell Weis, Roger. N. Nagel, Nicolous G. Odrey, "Industrial Robotics Technology, Programming and Applications ", Mc Graw Hill, Int 2005.

4. Richard D Klafter Thomas A.Chmielewski and Michael Negin, "Robotic Engineering: An Integrated approach", Prentice Hall of India, New Delhi, 2005.

5. Robert J Schilling, " Fundamentals of Robotics: Analysis and Control", Prentice Hall of India, New Delhi, 2005.

6. Nagrath I.J., Mittal R.K., "Robotics and Control", Tata McGraw Hill, Sixth Reprint, 2007.

09ER32 SMPS BASED POWER CONVERTERS

ASSESSMENT: THEORY

OBJECTIVE

To understand the basic principles of switch mode conversion and apply them to the design of different topologies. To solve problems encountered when designing high-frequency switched mode power supply with closed loop stability.

EXPECTED OUTCOME

The student will be able to analyze the steady state operation of DC-DC converters. They can understand the process of analyzing the waveforms. They can design non-isolated and isolated DC-DC converters. They also can design the magnetic components like transformers, inductors and current transformers for a given application. They can understand the soft switching techniques.

INTRODUCTION

Selection of different types of converters – power supply and system grounds – use and design of clamps and snubbers – RFI and EMI design considerations – power supply and product safety considerations. **(9)**

SWITCHING POWER SUPPLY TOPOLOGIES

Factors affecting the choice of an appropriate topology – non-transformer-isolated switching power supply topologies – buck regulator topology – boost regulator topology – buck-boost regulator topology. Transformer isolated switching power supply topologies – fly-back regulator topology – push-pull regulator topology – bridge regulator topology-DC to AC inverter topologies. **(9)**

MAGNETIC COMPONENTS IN A SWITCHING POWER SUPPLY

Basic magnetism and ferromagnetism – forward mode transformer – fly-back transformer – forward mode filter choke – mutually coupled forward mode filter inductors. Design of transformer and filters. **(9)**

SWITCHING POWER SUPPLY CONTROL ICs, PROTECTION AND TESTING

Voltage mode control – current mode control –power factor correction- quasi-resonant mode control – protecting the supply and load from the input line – protecting the load from the supply and itself – testing – line regulation – load regulation – dynamic load response time – dielectric withstanding voltage – hold-up time – over-current limb test- Application of microcontroller and DSP processors. **(9)**

CLOSED-LOOP FEEDBACK AND STABILITY

Bode plot as the basic tool – closing the loop – stability criteria applied to power supplies – control to output transfer functions of common switching power supply topologies – common error amplifier – compensation techniques. Switching power supply design examples.**(9)**

Total: 45

TEXT BOOK

1. Abraham Pressman" Switching Power Supply Design" McGraw Hill Publication, 1997.

REFERENCE BOOKS

1. Marty Brown, "Practical Switching Power Supply", Academic Press Inc., 1990.

2. Otmar Kilgensterin, "Switched Mode Power Supplies in Practice", John Wiley and Sons, New York, 1989.

4. Keith Billings, "Switch Mode Power Supply Hand Book" McGraw Hill Publication, 1999.

09ER33 SPECIAL ELECTRICAL MACHINES

ASSESSMENT: THEORY

OBJECTIVE

To make the students understand the concepts and broad principles of special electrical machines and their applications in the modern industries.

EXPECTED OUTCOME

At the end of the this course, the students will have clear understanding of the principle and operation of special electrical machines such as switched reluctance motor, stepper motor, reluctance motors, brushless DC motors, linear electrical machine and selection of motor for a particular application.

STEPPER MOTORS

Introduction-comparison with servo motors-types and construction features – method of operation - mechanism of torque production- characteristics of stepper motors - half stepping and the required switching sequence -open loop and closed loop control of VR stepper motor – single phase stepping motor-driver circuit for stepper motors: unipolar and bipolar driver circuits- ratings and applications. **(9)**

RELUCTANCE MOTORS

Introduction - general - types of synchronous motors - reluctance - motors - definitions - construction - polyphase and split phase reluctance motors - capacitor type reluctance motors - hysteresis motors - construction - polyphase - capacitor type and shaded pole hysteresis motors - universal motors - universal motors - application and torque - characteristics - essential parts of universal motors. **(9)**

BRUSHLESS DC MOTORS

Introduction-types and constructional features-principal of operation- unidirectional and bidirectional brushless DC motors-sensing and switching logic scheme-drive and power circuits-applications. **(9)**

SWITCHED RELUCTANCE MOTORS (SRM)

Introduction – principle of operation of Switched Reluctance Motors (SRM)-comparison between SRM and conventional reluctance motors-design aspects of stator and rotor pole arcs-derivation of torque expression-torque –speed characteristics-power converters for SRM-driver circuits-applications-switched reluctance generator. **(9)**

LINEAR ELECTRICAL MACHINES

Linear machines - basic difference between Linear Electrical Machines (LEMS) and rotating - machine - classification of LEMS, linear motors and levitation machines - linear induction motors - linear synchronous motors - DC linear motors - linear levitation machines.**(9)**

Total: 45

TEXT BOOK

1. Venkataratnam K.,"Special Electrical machines" Universities Press, First Edition 2008.

REFERENCE BOOKS

1. Miller T.J.E., "Electronic Control of Switched Reluctance Machines", Newnes Publishers, 2004.

2. S.A.Nasar, "Electric Machines and Electro Mechanics", Schaum Outlines Series, Second Edition,2006.

3. Krishnan R., "Switched Reluctance Motor Drives: Modeling, Simulation, Analysis, Design, and Applications", Industrial Electronics Series, CRC Press, New York, 2002.

4. Krishnan R., "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press, New York, 2009.

5. Nasar S.A., I.Boldea, "Linear Motion Electric Machines", John Wiley & Sons Inc, New York, 1976.

6. Cyril G. Veinott , "Fractional and Sub fractional Horsepower Electric Motors: Available Types, Basic Operating Principles, Selection, and Maintenance", McGraw Hill Publishers, Singapore, 2002.

09ER34 TRANSIENTS IN POWER SYSTEMS

ASSESSMENT: THEORY

OBJECTIVE

To study the fundamentals of transients in power systems caused by lightning and switching surges, the computation of transients in conversion equipment and insulation co ordination.

EXPECTED OUTCOME

The students will understand the effect of transients in power systems and recognize and solve problems connected with power networks and components.

INTRODUCTION AND SURVEY

Review of various types of power system transients- effect of transients on power systems – relevance of the study and computation of power system transients. **(5)**

LIGHTNING SURGES

Electrification of thunderclouds – lightning current surges – lightning current parameters and their values – stroke to tower and mid span – induced lightning surges. **(10)**

SWITCHING SURGES

Closing and reclosing of lines – load rejection – fault initiation – fault clearing – short line faults – Ferro – resonance – isolator switching surges – temporary over voltages – surges on an integrated system – switching – harmonics. **(10)**

COMPUTATION OF TRANSIENTS IN CONVERSION EQUIPMENT

Traveling wave method – Beweley's Lattice diagram – analysis in time and frequency domain – eigen value approach – Z-transform – EMTP software.
(10)

INSULATION CO ORDINATION

Over voltage protective devices – shielding wires, rods gaps, and surge diverters, principles of insulation co ordination – recent advancements in insulation co ordination – design of EHV system. **(10)**

TEXT BOOK

1. Allan Greenwood, “Electrical Transients in Power Systems”, Wiley Interscience, Second Edition, NewYork, 1991.

REFERENCE BOOKS

1. Klaus Ragaller, “Surges in High Voltage Networks”, Plenum Press, NewYork,1980.

2. Diesendorf W., “Over Voltages on High Voltage Systems”, Renselaer Bookstore, Troy NewYork,1971.

3. Peterson,H.A., “Transients in power systems”, Dover Publications, New York,1963.

4. Rakosh das Begamudre, “Extra High Voltage AC Transmission Engineering”, Wiley Eastern Ltd,New Delhi,2007.

09ER35 VIRTUAL INSTRUMENTATION

ASSESSMENT: THEORY

OBJECTIVE

To study the programming techniques in virtual instrumentation and the hardware features of interfacing.

EXPECTED OUTCOME

The learners will be able to use LABVIEW for any real time application.

REVIEW OF VIRTUAL INSTRUMENTATION

Historical Perspective, Advantages, Block Diagram and Architecture of a Virtual Instrument. **(9)**

DATA FLOW TECHNIQUES

Graphical Programming in Data Flow, Comparison with Conventional Programming. **(9)**

PROGRAMMING TECHNIQUES

VI and Sub-VI Loops and Charts Array, Clusters, and Graphs, Case and Sequence Structures, formula notes local and global variables, string and file I/O **(9)**

DATA ACQUISITION AND INSTRUMENT INTERFACES

ADC, DAC, DIO, Counters and Timers, PC Hardware Structures, Timing, Interrupts, DMA, Software and Hardware Installation. Current Loop, RS 232 C /RS 485, GPIB, USB and PCMCIA. **(9)**

ANALYSIS TOOLS AND APPLICATIONS

Fourier Transform, Power Spectrum, Correlation Methods, Windowing and Filtering. VI Application In Various Fields- VISA and IVI –Image Acquisition and Processing. **(9)**

Total: 45

TEXT BOOK

1. Jovitha Jerome, “Virtual Instrumentation Using Lab VIEW”, Prentice Hall of India Publishers, 2009.

REFERENCE BOOKS

1. Gary Johnson, “LABVIEW Graphical Programming”, Second Edition, McGraw Hill, 1997.

2. Lisa K Wells & Jeffery Travels, “LABVIEW for Everyone”, Prentice Hall, 1997.

3. Sokoloff, “Basic Concepts of LABVIEW 4”, Prentice Hall, 1998.

4. Gupta S., Gupta J.P., “PC Interfacing for Data Acquisition and Process Control”, Second Edition, Instrument Society of America, 1994.