SYLLABUS FOR BE ELECTRICAL ENGINEERING / (ELECTRICAL &ELECTRONICS ENGINEERING) / ELECTRICAL ENGINEERING (ELECTRONICS & POWER) SEMESTER PATTERN CHOICE BASED CREDIT GRADE SYSTEM

3EE01 /3 EP01 /3EX01 ENGINEERING MATHEMATICS - III

Course Outcomes:

After successfully completing the course, the students will be able to:

1. Demonstrate the knowledge of differential equations and partial differential equations, applied to electrical engineering systems.
2. Apply Laplace transform to solve differential equations.
3. Demonstrate the use of Fourier Transform to connect the time domain and frequency domain.
4. Apply Z Transform to solve of various Linear Difference equations with constant coefficients.
5. Apply the knowledge of vector calculus to solve physical problems.
6. Demonstrate the basic concepts of probability and statistics.

SECTION-A

UNIT-I:

Ordinary Differential Equations: - Complete solution, Operator D, Rules for finding complementary function, the inverse operator, Rules for finding the particular integral, Method of variations of parameters, Cauchy's and Legendre's linear differential equations. Applications to electrical circuits. (7)

UNIT-II:

Laplace Transforms: definition, standard forms, properties of Laplace transform, inverse Laplace transform, Laplace transform of some basic functions, initial and final value theorem, convolution theorem, Laplace transform of Periodic Function, Impulse Function, Unit Step Function. Solution of linear differential equation using Laplace transform. (7)

UNIT-III:

a) Partial differential equation of first order and first degree of following type-

(i) $f(p, q) = 0$; (ii) $f(p, q, z)=0$; (iii) $f(p, q, x, y) = 0$; (iv) $Pp + Qq = R$ (Lagrange's Form);

(v) Clairaut form $Z = px + qy + f(p, q)$

b) Fourier transforms- Definition, standard forms, inverse Fourier transform Fourier sine and Fourier cosine transforms and integrals. (7)

SECTION-B

UNIT-IV:

a) Difference Equation:- solution of difference equations of first order, solution of difference equations of higher order with constant coefficient.

b) Z-transform: Definition, standard forms, Z-transform of impulse function, Unit step functions, Properties of Z- transforms (Linearity, shifting, multiplication by k, change of scale), initial and final values, inverse Z- transforms (by direct division and partial fraction), Solution of difference equation by Z-transforms. (7)

UNIT-V:

Vector Calculus: - Scalar and Vector point functions, Differentiation of vectors, Curves in space, Gradient of a scalar point function, Directional derivatives, Divergence and curl of a vector point function and their physical meaning, expansion formulae (without proof), Irrotational and Solenoidal vector fields, Line Integral, Stokes and Divergence Theorem. (7)

UNIT-VI:

Statistics & Probability: Axioms, conditional probability, Bay's theorem, mathematical expectations, probability distributions: Binomial, Poisson and Normal. (7)

Books Recommended:

1. Elements of Applied Mathematics by P. N. Wartikar and J. N. Wartikar
2. Advancing Engineering Mathematics by E. K. Kreyzig.
3. Advance Engineering Mathematics by B. S. Grewal
4. Integral Transforms by Goyal & Gupta.
5. Statistical Methods by S.G. Gupta

3EE02/3 EP02/3EX02 ELECTRICAL CIRCUIT ANALYSIS

Course Outcomes:

After completing this course studentwill be able to:

1. Analyze electric and magnetic circuits using basic circuital laws
2. Analyze the circuit using Network simplification theorems.
3. Solve circuit problems using concepts of electric network topology.
4. Evaluate transient response of different circuits using Laplace transform
5. Evaluate two-port network parameters and network functions

Unit I:

a] Terminal Element Relationships: V-I relationship for Dependent &Independent , Voltage and Current Sources., Source Transformations. Source Functions: unit impulse, unit step, unit ramp and interrelationship, sinusoidal input, generalized exponential input.Magnetic Circuits: concept of self and mutual inductance, dot convention, coefficient of coupling, composite magnetic circuit, Analysis of series and parallel magnetic circuits.

b] Basic Nodal and mesh Analysis: Introduction, Nodal analysis, super node analysis, mesh analysis, super mesh analysis.

Unit II:

Network Theorems: Superposition theorem, Thevenin'stheorem, Norton's theorem, Maximum power transfer theorem, Reciprocity theorem, Millman's theorem, Substitution theorem, Compensation theorem, Tellegen's theorem

Unit III :

Graph Theory and Network Equation:-Graph of a network, Trees and loops, Tie-set and cut set matrix of a network, Network equilibrium equations, duality-network transformation.

Unit IV:

a] Transformation of a Circuit into s-domain: LaplaceTransformed equivalent of inductance, capacitance and mutual inductance, Impedance and admittance in the transform domain, Node Analysis and Mesh Analysis of the transformed circuit. Complete Solution ofLinear Differential Equations for Series RC, Parallel RC, Series RL, Parallel RL, Series RLC, Parallel RLC and Coupled Circuits-for step Inputs. Natural Response, Transient Response, Determination of initial conditions.

Unit V :

Two Port Networks: Two port networks: Open circuit impedance parameters, Short circuit admittance parameters, Transmission parameters, Hybrid parameters, Condition for reciprocity and symmetry of a two port network, Interrelationship between parameters, Interconnection of two port networks , Input impedance in terms of two port network parameters, Output impedance, Image impedance.

Unit VI :

Network functions: Ports and terminal pairs, Network functions, poles and zeros, Necessary conditions for driving point function, Necessary conditions for transfer function. Applications of network analysis in driving network functions, positive real functions, driving point and transfer impedance function.

Text Book: Network Analysis, M.E. Van Valkenburg, PHI, 2005.

Reference Books:

1. Circuits & Networks – Analysis, Design & Synthesis by M.S.Sukhija, T.K.Nagasarkar, OxfordUniversity Press, 2010.
2. Circuit and Network Analysis, SudhakarShyammohan, Tata Mc Graw Hill, 2005.
3. Network Analysis, P. Ramesh babu, SciTech Publications, Chennai, 2009.

3EE03/3 EP03/3EX03 ELECTRICAL MACHINE - I

Course Outcomes:

After Completing this course, students will be able to:

1. Explain the construction and working of DC Machines.

2. Illustrate the different Characteristics, types, their applications and parallel Operation of D.C. Generators.
3. Demonstrate the various characteristics, starting, speed control and braking operation on DC motors
4. Analyze the performance of DC machines by conducting the various tests on it.
5. Determine the parameters of equivalent circuits, performance parameters of single phase transformer and merits & demerits of autotransformer
6. Explain the construction, working, different connections, applications and testing of three phase transformer.

Unit I :

D.C. Machines: Construction, Principle of Operation, EMF Equation, Torque Equation. Armature winding – Lap, wave, single layer, double layer. Armature Reaction and commutation, method of improving commutation.

Unit II :

D.C. Generators:Types, Characteristics and Applications of D. C. Generators, Parallel Operation of D.C. Generators, Introduction to testing of D. C. Generators as per Indian standard.

Unit III :

D.C. Motors:Types, Characteristics & Modified Characteristics, Applications of D.C. Motors. Starting, Electric Braking, Speed Control of DC Motors. Losses, efficiency and testing of DC Motors.

Unit IV :

Single phase Transformer:Working Operation, EMF Equation, and separation of core losses in to its component. Equivalent Circuit, Parallel Operation. Open Circuit, Short Circuit & Sumpner's test on transformer as per Indian standard. Single phase Autotransformer: - construction, working, merits, demerits and its application.

Unit V :

Three Phase Transformer: Construction, Working, Types, connections, vector group connections, open delta Connection, OC, SC, Heat run test, load test, magnetic balance, vector group test on three phase transformer.

Unit VI :

Three Phase Transformer: Three-winding transformer, On load & Off load tap changers, Scott Connection, Power transformer and Distribution transformer. Waveforms of no load current & inrush current phenomenon.

Text Book:

Electrical Machines by D P Kothari & I J Nagrath Published by Tata McGraw-Hill Book Comp. New Delhi.

Reference Books:

1) C. Dawes: Electrical Engineering, Vol.I: Direct current (IV Edition), (McGraw Hill Book Company)

2) H. Cotton: Advance Electrical Technology, (Wheeler publication)

3) Indian Standard Guide for testing DC Machine. IS: 9320-1979, (Indian Standards Institution, New Delhi.)

4) Indian Standard Specification for safety transformer. IS: 1416-1972, (Indian Standards Institution, New Delhi.)

3EE04/3 EP04 – ENERGY RESOURCES AND GENERATION

Course Outcomes:

A student, on completion of this course, will be able to:

1. Explain the operation of Thermal, Hydro, Nuclear and Diesel power plants.
2. Summarize solar energy conversion, solar radiation measuring instruments, wind energy conversion and their applications.
3. Outline the principle and operation of fuel cells, ocean & tidal energy conversion, and other non- conventional energy resources.
4. Determine the various factorsand curves related to electrical load & generating plant.

Unit I:

Conventional and non conventional energy sources, Indian Energy Scenario.

Thermal and hydro power plant: Layout of Thermal power plant, Selection of site, working of various parts: Economizer, air preheater, condenser, cooling tower, ash &coal handling plant, advantages & disadvantages

Layout of Hydro power plant, classification of hydro power plant according to available head, nature of load, functions of different components and their working, mini and micro hydro-electric power generation, advantages & disadvantages.

Unit II :

Nuclear and Diesel power plant: nuclear fission and fusion, Layout of Nuclear power plant, Selection of site, Functions of different components of nuclear plant, types of nuclear reactors , advantages & disadvantages of different nuclear reactors, nuclear waste disposal., safety measures.

Layout of Diesel power plant, functions of different components of diesel plant, advantages & disadvantages.

Unit III :

Solar Energy and its measurement: Solar cell, array & module, Solar constants, solar radiation at earth’s surface, Solar radiation geometry, solar radiation measurement, estimation of average solar

radiation, solar radiation on tilted surface, principle of solar energy conversion in to heat, types of solar collectors, energy balance equation and collector efficiency.

Unit IV:

a]Fuel cells: Chemistry applied to fuel cells, principle and operation ,classification and types of fuel cells, performance characteristics of fuel cells, classification of fuel cell system.

b] Wind energy :Basic principle of wind energy conversion, wind data and energy estimation, selection of site ,basic components of wind energy conversion system ,classification of WEC systems ,generating system, applications of wind energy.

Unit V :

Ocean, Tidal & Other non-conventional energy resources: Ocean energy resources, ocean energy routes, ocean thermal energy conversion, basic principle of tidal power, components of tidal power plants, operation methods of utilization of tidal energy, estimation of power and energy in single and double basin tidal system,. Operating principles of energy from biomass, energy from biogas, geothermal energy, MHD power generation, energy from urban and rural waste.

Unit VI :

Load-Generation factors: connected load, maximum demand, demand factor, load factor, diversity factors, plant capacity and utilization factor, types of loads, load curve, chronological load curve, load duration curve, energy load curve, energy duration curve, load survey, base load and peak load station.

Text Book: Generation of electrical energy by B.R.Gupta, Eurasia Publishing House, New Delhi.

Reference Books:

1. Non conventional energy resources. By G.D.Rai, Khanna Publishers New Delhi
2. Solar energy by S.P.Sukhatme Tata McGraw Hill Publication
3. Principles of Power System by V.K.Mehta, S.Chand publication.
4. Conventional energy technology by S.B.Pandya, Tata McGraw Hill Publication.

3EE05/3 EP05ELECTRONIC DEVICES AND CIRCUITS

Course Outcomes:

After successfully completing the course, the students will be able to :

1. Demonstrate the knowledge of semiconductor physics and PN Junction Diode
2. Analyze the rectifier and regulator circuits.
3. Analyze the operational parameters of BJT
4. Analyze various multistage amplifier circuits
5. Demonstrate the knowledge of JFET, MOSFET, UJT and their operational parameters

UNIT-I:

P-N Junction diode theory, Energy bands in intrinsic and extrinsic silicon, carrier transport, diffusion current , drift current, mobility and resistivity, generation and recombination of carriers, PN junction

diode , zener diode, zener diode as voltage regulator, Numericals based on voltage regulator (line and load regulation, Numericals based on resistivity, conductivity, mass action law)

UNIT-II:

Half wave, full wave center tapped full wave and bridge rectifier. Filters-C, LC and their analysis, clipping and clamping, Numericals based on clipping and clamping

UNIT-III:

Theory and Analysis of Bipolar Junction transistor, 'H' Parameter, methods of biasing, their needs, 'Q' and stability factors, compensation techniques.

UNIT-IV

Study of typical transistor amplifier circuits i) Emitter follower, ii) Darlington emitter follower. iii) Bootstrap emitter follower, iv) RC coupled amplifier, v) Transformer coupled amplifier, vi) Cascaded amplifier, vii) Direct coupled amplifier, viii) Cascade stage.

UNIT-V :

FETs (JFET & MOSFET): Types, Characteristics and parameters (u, gm &Rds), Applications of FET amplifiers, UJT: Characteristics, working, UJT as relaxation oscillator.

UNIT-VI :

Theory, construction and applications of Schottky diode, Tunnel diode, Varactor diode, Selenium diode, LED, Photo diode, PIN diode, photo-transistor.

Text Book: Millman's Electronic Devices & Circuits by J.Millman, C.Halkias, Satyabrata Jit TMH 3rd ed, 2nd reprint 2011.

Reference Books:

1. Electronic Devices and Circuits 5/e – David Bell Oxford University Press
2. Microelectronic Circuits 5/3 – Sedranad Smith Oxford University Press
3. Boylestad R. and "Electronics Devices & Circuits", Prentice Hall of India Private Limited, New Delhi (Fifth Edition), 1993.

3EE06/3 EP06/3EX06 ELECTRICAL CIRCUIT ANALYSIS LAB

Minimum eight experiments based on the syllabus content of 3EP02 Electrical Circuit Analysis. The intensive list of experiment is given below.

1. Verification of output response of series R-C circuit for step input
2. Study of dot convention and determination of

A) Mutual inductance

B) Coupling coefficient of b transformer

3. Verification of Mesh and Node analysis.
4. Verification of Superposition theorem.
5. Verification of Thevenin's theorem.
6. Verification of Maximum Power Transfer theorem.

7. Verification of reciprocity theorem.
8. Study of Milliman's theorem& verification.
9. Verification of Norton's theorem.
10. Determination of ABCD parametersT-network &Π-network.
11. Study of Tie set and Cut set schedule for a given network.
12. MATLAB simulation for o/p verification of any theorem.
13. Determination of Z and Y parameter.
14. Determination of hybrid parameter.

3EE07/3 EP07/3EX07 ELECTRICAL MACHINES - I LAB.

Minimum eight experiments based on the syllabus content of 3EP03Electrical Machines – I. The indicative list of experiments is given below.

1. Plot the OCC of DC generator and find its critical resistance and critical speed.
2. To study the build-up of DC shunt generator, calculate critical resistance at different speeds.
3. Plot/Compare: External, Internal Characteristics of DC Shunt/series/compound generator.
4. Calculate the efficiency and voltage regulation of DC generator by the direct load test.
5. Speed Control of DC Shunt motor by armature control & Field Control method.
6. Perform the direct load test on DC series/shunt/compound motor to plot its performance characteristics, and determine its efficiency and speed regulation.
7. Conduct the Swinburn's test on DC machine to estimate its performance at any desired load condition.
8. Conduct the Hopkinson's test on DC Machine to analyze its performance.
9. Perform Electric Braking Operation on DC shunt Motor.
10. Conduct the Polarity test and Ratio test on transformer
11. Calculate the Equivalent circuit parameters of single-phase transformer by performing OC & SC test on itand determine its efficiency and voltage regulation.
12. Perform the direct load test on single phase/three phase transformer and determine its efficiency and voltage regulation.
13. Conduct back to back test (Sumpner's test)on two single phase transformers and determine the temperature rise.
14. Conduct the magnetic balance test on three phase transformer.
15. Conduct the vector group test on three phase transformer.
16. Conversion of three phase to two phase supply system using Scott Connection
17. Capture the waveform of inrush current of single phase/three phase transformer using DSO.

Reference:

S.G.Tarnekar, P.K.Kharbanda, S.B.Bodkhe, S.D.Naik and D.J.Dahigaonkar"Laboratory Courses in Electrical Engineering", S. Chand & Co. New Delhi, 2013.

3EE08/3 EP08/3EX08 ELECTRONIC DEVICES & CIRCUITS LAB

Minimum eight experiments based on the syllabus content of 3EP05Electronic Devices & Circuits. The intensive list of experiment is given below.

1. To study and verify V-I characteristics of semiconductor diode
2. To study and verify V-I characteristics of Zener diode.
3. To verify the performance of half wave rectifier circuit with and without filter.
4. To verify the performance of full wave bridge rectifier circuit and determination of load regulation.
5. To verify the performance of Zener voltage regulator.
6. To verify characteristics of bipolar junction transistor
7. To study and perform C-E amplifier gain with variation of load resistance.
8. To study and verify the characteristics of FET
9. To study UJT as a relaxation oscillator
10. To study phase shift oscillator & determine frequency of oscillation
11. To study characteristics of MOSFT
12. To study clipper circuits using diodes
13. To study clamper circuits using diodes
14. To study and verify operation of cascade amplifiers
15. To verify operation of transistor as a switch

3EE09/3 EP09/3EX09 ELECTRICAL TECHNOLOGY - LAB

Perform minimum Eight practicals / demonstration from the following list and prepare the report as a term work for this laboratory.

1. Introduction to standard symbols used in wiring diagrams
2. Introduction to different wiring accessories.
3. Demonstration of different types of wirings eg. Domestic wiring, commercial wiring, Industrial wiring.
4. Connection of Staircase wiring, Godown wiring, fluorescent lamp. Ceiling fan, air cooler etc
5. Domestic wiring diagrams
6. Connections of switch board, MCB and energy meter
7. Testing and electrical Maintenance of domestic appliances like lamps, electric iron, heater, geyser, air cooler, fan, microwave-oven, induction heater, etc.

8. Insulation resistance and earth resistance measurement
9. Conduct the load survey for domestic/commercial /Industrial consumers
10. Illumination system Design (selection of type and number of lamps required for any location)
11. Calculation of Energy bill for LT & HT consumers.
12. Safety precautions while working with electrical system
13. Demonstration of first aid treatment after getting electric shock.
14. Study of various components of solar power plant.
15. Design calculation of small capacity roof top solar power plant

SEMESTER – IV

4EE01/4EP01/4EX01 ELECTROMAGNETIC FIELDS

Course outcomes :

At the end of the course the student should be able to:

1. Demonstrate the basic mathematical concepts related to electromagnetic vector fields.
2. Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
3. Apply the principles of magneto statics to the solutions of problems relating to magnetic field.
4. Apply Maxwell's equation in different forms (differential and integral) to diverse engineering problems.

Unit I : Review of Vector Analysis: Cartesian, cylindrical and spherical co-ordinate systems, vector algebra and vector calculus. Line integral and multiple integrals. Gauss theorem.

Unit II : Electrostatics: Coulomb's law, electric field, Gauss flux theorem in integral and differential form. Electrostatics potential, Poison and Laplace equations.

Unit III : Electrostatics fields in dielectrics: electric dipole, polarization. P and D vectors, boundary conditions. Capacitance and electrical energy.

Unit IV : Magnetic fields: Biot-Savart law, Ampere's law in integral and differential form. Continuity equation, time of relaxation. Vector and Scalar magnetic potential, electric current, J vector..

Unit V : Magnetic fields in materials: magnetic dipole equivalent volume and plane section curve. H vector, magnetization vector M, boundary conditions between magnetic materials, inductance, Electromagnetic Energy.

Unit VI : Maxwell equations and wave equations: Displacement current, time varying fields and Maxwell's equations, plane uniform magnetic waves. Depth of penetration Poynting vector

Books Recommended:

Text Book: Engineering Electro- magnetics by Hayt W.H. Tata Mc-Graw Hill publication

Reference Books:

1. Electromagnetic fields by TVS Arun Murthy S Chand & Co
2. Principles and applications of Electromagnetic fields by Plansycollin , Mc-Graw Hill Books Co.
3. Foundations of electromagnetic theory by John Reitz, Addison Wesley Pub Co.
4. Basic electromagnetic field by Herbert Neelf, Harber International education
5. Introduction to electromagnetic, Derucy and Johnson, Mc-Graw Hill Books Co.

4EE02/4EP02/4EX02 ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Course Outcomes:

A student completing this course, should be able to:

1. Classify the various measuring instruments like PMMC, MI, Electrodynamometer, and Induction type instruments for measurement of current, voltage, power, and energy.
2. Demonstrate the construction & working of Instrument Transformers/special purpose meters.
3. Analyze various methods for measurement of resistance, inductance, capacitance using bridges.
4. Explain the working of various Digital measuring instruments.
5. Explain the generalized Instrumentation system & working of different transducers used for measurement of various non electrical quantities.

Unit-I :

Analog Instruments - Classification of measuring instrument, Different torques in measuring instrument, Analog Ammeter, Voltmeter, Electrodynamic type Construction, ,theory of operation, torque equation, errors, merits and demerits of each type.

Unit II : Wattmeter and Energy meter-Construction, theory of operation, torque equation, errors, merits and demerits of each type. Analysis of three phase balanced load:- Blondell's theorem, Measurement of active and reactive power in single phase and three phase circuits.

Unit III :

Instrument transformers- C.T.and P.T., Importance, theory and construction, phasor diagram, causes of errors, testing, and applications.

Special Instruments- Frequency meter, Power factor meter, Phase sequence indicator, Synchroscopeand Stroboscope.

Unit IV:

Measurement of circuit parameters- Different methods of measurement of low, medium, high value of resistance, sensitivity and accuracy of different methods. AC and DC bridges, Wheat -stone, Kelvin, Maxwell , Wein , Hay , De-Sauty ,Schering , Owen , Anderson's bridge

Unit V:

Digital methods of measurements,Introduction to A/D, D/A techniques , F/V and V/F conversion techniques , Digital voltmeter (DVM), ammeter, wattmeter, multimeter and Electronic energy meter, Sources of error, Inherent error in digital meters

Unit VI:

Generalized Instrumentation system- characteristics of measurement and Instrumentation system. Transducers: Definition, classification, Specification, selection, loading effect, Displacement, velocity transducers, Force and torque transducers, Resistive, inductive, Capacitive, strain gauge transducers, Piezoelectric, current and voltage transducers. Elastic-members (Bellows, Bourdon tube, Diaphragm)

Text Book: A.K. Sawhney, 'Electrical & Electronic Measurements and Instrumentation', Dhanpat Rai& Co (P) Ltd.

Reference Books:

1. E.W.Golding&F.C.Widdis, 'Electrical Measurements & Measuring Instruments', A.H.Wheeler& Co.

2. Albert D. Helfrick& William D. Cooper, 'Modern Electronic Instrumentation & Measurement Techniques', Prentice Hall of India, .
3. Joseph. J. Carr, 'Elements of Electronic Instrumentation & Measurements', III edition, Pearson Education.
4. Bouwens, A.J., "Digital Instrumentation", McGraw Hill.

4EE03/4EX03 POWER SYSTEM - I

Course Outcomes:

At the end of the course the student should be able to:

1. Calculate the transmission line parameters like resistance, inductances and capacitances.
2. Explain the various configurations of line conductors and their effects on the line parameters.
3. Estimate the electrical characteristics of transmission lines and hence to evaluate the performance of the lines.
4. Draw the single line diagram of any electrical system.
5. Perform the per unit calculation of any electrical system.
6. Apply knowledge of voltage control and power factor improve methods practically.
7. Perform the load flow or power flow methods to any electrical system.
8. Design HV, EHV lines, insulators used.
9. Evaluate the mechanical parameters of line supports.
10. draw the various underground cable configurations and to calculate their electrical parameters.

Unit I :

Transmission line parameters: Calculation of resistance, inductance and capacitance of single phase and three phase transmission lines, skin effect and proximity effect, transposition, G.M.D. & G.M.R. methods, double circuit lines, bundled conductors, effect of earth on capacitance, interference with communication lines.

Unit II :

Electrical characteristics of transmission line : V-I characteristics of short, medium and long lines, A, B, C, D constants, nominal Π and nominal T representations, Ferranti effect, corona phenomenon, effect of corona. Representation of power systems: per unit system and one-line reactance diagrams

Unit III :

Voltage control and power factor improvement: Receiving and sending end power circle diagrams, methods of voltage control and power factor improvement, use of static VAR generators and synchronous phase modifiers.

Unit IV : Load flow studies: Load flow problem, classification of buses, network modelling, Y-bus matrix, load flow equation, Gauss-Seidel and Newton-Raphson methods, and comparison of these methods.

Unit V :

Mechanical design: Materials used, types of insulators, comparison of pin type and suspension type insulators, voltage distribution and string efficiency, methods of increasing string efficiency, grading rings and arcing horns. Line supports for LV, HV and EHV, sag calculation.

Unit VI :

Underground cables: Material used for conductor & insulation, different types of cables and their manufacture, parameters of underground cable, grading of cable.

Text Book: C.L.WadhwaEngineering Electrical Power Systems, , 6th Edition 2010, New Age International Pub.

Reference Books:

1.Power System Engineering by D.P.Kothari, I.J.Nagrath TMH 2nd edition, 9th reprint 2010
2.Power System Analysis, N.V.Ramana, PEARSON education, 2010.
3.Power System Analysis, Arthur R. Bergen, Vijay Vittal,2nd Edition, 2009, Pearson Education.

4EE04/ 4EP05 /4EX04 ANALOG AND DIGITAL CIRCUITS

Course Outcomes:

After completing the course, students will be able to

1. Explain the principles of operational amplifiers, parameters of op-amp
2. Illustrate the linear and nonlinear applications of op-amp
3. Demonstrate the knowledge of Voltage regulator and Timer ICs
4. Describe the working of Logic families and their applications.
5. Demonstrate the knowledge of combinational and sequential circuits and its application

Unit I:

Introduction to IC's: Operation amplifier; Block schematic internal circuits, Level shifting, overload protection, study of IC 741 op-amp, Measurement of op-amp parameter.

Unit II:

Linear and Non-linear Application of Op-amp: Inverting and non inverting amplifiers, voltage follower, integrator, differentiator differential amplifier, op amp as adder subtractor, op amp as a log and antilog amplifier

Sinusoidal RC-phase shift and Wein bridge oscillators, clipping, clamping and comparator circuits using op-amps.

Unit III:

Other linear IC's : Block schematic of regulator IC 723, and its applications, study of 78XX, 79XX and its applications, SMPS, Block schematic of timer IC 555 and its applications as a timer, a stable, mono stable, bistable multivibrator and other applications, Operation of phase lock loop system and IC 565 PLL, its application.

Unit IV:

Basic Logic Circuits : Logic gate characteristics, NMOS inverter, propagation delay, NMOS logic gate, CMOS inverter, CMOS logic gates, BJT inverter, TTL, NAND gate, TTL output, state TTL logic families, ECL circuits, composition logic families.

Unit V:

Combinational Digital Circuits: Standard gate assemblies, Binary adder, Arithmetic functions, Digital comparator, Parity check generator, Decoder / demultiplexer, Data selector / multiplexer, Encoder

Unit VI:

Sequential Circuits and Systems: Bistable Latch, Flip-Flop clocked SR,J-K, T, D type shift Registers, counter. Design using filp-flops, Ripple and synchronous types, application of counters

Text Book: Millman, Microelectronics, 2nd Ed., McGraw Hill.

Reference Books:

1. Gayakwad, Op-Amp & LLG, 2nd Ed.
4. Malvino& Leach, Digital Principles & Applications, 4th Ed., McGraw Hill.

5. K.B.Botkar, Integrated Electronics (Khanna Publishers.)

4EE05/4EX05 SIGNALS & SYSTEMS

Course Outcomes:

After completing the course, students will be able to

1. Understand importance and applications of signals and systems
2. Classify Systems into various categories
3. Perform convolution of Analog and Discrete time signals
4. Convert Analog signal into discrete signal by using Sampling Method
5. Apply CTFT,Z-Transform, DTFT, FFT for the analysis of Various Signals and Systems.

Unit-I :

Introduction to Signals and Systems: Signals and Systems, Classification of Signals, Classification of Systems, Some Ideal Signals, Energy and Power Signals, Discretization of Continuous-Time Signals, Analysis of Continuous- Time Systems, Time Domain, Properties of Elementary Signals Linear Convolution Integral, Response of Continuous-Time Systems.

Unit-II :

Fourier series and Its Properties Fourier Transform Properties of Fourier Transform, Tables of Fourier Transform Pairs Fourier Transform of Periodic Signals, Frequency-Domain Analysis of Systems Fourier analysis of Sampled Signals

Unit-III :

Analysis of LTI Discrete-Time Systems: Time Domain and Frequency Domain, Properties of Discrete-Time Sequences Linear Convolution, Discrete-Time System Response.

Unit-IV :

Sampling: Representation of a continuous–Time Signal by its Samples; The Sampling Theorem; Reconstruction of Signals form its Samples using Interpolation; Effect of Under Sampling (Frequency Domain Aliasing); Discrete Time processing of Continuous–Time Signals

Unit-V :

The Z Transform: The Z Transform; The Region of Convergence for the Z- Transform; Geometric Evaluation of the Fourier Transform from the Pole-Zero Plot; Properties of Z-Transform; Analysis

and Characterization of Discrete- Time LTI Systems using Z-Transform; System Transfer Function; Block Diagram Representation; The Unilateral Z- Transform; Solution of Difference Equation using the Unilateral Z-Transform.

Unit-VI :

Discrete Fourier Transform and Fast Fourier Transform Representation of Discrete-Time aperiodic signals and the Discrete-Time Fourier Transform; Fourier Transform for Periodic Signals; Properties of the Discrete-Time Fourier Transform; Discrete-Time LTI Systems and Discrete-Time Fourier Transform

Text Book: Signals and systems, Oppenheim and Schafer PHI. 2nd Edition 1997

Reference Books:

1. Signals &Syatems, Smarajit Ghosh, PEARSON education, 2006
2. Signals And Systems , S.Haykin, 2nd Edition, John Wiley And Sons 1999
3. Analog And Digital Signal Processing , Ambardar A, 2/3; Thomson Learning-2005

4EE07/ 4EP06 /4EX06 ELECTRICAL MEASUREMENTS & INSTRUMENTATION-LAB

Minimum eight experiments based on the syllabus content of 4EP02 Electrical Measurements & Instrumentation. The intensive list of experiment is given below.

1. Measurements of Low resistance by using Kelvin double Bridge.
2. Measurements of Medium resistance by Ammeter Voltmeter method/Wheatstone Bridge
3. Measurement of High resistance by Loss of Charge method.
4. Measurement of Insulation resistance by using Megger
5. Measurement of unknown Inductance using Maxwell Bridge/Hay Bridge/Anderson Bridge
6. Measurement of Unknown Capacitance by Desauty Bridge/Schering Bridge
7. Measurement of frequency using Wien Bridge
8. Extension of range of ammeter using shunt/CT.
9. Extension of range of voltmeter using multiplier/PT.
10. Calibration of Wattmeter by Phantom loading
11. Calibration of energy meter to detect the error in it.
12. Measurement of active & reactive power measurement in 1 phase / 3 phase circuit.

13. Measurement of rotational speed using stroboscope

14. Conversion of non electrical quantity into its equivalent electrical quantity using proper transducer.

15. Compare the accuracy, preciseness, sensitivity of Analog & Digital Measuring Instruments.

4EE08/4EX07 POWER SYSTEMS I - LAB

Minimum Eight experiments based on the syllabus content of 4EE03/4EX03 Power System – I The intensive list of experiment is given below.

1. To study the performance of a transmission line (using a nominal T and π methods).
2. To calculate A,B,C,D parameters for a transmission line by using nominal T method (either using model or simulation).
3. To calculate A,B,C,D parameters for a transmission line by using nominal π method (either using model or simulation).
4. To study skin effect, proximity effect and Ferranti effect in transmission line.
5. To study Corona phenomenon and corona loss and its control in transmission line.
6. To study conversion of single line diagram to impedance diagram and reactance diagram for a typical power system.
7. To draw the circle diagram for a typical power system.
8. Study of a tap changing transformer (ON and OFF load tap changing).
9. Study of static VAR generator and synchronous condenser.
10. Load flow study for a typical power system (A simulation).
11. To study different types of insulators used in power system.
12. To conduct a dry and wet test on a pin type insulator.
13. To conduct a flashover test on a suspension type insulator.
14. To study a horn gap.
15. To study different types of power cables.
16. To study testing of cables.

Note: One may use models, simulation, numerical, drawing sheets or Experimentation for conducting the above experiments.

4EE09/ 4EP08 /4EX08 ANALOG AND DIGITAL CIRCUIT LAB

Minimum eight experiments based on the syllabus content of 4EP05Analog & Digital Circuit. The intensive list of experiment is given below.

1. To Plot Frequency Response Of Non-Inverting Mode Of Op-Amp Using IC741 and Determine the Bandwidth & Maximum Gain
2. To Plot Frequency Response Of Inverting Mode Of Op-Amp Using IC741 and Determine the Bandwidth & Maximum Gain
3. To Perform Op-Amp as Differentiator Using IC741 .
4. Design The Circuit for Supplying 5V,25mA As A Low Voltage Regulator Using IC 723
5. Verification Of Truth Table Of Various Logic Gates Using ICs
6. To Study and Verify The Operation Of SR and MS ,JK Flip Flop
7. To Verify The Operation Of Multiplexer Using IC74153.
8. To Design And Verify Function Of Decade Counterusing IC 7490
9. To Verify The Truth Table Of 4 Bit Comparator
10. To Perform Op-Amp As Integrator Using IC741
11. A stable Multi-vibrator Using IC 555timer
12. To Study And Verify The Operation Of Half-Adder And Full-Adder.

4EE10/ 4EP09 /4EX09 ELECTRONIC TECHNOLOGY LAB

Perform Minimum Eight experiments / demonstration based on the following contentand prepare the report as a term work for this laboratory.

- Study of electronic Components: Identification of components, name, types, symbol, size, rating and application.
- Handling Electronic Components: Finding values and testing (using DMM), test working condition, fault detection.
- Working with breadboards: understanding the breadboards for component mounting, working with small circuits on breadboard
- Soldering: Soldering skill tips- use of proper soldering Iron, Metal, Flux, Cleaning, Tinning etc., mounting components on zero PCB, testing of small circuits mounted on zero PCB. De-soldering of components
- PCB Layout and design: Understanding different PCBs, Working on PCB Layout (Software), PCB etching, drilling on PCB, Mounting components on PCB, Working with small circuits on PCB and their testing
- Electronic circuit Simulation: Familiarizing with the simulation software, simulation and result validation of simple circuit with software.

SYLLABUS OF V & VI SEMESTER B.E ELECTRICAL, ELECTRICAL (ELECTRONICS & POWER) AND ELECTRICAL & ELECTRONICS

B.E.(ELECTRICAL ENGG.) (C.B.C.S.)

SEMESTER –V

5EE01 CONTROL SYSTEM

Course Outcomes:

After completing this course, Students will be able to:

1. Demonstrate the fundamental concepts of automatic Control and mathematical modeling of the Systems.
2. Determine the transfer function of control system components.
3. Analyze the time response of various systems and performance of controllers.
4. Evaluate the stability of linear systems using various methods.

Unit I: Introduction to automatic control: Open loop and closed loop system, servo-mechanisms, mathematical modeling of physical systems, transfer functions, block diagrams and signal flow graphs. Effect of feedback on sensitivity to parameter variation and reduction of the noise.

Unit II: Control System Components: Electrical / Electro-mechanical components such as A.C./D.C. servomotors, stepper motors, synchros,potentiometers, tacho-generators, encoders, their functional analysis and operating characteristics and their application.

Unit III: Time response of first and second order systems to standard inputs. Time response specifications, types of system, error analysis, error coefficients, steady state errors, dynamic error series. Approximate methods for higher order system, proportional, derivative and integral control.

Unit IV: Stability : Stability of control systems, characteristics equation, impulse response, Routh-Hurwitz stability criterion, relative stability. Root Locus: construction of root locus, determination of roots from root locus conditions on variable parameter for stability, effect of addition of poles and zeros.

Unit V: Frequency Response Method: Frequency response of linear system, specification, Logarithmic frequency response (Bode) plots from transfer function for various systems. Polar plots for various systems. Estimation of approximate transfer functions from the frequency response.

Unit VI: Stability analysis from frequency response: Gain margin and Phase margin; Stability analysis from Bode plots. Nyquist criterion, Nyquist plots and stability analysis.

Books Recommended:

Text Books:

Nagrath I.J., Gopal M.: Control System Engineering, Wiley Eastern.

Reference Books:

1. Control Engineering, D.Ganesh Rao, k. Chennavenkatesh, 2010, PEARSON
2. Ogata K.: Modern Control Systems, Prentice Hall of India.
3. Control Systems by K.R.Varmah TMH edition 2010
4. Linear Control Systems, Ashfaq Hussain, Haroon Ashfaq, Dhanpat Rai &Co.

5EE02 MICROPROCESSOR & MICROCONTROLLER

Course Outcomes:

After completing this course, Students will be able to:

1. Recite Fundamentals and Architecture of Microprocessor 8085, Microcontroller 8051
2. Interpret Assembly Language Programming of Microprocessor 8085, Microcontroller 8051
3. Illustrate interfacing with Microprocessor 8085, Microcontroller 8051
4. Develop applications of Microprocessor 8085, Microcontroller 8051.

Unit I:8085- architecture and Pin Diagram, Microprocessor Operations (Initiated, Internal and External) BUS organization and register structure, instruction set of 8085, addressing modes, Machine Cycles & Bus Timings.

Unit II: Assembly Language Programming of 8085, counters and time delays, stack and subroutines, Memory mapped I/O and I/O mapped I/O, address decoding techniques. Interrupt system of 8085, Data transfer schemes, serial data transfer through SOD and SID line.

Unit III: Programmable Interfacing devices: Internal architecture, programming and interfacing of Programmable Peripheral Interface PPI (8255), Programmable Interrupt Controller PIC (8259),Universal Synchronous Asynchronous Receiver Transmitter USART (8251) and Programmable Interval Timer PIT(8253)

Unit IV Introduction to microcontroller: 8051 pin configuration and architecture, 8051 Internal resources, pin diagram, I/ O pins, ports and their internal logic circuits, counters, serial ports, interrupt structure, SFRs and their addressing, watch-dog timer, internal code memory, data memory, stack pointer, flags, bit addressable memory.

Unit V Instruction set of 8051. Addressing modes. Various groups of instructions: data transfer. Arithmetic- logical group. Interrupt, timer counter related instructions. Interfacing of 8051with external memories. Programming 8051 with interfacing examples

Unit VI: 8085 Microprocessors / 8051 Microcontroller Applications: hardware & software developments: signal conditioning & data acquisition system components. Measurement of Pulse width and Magnitude using 8085. Measurement of fundamental quantities -voltage, current, frequency, speed using 8051 Microcontroller.

Books Recommended:

Text Books:

1. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar PHI Publication-2006

2. The 8051 Microcontroller and Embedded SystemsMazidi, J.GMazidi, Mckinlay , Pearson Ed.

Reference Books:

1. An Introduction to Microcomputers, Adam Osborne Osborne-Mc-Graw Hill,
2. Advance Microprocessor and Peripherals, K.M.Bhurchandi & A.K.Ray, TMH, 2006.
3. Subrata Ghoshal "8051 Microcontroller" Pearson Education.
4. Richard Barnett , The 8051Family of Microcontrollers Prentice-Hall, Inc-2000

5EE03 ELECTRICAL MACHINE - II

Course Outcomes:

After completing this course, Students will be able to:

1. Describe the construction, working operation & performance characteristics of the three phase Induction Motor
2. Analyze the starting, braking and speed control of three phase induction motors by various methods.
3. Describe the construction, working operation & performance characteristics of single –phase Induction Motor
4. Demonstrate the construction, working operation & performance characteristics of synchronous machine.
5. Explain the construction & working of special motors like Universal, Reluctance, PMSM & BLDC Motor.

Unit I: Three phase induction motor –I: Construction, Types (squirrel cage and slip ring), Rotating Magnetic Fields, Principle of operation, Torque Slip Characteristics, Starting and Maximum Torque. Effect of parameter variation on torque slip characteristics. Equivalent circuit, Phasor Diagram, Performance evaluation by direct& indirect testing ,circle diagram.

Unit II: Three phase induction motor –II:

Starters for squirrel cage & slip-ring type IM, Methods of speed control, electric braking, High Torque IM, single phasing, cogging and crawling, Doubly-Fed Induction Machines.

Unit III: Single phase induction motor :

Double revolving field theory, Constructional features, equivalent circuit, working, Split-phase starting methods and applications of single-phase Induction motors.

Unit IV: Synchronous Generator : Constructional details, working principle, operation, armature reaction, circuit model, determinations of parameters of the circuit model and phasor diagram,

methods of determining the regulations and efficiency, Parallel operation of alternators-Synchronization.

Unit V: Synchronous motor : Construction, principle of operation, working, starting methods, torque equation - V-curve, Inverted V curve &power angle characteristics, hunting & damping, applications. Transient, subtransient & steady state reactance of synchronous machines.

Unit VI: Special motor : Construction, working principle, operation, characteristics and applications of Universal motor, Reluctance Motor, Permanent Magnet Synchronous Motor & BLDC Motor.

Books Recommended:

Text Books:

1. D.P.Kothari & I.J.Nagrath,"Electrical Machines"-5thEdition, TMH Publication.
2. S.Langsdorf,"Alternating Current Machines", Mc-Graw Hill Publication.

Reference Books:

1. Fitzgerald and Kingsley's Electric Machinery", 7th Edition, McGraw Hill.
2. M.G.Say,"PerformanceanddesignofACmachines",CBSPublishers, 2002.
3. P.S.Bimbhra,"ElectricalMachinery", KhannaPublishers,2011.
4. C L Dawes, "A Course in Electrical Engineering (Volume -2)", McGraw Hill.

5EE04 PROFESSIONAL ELECTIVE – I : POWER SYSTEM OPERATION AND CONTROL

Course Outcomes:

After completing this course, Students will be able to:

1. To impart knowledge to describe, calculate and analyze energy generation, unit commitment problem in thermal power plant, power system behavior and economics of generating costs.
2. To understand and analyze optimal dispatch with transmission losses, penalty factor and automatic load dispatch.
3. To learn the concept of real and reactive power flow and its control in power system.
4. To learn the automatic voltage regulator and automatic load frequency control.
5. To learn tie line interchange between interconnected utilities.
6. To illustrate various ways of interchange of power between interconnected utilities.
7. To impart knowledge about various advanced controllers such as FACTs controllers with itsevolution, principle of operation, circuit diagram and applications

Unit – I : Econonmic operation – Part I:

Meaning of optimum scheduling, UCP and LSP; Input – Output characteristics, Heat rate characteristic, Incremental fuel rate, Incremental fuel cost; Methods of obtaining incremental fuel costs; Conditions for incremental loading; Optimum scheduling of generation between different units (Only Two plant system without transmission loss).

Unit – II : Econonmic operation – Part II:

Transmission loss as a function of plant generation; Calculation of loss co-efficient (Two plant system); Incremental transmission loss; Optimum scheduling of generation between different plants including transmission loss; Concept and significance of penalty factor; Automatic load dispatch: Operation and Functions.

Unit – III :A. Generator control Loops

Concept of real and reactive power; Effect of real and reactive power on system parameters; Basic generator control loops.

B. Automatic Voltage Regulator (AVR)

Functions of AVR; Types of Exciter; Brushless AVR loop: Exciter modeling, Generator modeling, Transfer function block diagram representation, Static performance, dynamic response, Stability compensation, Effect of generator loading.

Unit – IV: Automatic Load Frequency Control:

Automatic generation control (AGC); Speed governing system; Transfer function modeling: Governor, Hydraulic valve actuator, Turbine, Generator, Load; Transfer function representation of an isolated generator; Static performance of speed governor; Closing of ALFC loop.

Unit V:Control Area : Meaning; Primary ALFC Loop: Static response, Dynamic response, physical interpretation of results; Secondary ALFC loop; Integral Control; Pool operation; Tie-line Modeling; Two area system – Dynamic response; Tie-line bias control.

Unit VI: Energy Control of power System : Interchange of power between interconnected utilities, economy interchange evaluation, interchange evaluation with unit commitment, types of interchange, capacity and diversity interchange, energy banking, emergency power interchange, inadvertent power exchange, power pools, Circuit diagram and applications of FACTs Technology :- SVC, TCSC, STATCOM and UPFC.

TEXT BOOK:-

1. O. L. Elgerd Electric Energy Systems Theory: An Introduction – 2nd edition, McGraw -Hill Book Comp. N. Y. 1987.

2. Power System Operation & Control, N.V.Ramana, PEARSON education, 2010.

REFENCE BOOK

1. L. K. Kirchamayor – Economic Operation of Power System- Wiley Estern Pvt. Ltd., New Delhi.

2. Hadi Saadat – Power System Analysis – WCB/McGraw-Hill International Edition 1999

3. I.J. Nagrath, D. P. Kothari – Modern Power System Analysis – Second edition, Tata Mc-Graw Hill Publishing Company, New Delhi

4. P. S. R. Murty – Power System Operation and Control – Tata Mc-Graw Hill Publishing Company, New Delhi.

5EE04 PROFESSIONAL ELECTIVE – I : ELECTRICAL ENGINEERING MATERIAL

Course Outcomes:

After completing this course, Students will be able to:

1. Understand importance of electrical engineering materials
2. Understand how electric conduction takes place in conductors
3. Understand importance of semiconductors and magnetic materials in electrical engineering.
4. Understand importance of dielectric materials in electrical engineering.
5. Identify the need of special materials in electrical engineering.

Unit 1 :Introduction to Electrical Engineering Material: Importance of materials, Classification of electrical materials, Scope of electrical materials, Requirement of Engineering materials. Types of engineering materials, Levels of material structure.

Unit 2: Conducting Material: Review of metallic conduction on the basis of free electron theory. variation of conductivity with temperature and composition, materials for electric resistors- General Electric properties; material for brushes of electrical machines, lamp filaments, fuses and solder.

Unit 3: Semiconductors: Mechanism of conduction in semiconductors, types of semiconductors.

Hall effect, compound semiconductors, basic ideas of amorphous and organic semiconductors.

Unit 4: Magnetic Material: Classification of magnetic materials- origin of permanent magnetic dipoles, magneto materials used in electrical machines, instruments and relays. Magnetic Circuit terminology, Relation between relative permeability and magnetic susceptibility. Classification of magnetic materials, Diamagnetic, Paramagnetic, Ferromagnetic, Anti ferromagnetic. Magnetization curve, Initial and maximum permeability. Hysteresis loop and loss, Eddy current loss.

Unit 5: Dielectrics & insulating Materials: Dielectrics, Factors influencing dielectric strength. Capacito rmaterials. Insulating materials. Insulating Materials: Inorganic materials (mica, glass, porcelain, asbestos), organic materials (paper, rubber, cotton silk fiber, wood, plastics and bakelite), resins and varnishes, liquid insulators (transformer oil) gaseous insulators (air, SF6 and nitrogen) and ageing of insulators.

Unit 6: Materials for special application materials: Materials for solar cells, fuel cells and battery. Materials for coatings for enhanced solar thermal energy collection and solar selective coatings, Cold mirror coatings, heat mirror coatings, antireflection coatings, sintered alloys for breaker and switch contacts.

Text Book: Electrical Engineering Materials by Dekker A.J (PHI)

Reference Books:

1. S.P.Seth Electrical Engineering Materials (Dhanpat rai and Sons)
2. C. S Indulkar & S. Thiruvelgadam, an Introduction to Electrical Engineering Materials (S Chand Publication)

5EE04 PROFESSIONAL ELECTIVE – I : ELECTRONIC COMMUNICATION THEORY

Course Outcomes:

After completing this course, Students will be able to:

1. Explain various types of signal & elements of communication system.
2. Analyze the signal using Fourier Transform
3. Apply Amplitude modulation & Frequency modulation on the communication signal
4. Compare Pulse communication & Digital communication
5. Describe microwave communication system

Unit I: Introduction to electronics communication systems:Signals: Analog & digital, Deterministic & Non-deterministic, Periodic & nonperiodic, Elements of Communication Systems, Transmitter, Receiver, Need for Modulation, band width requirements, Noise, External, internal noise, noise calculation, noise figure.

Unit II: Signal Analysis: Fourier Series, Exponential Fourier Series, Fourier Transform, Properties of Fourier Transform, Dirac Delta Function, Fourier Transform of Periodic functions, Fundamental of Power Spectral Density & Energy Spectral Density.

Unit III : Amplitude Modulation: Amplitude Modulation Theory, Generation of Amplitude Modulation, Single Side band Communication, suppression of carrier, suppression of unwanted side band, AM receiver.

Unit IV: Frequency Modulation:

Theory of Frequency Modulation, characteristics of FM, Generation of FM, pre-emphasis, De-emphasis,wide &Narrow band FM Transmission, FM receiver.

Unit V: Pulse Communication :

Information Theory, Classification of pulse modulation, Sampling process, pulse amplitude modulation, PWM and PPM modulation pulse co-demodulation.

A: Digital Communication :Fundamentals of data communication systems, data sets and inter-connection requirements.

Unit VI: Microwave communication system:

Analog microwave communication: LOS, OTH microwave system Satellite communication: Satellite orbits, frequencies, attitude, transmission path.

Text Books: Electronic Communication System by Kennedy, Davis,TMH

Reference Books:

1. Electronics Communication by K.Shoenbcle PHI, India.
2. Electronics Communication Techniques, Paul Young,Willey Eastern Pub.
3. Principle of Communication Engineering, Taub Schilling. TMH.
4. Electronics Communication – Robert Shrader Mc-Graw Hill.

5EE05 Open Elective – I POWER PLANT ENGINEERING

Course Outcomes:

After completing this course, Students will be able to:

1) Describe different Sources of Energy Generation.
2) Explain the Working and layout of steam power plant & hydro power plant.
3) Discuss the working principle and basic component of Nuclear, Diesel & gas power plant
4) Illustrate various terms related to power plant economics & tariff.

UNIT 1 INTRODUCTION: Energy resources and their availability, types of powe rplants, selection of the plants, Introduction to basic thermodynamic cycles used in power plants, Conventional and non-conventional energy sources, Indian Energy Scenario.

UNIT 2:HYDRO ELECTRIC POWER PLANT : Rainfall and run-off measurements and plotting of various curves for estimating stream flow andsize of reservoir, Layout of Hydro power plant, operation of different components of hydro-electric power plant , classification of hydro Electric power plant, Pump Storage Plant, site selection, advantages & disadvantages

UNIT 3: STEAM POWER PLANTS: Flow sheet and working of modern-thermal power plants, super critical pressure steam stations, Layout of Thermal power plant, Site selection, coal storage, coal handling systems, ash Handling systems, working of various parts: Economizer, air pre-heater, condenser, cooling tower, Electrostatic Precipitator, advantages & disadvantages.

UNIT 4: NUCLEAR POWER PLANT : Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working ofNuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANadaDeuterium- Uranium reactor (CANDU) fast breeder reactor, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT 5 DIESEL & GAS POWER PLANT: Layout of Diesel power plant, functions of different components of diesel plant, advantages &disadvantages, Principle of Operation of Gas Turbine Plants, Open cycle gas turbine plant, closedcycle gas power plant, Combined gas and steam cycle.

UNIT 6: POWER PLANT ECONOMCS: Load curve, energy load curve, energy duration curve, connected load, maximum demand, demand factor, load factor, diversity factors, plant capacity and utilization factor, types of loads, operating cost, annual plant cost, Generation cost, Depreciation, Objectives/Types of Tariff,

TEST BOOKS:

1. Generation of Electrical Energy by B.R.Gupta, Eurasia Publishing House, New Delhi.
2. Power Plant Engineering; R.K.Rajput; Laxmi Publications.

REFERENCE BOOKS:

1. Non-Conventional Energy Resources by G.D.Rai, Khanna Publishers, New Delhi.
2. Principles of PowerSystem byV.K.Mehta, S.Chand Publication.
3. Conventional energy technology by S.B.Pandya,Tata Mc-Graw Hill Publication.
4. Power Plant Engineering, P.K.Nag.

5EE05 OPEN ELECTIVE – ELECTRIC DRIVES

COURSE OUTCOMES

After completing this course, Students will be able to:

1. Explain the basic Concept of electrical drives
2. Describe Power Electronics devices & their Industrial Applications
3. Demonstrate various starting, braking and speed control methods of DC Motor Drivs
4. Demonstrate various starting, braking and speed control methods of three phase Induction Motor.
5. Describe the construction, working principle and applications of single phase Induction Motor & special motors

UNIT 1: ELECTRIC DRIVE: Concept, classification, parts, and advantages of electrical dives. Types of Loads, Components of load toques, Fundamental torque equations, Equivalent value of drive parameters for loads with rotational and translational motion. Multi quadrant operation of drives. Load equalization

UNIT 2 MOTOTR POWER RATING: Thermal model of motor for heating and cooling, classes of motor duty, determination of motor rating for continuous, short time and intermittent duty, equivalent current, torque and power methods of determination of rating for fluctuating and intermittent loads. Effect of load inertia & environmental factors.

UNIT 3: Starting & Braking of Electric Drives: Effect of starting on Power supply, motor and load. Methods of starting of electric motors. Acceleration time Energy relation during starting, methods to reduce the Energy loss during starting. Types of braking, braking of DC motor, Induction motor and Synchronous motor, Energy loss during braking

UNIT 4: Modeling of DC motors, block diagram & Transfer function, Single phase, three phases fully controlled and half controlled DC drives. Dual converter control of DC drives. Power factor, supply harmonics and ripple in motor current, Chopper controlled DC motor drives

UNIT 5: Induction motor drives: Stator voltage variation by three phase controllers, Speed control using chopper resistance in the rotor circuit, slip power recovery scheme. Pulse width modulated inverter fed induction motor drive. Volts / Hertz Control

UNIT 6 :Industrial applications of Electric Drives: Introduction to Solar and Battery Powered Drive, Stepper motor, Switched Reluctance motor drive Industrial application: Drive consideration for Textile mills, Steel rolling mills, Cement mills, Paper mills, Machine tools. Cranes & hoist drives.

TEXT BOOKS:

1. Fundamental of Electrical Drives, G.K. Dubey, New Age International Publication.
2. A first course on Electrical Drives, S.K. Pillai, , New Age International Publication.

REFERENCE BOOK:

1. Electric Drives, Vedam Subrahmanyam, TMH
2. Bose, B.K., Modern Power Electronics and AC Drives, PHI
3. Electric Motor Drives, R. Krishnan, PHI
4. Sen, P.C., Thyristor DC Drives, John Wiley and Sons (1981).

5EE06 CONTROL SYSTEM – LAB

Student should perform minimum eight practicals based on the followings.

LIST OF EXPERIMENTS

1. Study of Potentiometer
2. Study of A.C. Synchro and its characteristics
3. Determination of Transfer Function of D.C. Generator
4. Determination of Transfer Function of D.C.Servomotor and Its Characteristics
5. Performance Characteristics of a D.C. Motor Angular Position Control System
6. Determination of Frequency Response of Given R-C Network
7. Determination of Transfer Function of A.C. Tacho-Generator
8. Experimental Study of The Operating Characteristics of a Small Stepper Motor and Its Controller
9. Study Closed Loop PI Controller System and Its Time Response to Different Input.
10. Experimental Study of Position Control of DC Motor using Ardiuno
11. Experimental Study of Time Domain Analysis of Second Order Control System
12. Study AC Position Control System

NOTE: Above experiments may be conducted by using models, simulation, numerical, drawing sheets or experimentation.

5EE07 MICROPROCESSOR & MICROCONTROLLER – LAB

LIST OF EXPERIMENTS

1. Write an Assembly Language Program for the Addition of two8-bit/16-bit numbers
2. Write an Assembly Language Program for the Subtraction of two 8-bit numbers
3. Write a Program for Finding the larger and smaller one among the two 8-bit numbers
4. Write a Program for Finding the largest/smallest number in array of 8-bit numbers
5. Write a Program for Masking and setting of nibbles
6. Write a Program for Block data transfer in same and reverse order
7. Write a Program for Sorting of even and odd numbers from an array of 8-bit numbers
8. Write a Program for Multiplication of two 8-bit numbers
9. Write a Program for Square wave generation using 8255 PPI
10. Write a Program for Stepper motor control using 8255 PPI
11. Write a Program for Interfacing ADC with 8085/8051 using 8255 PPI

12. Write a Program for Interfacing DAC with 8085/8051 using 8255 PPI
13. Write a Program for Lamp load control using 8255 PPI
14. Write a Program for measurement of DC Voltage /Current using ADC, 8255 PPI
15. Study of Architectural Differences: Microprocessor 8085, and Microcontroller 8051

5EE08 ELECTRICAL MACHINES – II LAB

LIST OF EXPERIMENTS

1. Perform the load test on three phase IM & plot its performance characteristics.
2. Perform the No load test on three phase IM to separate out its no load losses.
3. Estimate the performance parameters of three phase IM from its circle diagram.
4. Plot the equivalent circuit of three phase Induction motor.
5. Study of different types of starters used for three phase IM
6. Speed control of three phase squirrel cage Induction motor by various methods like stator voltage control method, frequency control method, changing number of poles.
7. Speed control of three phase Induction motor.
8. Perform the electric braking of three phase Induction motor.
9. Perform the load test on single phase IM & plot its performance characteristics.
10. Load test on three phase alternator to determine its performance parameters.
11. Synchronize the three – phase alternator within finite bus-bar
12. Perform the OC & SC test on synchronous generator to estimate its regulation by EMF & MF methods
13. Estimate the regulation of three phase alternator using ZPF method.
14. Perform the load test on three phase Synchronous motor.
15. Plot the V& inverted V curves of synchronous motor.

5EE09 INFORMATION & COMMUNICATION TECHNOLOGY – LAB

WORD PROCESSING WITH MS- WORD:

- Basic operations- Editing and Formatting text, paragraphs and pages, printing.
- Working with tables, figures, images.
- Mailmerge.Working with Charts, Equations, Symbols.

MS EXCEL : WORKING WITH WORK BOOKS/ WORK SHEETS:

- Data Entry techniques & defining datas etasa Table. Setting, Previewing, and Printing under MS-Excel.
- Performing Calculations, using Excel Formulas, Functions and Charts. Sorting / Filtering data in excel sheet.

WORKING WITH MS POWER POINT :

- Presentation Basics. Adding more components to the slides, printing the slides.

- Formatting Presentations, backgrounds and layout. Applying Themes. Using SlideMaster.
- Working with Graphics, Images and Clips. Multimedia. Inserting Sound and Narration
- Delivering Presentations. Animating Objects. Adding Action effects.
- Live Presentation. Using Custom Shows.
- Saving / Protecting the Presentation.

WEB PAGE DEVELOPMENT:

- Introduction to HTML, CSS, JAVA Scripting
- Development of Webpage.

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SEMESTER SIXTH

6EE01 POWER ELECTRONICS

COURSE OUTCOMES

After completing this course student will be able to

1. Explain the concepts and techniques used in power electronics
2. Apply the knowledge of series and parallel connection of SCRs in power control applications
3. Analyze various power converter circuits
4. Analyze the single phase and three phase Inverter circuits
5. Explain the operation of DC/DC converter circuits
6. Demonstrate the applications of power electronic circuits.

UNIT 1 - SCR, Triac, Diac – Construction and Applications, two Transistor Analogy of SCR, SCR turnON mechanism, different methods for turning ON SCR, turn OFF mechanism, Thyristor firing circuits, introduction to Power MOSFET and IGBT their construction and characteristics.

UNIT 2 -Series-Parallel operation of SCRs, firing circuits for series and parallel operations, static and dynamic equalizing circuit, equalization of current in parallel connected SCRs, string efficiency, de-rating factors, protections of SCRs against di/dt, dv/dt, over-voltage/ over-current protection.

UNIT 3 – Princple of phase control, half wave controlled rectifier, half controlled bridge and fully controlled bridge rectifier for R, RL and RLE load, derivation for output voltage and current, effect of freewheeling diode, effect of source inductance.

UNIT 4 – classification of circuit for forced commutation, series inverter, improved series inverter, parallel inverter, single phase PWM inverters, principle of operation of three phase bridge inverter in 120˚ and 180˚ mode.

UNIT 5 - Basic principle of Chopper, Time ratio control and current limit controlled technique, Voltage commutated Chopper circuit, Jones Chopper, Step up Chopper, Step down Chopper and AC Chopper.

UNI 6- Speed control of DC series motor using chopper, Speed control of DC shunt motor using phase controlled rectifier. Speed control of three phase Induction motor by stator voltage control method, V/f control.

TEXT BOOKS

Rashid Muhammad, H., "Power Electronics: Circuits, Devices and Applications", 4th Edn., Pearson Education.

REFERENCE BOOKS

1. Mohan Ned, Undeland Tore, M. and Robbins William, P., "Power Electronics: Converter, Applications and Design", John Wiley & Sons, 1994.
2. LandevCyrill, W., "Power Electronics", McGraw Hills, London, 1981.
3. Dewan, S.B. and Satrughan A., "Power Semiconductor Circuits", John Wiley & Sons,
4. M.D. Singh & K.B. Khanchandani, "Power Electronics "Tata Mc-Graw Hill, New Delhi

6EE02 POWER SYSTEM – II

COURSE OUTCOMES:

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

1. Understand power factor improvement, capacitor bank installation in distribution system, metering system in industries and residential area.
2. Understand Positive Sequence, Negative & zero sequence system and fault analysis.
3. Create computational models for analysis of both symmetrical and unsymmetrical conditions in power systems,
4. Analyse the system performance where there is an unbalanced fault, and also calculate the corresponding fault current.
5. Examine the need of various analysis like fault analysis, short circuit analysis stability analysis, steady state and transient analysis.

UNIT I: SYMMETRICAL COMPONENTS: Definition and choice, Alpha operator, transformation matrices, sequence components, power invariance, line and phase sequence quantities relations, three phase delta/star transformer bank- sequence voltages and currents relationship.

UNIT II: POWER SYSTEM ELEMENTS – sequence impedance and sequence networks ; Various three phase transformer connections – zero sequence rules; Unbalanced load system - Power Factor improvement, Capacitor bank installation in distribution system, Metering system in Industries and Residential area

UNIT III SYMMETRICAL FAULT ANALYSIS: Transmission line transients, three phase symmetrical short circuit at alternator terminals, Power system fault calculations, short circuit MVA, Current limiting reactors, ring system and tie bar system, Circuit breaker rating calculation.

UNIT IV: UNSYMMETRIACAL FAULT ANALYSIS L-G, L-L-G and L-L faults at unloaded generator terminals, Equivalent sequence network diagram, Fault impedance, Unsymmetrical faults through impedance, Power system faults- loaded and unloaded conditions.

UNIT V: OVERVOLTAGES: Causes – internal and external; Voltage surge, Basic insulation level, Protection – earthing screen, overhead ground wire, lightning arresters.

UNIT VI :CORONA EFFECTPower loss due to corona, Practical importance of corona, use of bundled conductors in E.H.V transmission lines and its advantages, Overhead line insulators ,Voltage distribution in suspension type insulator, String efficiency , Grading . Sag and stress calculation of overhead conductance, Vibration dampers.

TEXT BOOKS:

1. Power System Analysis, N.V.Ramana, Pearson Education, 2010.

REFENECE BOOK:

1. Power System Analysis, Arthur R. Bergen, Vijay Vittal,2/e, PEARSON Education
2. I. J. Nagrath & D. P. Kothari – "Modern Power System Analysis", TMHPublishing.
3. Depriya Das, Electrical Power System

6EE03 COMPTUTER AIDED ELECTRICAL MACHINE DESIGN

COURSE OUTCOMES

After completing this course, student will be able to

1. Explain the Basics of Computer aided machine design & material selection.
2. Derive the design parameters of single & three phase transformer core.
3. Calculate the winding& cooling system parameters of the transformer
4. Develop the armature winding diagram for three phase Induction Motor
5. Determine the stator core dimensions of three phase Induction motor
6. Design the squirrel cage & wound type rotor for three phase Induction motor

UNIT I : INTRODUCTION: Review of transformer & Induction motor constructional features, Major considerations in electrical machine design, optimization, electrical engineering materials: Conducting, Insulating & Magnetic Materials, Limitations of traditional design, need for CAD, analysis, synthesis and hybrid methods of CAD.

UNIT II: TRANSFORMER DESIGN – I:Transformer Core Design - Material selection, type of construction, Specific magnetic & electric loadings, output equation, core and yoke cross sections, window dimensions, overall core dimensions calculations, core loss estimation from design data. Optimum core design for Minimum cost, Minimum losses, Minimum weight & Minimum volume.

UNIT III : TRANSFORMER DESIGN – II: Transformer Winding - types, and design calculation, Layout, no-load current calculation, primary and secondary winding resistance and leakage reactance from design data, mechanical forces – types & causes. Estimation of efficiency & regulation from

design data. Cooling methods for a transformer, design of transformer tank. Calculation of cooling tubes.

UNIT IV- AC WINFING DESIGN: Concentrated & distributed winding, Integral slot & fractional slot winding, Full pitch & short pitch windings, Single layer& double layer winding, distribution factor, coil pitch factor and winding factor, EMF equation, Development of winding diagrams.

UNIT V: INSDUCTION MOTOR STATOR DESIGN : Specific electric and magnetic loadings selection, output equation, main dimensions (D&L) calculation, stator slot- numbers, shape and dimensions, stator teeth dimension, stator core dimensions. Air gap length calculation.

UNIT INDUCTION MOTOR ROTOR DESIGN : SQUIRREL CAGE ROTOR DESIGN : selecting number of rotor slots, design of rotor bars & slots, design of end rings. - rotor winding design, rotor slots design, and rotor core design. Bearings, shaft design. estimation of no-load current, stator and rotor winding resistances from design data, dispersion coefficient & its effect on performance of IM.

TEXT BOOKS

1. A. K. Sawhney, "A Course in Electrical Machine Design" Dhanpat Rai & Co Ltd, 2016
2. R.K.Agrawal, "Principles of Electrical Machine Design", S.K.Kataria and Sons, Delhi

REFENECE BOOKS:

1. K.G.Upadhyay,"Design of Electrical Machines", New Age international Publishers,1st Edition 2008
2. S.K.Sen,"Principles of Electrical Machine Design with Computer Programs", Oxford and I.B.H. Company Pvt. Ltd., New Delhi
3. IndrajitDasgupta, "Design of Transformers", TMH 1st Edition 2002
4. Indian Standards for Transformer & Three phase IM design from BIS websites

6EE04 Professional Elective - II

ADVANCED CONTROL SYSTEM

Course Outcomes

After completing this course students will be able to:

1. Design compensator using time domain and frequency domain specifications
2. Represent system using state space model
3. Analyze controllability and observability for systems.
4. Design state feedback controller.
5. Analyze digital systems using Z Transform
6. Develop the describing function for the nonlinearity to assess the stability of the system.
7. Analyzethe Nonlinear system using Phase plane Analysis

Syllabus :

Unit I : Compensation Technique :

Introduction, preliminary consideration of classical design. Lead compensator, Lag Compensator, Lead-Lag compensator, Feedback compensation in frequency domain.

Unit II : State Space Technique I :

State, state space and state variables ,SISO /MIMO linear systems state Variable models-differential equations, transfer functions, block diagrams And state diagrams. Transfer function decomposition –Phase variable Forms, canonical forms and Jordan canonical forms, STM computation, L.T, Canonical transformation, and Cayley Hamilton theorem. Time Response –SISO systems.

Unit III : State Space Technique II :

Concept-controllability and observability, SISO/ MIMO linear Systems Gilbert's method and Kalman's test; SISO controllable Systems design –state feedback.

Unit IV : Sampled Data Control System :

Representation, Z transform, Sampler and hold, ZOH, Open loop and closed loop SDCS, Z transfer Function, difference equation, solution, Pulse transfer function, Stability Analysis, S and Z domain relationship, Jury's test, and bilinear Transformation. Root locus method.

Unit V : Non-Linear System Analysis I :

Non linear system behaviour, types and characteristics, Describing function Stability analysis limit cycles, Limitation of Describing function.

Unit VI : Non-Linear System Analysis :

Linearization, Singular points, Classification and nature, Phase plane method, non linear system analysis, Phase trajectories, construction –analytical and graphical method by isoclines, stability analysis, limit cycles, limitations – phase plane method.

Text Books :

1. Nagrath and Gopal," Control system Engineering" Wiley Eastern Ltd , New Delhi
2. K.Ogata," Modern Control Theory "Prentice Hall Of India Pvt Ltd , New Delhi.

Reference Books :

1. Naresh Sinha. "Control system Engineering" Wiley Eastern Pvt. Ltd., New Delhi.
2. B.C. Kuo. "Automatic Control system" Prentice Hall Of India Pvt Ltd Delhi.
3. D Roy Choudhury, "Modern Control Engineering"Publisher: PHI Learning.

6EE04 Professional Elective – II

DIGITAL COMMUNICATION SYSTEM

Course Outcome :

After Completing this course student will be able to:

1. To study basic building blocks of digital communication system.
2. To learn information theory and theoretical bounds on the data rates of digital communication.
3. To understand and analyze communication channel.
4. To study and analyze different digital modulation techniques.
5. To study baseband transmission of the signal.
6. To understand importance of channel encoding and decoding in digital communication.
7. To study multiple access schemes and spread spectrum communication.

Syllabus :

Unit I : Introduction to Digital Communication System :

Functionall Bloks of Digital Communication System; Source Encoder and Decoder, Channel Encoder and Decoder, Modulator and Demodulator. Line Coding: Need for Line coding, Properties of Line Coding, Unipolar RZ and NRZ, Polar RZ and NRZ, Bipolar NRZ (AMI), Split Phase Manchester Coding, Polar Quaternary NRZ Coding, HDB3 Coding, Scrambler and Unscrambler.

Unit II : Information Theory :

Measure of Information, Entropy and Information Rate of Long Independent and Dependent Sequences. Source Encoding: Huffman Encoding, Shannon's Encoding Algorithm, Shannon-Fano Algorithm. Discrete Communication Channel: Noiseless Channel, Deterministic Channel, Binary Symmetric Channel, Rate of Information Transfer over Discrete Channel, Capacity of Discrete Memoryless Channel.Continuous Channel: Shannon Hartley Theorem for channel capacity, Signal to Noise Ratio –Bandwidth Tradeoff.

Unit III : Bandpass Modulation And Demodulation techniques :

BPSK, BFSK, ASK and DPSK generation and reception, Signal space diagram, PSD and Bandwidth of BPSK and BFSK systems, QPSK. Transmitter and Receiver, Signal space diagram, PSD and Bandwidth of QPSK, Probability of Error of ASK, BPSK and BFSK systems, Comparison of Digital modulation systems. Coherent Detection: Matched Filter (Impulse response and Probability of Error).

Unit IV : Base Band Transmission :

Base Band Binary PAM systems, Inter Symbol Interference, Base Band Pulse Shaping and Nyquist Criterion, Eye Diagram, Correlative Coding: Duobinary Encoder with Pre-coder, Modified Duobinary Encoder, Modified Duobinary Encoder with Pre-coder. Equaliation: Need for equalization, Transversal Equalizer (Problems Expected), Preset Equalizer, Adaptive Equalizer, Clock and Carrier Synchronization.

Unit V : Error Control Coding :

Introduction to Error Control Coding, Types of Errors, Methods of Controlling Errors, Linear Bloc Codes:Matrix Description of Linear Block codes, Hamming Distance, Hamming Weight, Minimum Hamming Distance, Hamming Codes, Encoder for Linear Block code, Syndrome Decoding, Syndrome Decoder for (n, k) Linear Block Code, Error Detection and Correction capability of Linear Block Codes (Derivation expected). Cclic Codes: Properties of Cyclic Codes, Systematic and Non-Systematic generator Matrix, Parity Check Matrices for Cyclic Codes, Encoders for Cyclic Codes, Syndrome Decoding for Cyclic Codes. Convolution Codes:Time Domain Approach and Transform domain approach for convolution code generation, Code Tree and Code Trellis for Convolution code.

Unit VI : Multiple Access Schemes and Spread Spectrum Communication :

Multiple Access schemes: Time Division Multiple Access, Frequency Division Multiple Access, Code Division Multiple Access, Space Division Multiple Access. Spread Spectrum Sytems: Notion of Spread Spectrum, PN Sequence Generation (Problems Expected), Direct Sequence Spread Spectrum (DSSS), Jamming Margin, Processing Gain, Eb/No Ratio, Frequency Hopped Spread Spectrum, Slow and Fast frequency Hopping

Text Books :

Proakis J. K., “Digital Communication”, Mc-Graw Hill Book Co., London (Second Edition)

Reference Books :

1. Shanmugam K.S., “Digital & Analog Communication Systems”, John Wiley & Sons, New York, 1996

2. Taub, Herbert, Schilling D. L., “Principles of Communication Systems”, Mc-Graw Hill International Book Co., Tokyo.

3. W.C.Y. Lee, “Mobile Cellular Telecommunications Systems”, Mc-Graw Hill International Editions, 1990.

4.Glover and Grant, “Digital Communication”, Prentice Hall Publication.

6EE04 Professional Elective – II

INDUSTRIAL ELECTRICAL SYSTEM

Course Outcome :

At the end of this course, students will demonstrate the ability to

1. Understand the electrical wiring systems for residential, commercial and industrial consumers.

2. Representing the systems with standard symbols and drawings, SLD.

3. Understand various components of industrial electrical systems.

4. Analyze and select the proper size of various electrical system components.

Unit I : Electrical System components :

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices

Unit II : Residential And Commercial Electrical Systems :

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit III : Illumination System :

Understanding various terms regarding light, lumen, intensity, candle power, lamp efficiency, specific consumption, glare, space to height ratio, waste light factor, depreciation factor, various illumination schemes, Incandescent lamps and modern luminaries like CFL, LED and their operation, energy saving in illumination systems, design of a lighting scheme for a residential and commercial premises, flood lighting.

Unit IV : Industrial Electrical System-I :

HT connection, industrial substation, Transformer selection, Industrial loads, motors, starting of motors, SLD, Cable and Switchgear selection, Lightning Protection, Earthing design, Power factor correction – kVAR calculations, type of compensation, Introduction to PCC,MCC panels. Specifications of LT Breakers, MCB and other LT panel components.

Unit V : : Industrial Electrical System-II :

DG Systems, UPS System, Electrical Systems for the elevators, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Unit VI : : Industrial Electrical System Automation :

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text Books :

S.L.Uppal and G.C.Garg, "Electrical Wiring, Estimating and costing",Khanna Publishers.

Reference Books :

1. K. B. Raina, "Electrical Design, Estimating & Costing", New age International, 2007.
2. S. Singh and R. D. Singh, "Electrical estimating and costing", Dhanpat Rai and Co.,
3. Web site for IS Standards.
4. H. Joshi, "Residential Commercial and Industrial Systems", McGraw Hill Education, 2008.

6EE05 OPEN ELECTIVE – II
ENERGY AUDIT AND MANAGEMENT

Course outcome :

After completing this course student will be able to:

1. Discuss energy scenario and it's management.
2. Conduct the energy audit of different systems.
3. Determine the economics of energy conservation
4. Discussvarious energy Conservation methods & their case studies
5. Explain fundamentals of Harmonics.

Syllabus :

Unit I : Electrical Installation :

Indian energy scenario, Energy needs of growing economy, Energy pricing in India Energy sector reforms, various forms of energy, Primary and secondary energy, commercial and non-commercial energy, Global primary energy reserves, Energy and environment, Necessity of conserving energy, Energy strategy for the future, Electrical energy management, Concept of supply side management and demand side management, Methods of implementing Demand side management and advantages to consumer, utility and society.

Unit II : Energy Audit :

Definition, Need of energy audit, Preliminary and detailed energy audit. Procedure for carrying out energy audit, Instruments used for energy audit, Data Analysis-Energy— production relationship, specific energy consumption, Sankey diagram, CUSUM Technique, Bench marking energy performance, Recommendations for energy conservation, Action plan, Executive Summary.

Unit III : Economics of Energy Conservation :

Cost factors, Budgeting, Standard costing and Sources of capital, Cash flow diagram and activity chart, Simple Payback period analysis, Time value of money, Net present value method, internal rate of return method, Profitability index for benefit cost ratio

Unit IV : Energy Conservation :

Energy conservation in motive power, Illumination, Heating & cooling systems, Pumping systems, thermal power stations and Transmission & Distribution Sector. Cogeneration &Waste heat recovery systems.

Unit V : Energy Audit Case Studies :

Energy Intensive Industries, Commercial, Industrial, Municipal and Agriculture Sector, IT industries, Hospitals.

Unit VI : Fundamentals of Harmonics :

Harmonic distortion, voltage versus current distortion, Power systems quantities under non sinusoidal conditions-active reactive and apparent power, displacement and true power factor, harmonic phase sequences, triplen harmonics, harmonic indices- Total harmonic distortion (THD), Total demand distortion (TDD) , Harmonic sources from commercial and industrial load.

Text Books :

Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, Book-2, Book-3, Book-4 (available online BEE website)

Reference Books:

1. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, McGraw Hill, 1991.
2. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)
3. Energy Conservation and Audit ByThumman, Fairmont Press

4. Energy Audit and Conservation TERI.

6EE05 OPEN ELECTIVE – II
ELECTRICAL ISTIMATING AND COSTING

Course Outcome:

After completion of the course students will be able to

1. Understand methods of installation and estimation of service connection
2. Decide type of wiring, its estimation and costing for residential building
3. Carry out electrification of commercial complex, factory unit installations
4. Design & estimate for feeders & distributors
5. Understand contract, tendering and work execution process.

Syllabus :

Unit I : Electrical Installation :

Classification of Electrical Installation, General requirement of Electrical Installation. Important definitions related to Installation.

Service Connection: Concept of service connection, Types of service connection & their features. Methods of Installation of service connection.Estimation of service connection.

Unit II : Residential Building Electrification :

Procedures for designing the circuits and deciding the number of circuits.Selection of type of wiring and rating of wires &cables..Earthing of Residential Installation. Estimate and cost Preparation of Residential Installation.

Unit III : Electrification Of Commercial Installation :

Concept of commercial Installation. Differentiate between electrification of Residential and commercial Installation Deciding the size of cables, busbar and busbar chambers. Earthing of the electrical Installation Selection of type wire, wiring system.Preparation of detailed estimate and costing of commercial Installation.

Unit IV : Electrification of Factory Unit installation :

Concept of Industrial load. concept of Motor wiring circuit.Important guidelines about power wiring and Motor wiring.Selection and rating of wire, cable size.Sequence to be followed to prepare estimate.Preparations of detailed estimate and costing of small factory unit/ workshop.

Unit V : Design And Estimate For Feeders And Distributors :

Different schemes for feeders & distributors, estimates for different feeders & distributors, Distribution transformer, Deciding Size & location, Estimate for outdoor & indoor type distribution substation.

Unit VI : Contracts, Tenders And Execution :

Tender and tender notices. Procedure for submission and opening tenders. Comparative statements, criteria for selecting contractors, General conditions in order form. Principles of Execution of works administrative approval, technicalsanctions. Billing of executed work.

Text Books :

Electrical Design; Estimating and costing by K.B. Raina, S.K.Bhattacharya New Age International (p) Limited, New Delhi.

Reference Books :

1. Electrical Estimating and costing by Surjit Singh Dhanpat Rai and company, New Delhi.
2. Electrical Estimating and costing by N. Alagappan S. Ekambaram, Tata Mc Graw Hill Publication New Delhi

6EE06 POWER ELECTRONICS - LAB

List of Experiments :

1. To verify the V-I characteristics of SCR
2. To verify forward and reverse characteristics of DIAC
3. To verify forward and reverse characteristics of TRIAC
4. To study UJT as relaxation oscillator
5. AC voltage control using triac - diac combination
6. To verify the operation of half and full controlled converter
7. To verify the operation of SCR commutation circuits
8. To design & simulate dc-dc buck converter
9. To design & simulate dc-dc boost converter
10. Construct and test the dc chopper control circuit using thyristor
11. Study of PWM based step down dc chopper using MOSFET/IGBT
12. To verify the operation of Single phase single pulse / sinusoidal PWM inverter using MOSFET/IGBT
13. To verify the operation of Single phase parallel inverter using MOSFET/IGBT
14. To verify the operation of Single phase to single phase cycloconverter
15. To verify the operation of Single phase dual converter With R - RL loads

16. To verify the operation of Single phase ac voltage controller

6EE07 POWER SYSTEM – II LAB

List of Experiments :

1. Determination of negative sequence reactance of a synchronous generator
2. Determination of zero sequence reactance of a synchronous generator
3. To study various types of current limiting reactors
4. To study the mechanism of lightning arrester
5. Introduction to use of Simulation package (Power World Simulator) for power systems
6. To study substation layout and its components
7. To study HVDC Transmission System
8. To simulate three phase fault for a given power system using MATLAB Simulink
9. To find the direct axis synchronous reactance, X_d& quadrature axis synchronous reactance, X_q of a salient pole synchronous machine by slip test
10. To find the direct axis subtransient reactance, X_d" & quadrature axis sub –transient reactance, X_q" of a salient pole synchronous machine by conducting static test
11. TO study of corona on EHV lines.
12. To study of faults at overhead line insulators
13. To study of sag and stress on overhead conductors

6EE08 COMPUTER AIDED ELECTRICAL MACHINE DESIGN - LAB

Develop Minimum Eight (8) Computer programme:

List of Computer Programme :

1. Develop a computer programme for core design of a single-phase core type transformer
2. Develop a computer programme for core design of a single-phase shell type transformer
3. Develop a computer programme for core design of a three-phase core type transformer
4. Develop a computer programme for optimum core design of a three-phase core type transformer for minimum cost or maximum efficiency.
5. Develop a computer programme for Estimation of Iron losses in a three-phase core type transformer.
6. Develop a computer programme for windings design of a single-phase transformer
7. Develop a computer programme for windings design of a three-phase transformer

8. Develop a computer programme for calculating the No load current of a single-phase transformer.
9. Develop a computer programme for calculating the No load current of a three-phase transformer.
10. Develop a computer programme for a tank design and calculating the number of cooling tubes required for three phase core type transformer.
11.Develop a computer programme to calculate Main dimensions (D & L) of a three phase Induction motor.
12. Develop a computer programme for stator core design of three phase induction motor.
13. Develop a computer programme for squirrel cage rotor design of three phase induction motor.
14. Develop a computer programme for wound type rotor design of three phase induction motor.
15. Develop a computer programme for estimating magnetizing current of a squirrel cage type three phase induction motor.

6EE09 COMPUTER TECHNOLOGY – LAB

Student needs to complete minimum eight assignments based on the following

- Computer Network: Basic Hardware and Terminology in networks, Classifications, The Internet, The Intranet and Extranet.
- Installation of Operating systems, Application software in Personnel Computer or laptop.
- Study of PLCs usedforIndustrial automation, developing the ladder diagram for given task in automation using PLC.
- Basics of IoT, IoT based Monitoring & Controlling of various Electrical Equipment.
- Develop the simulation models for various tasks in electrical engineering using Simulation software.
- Develop the computer programme for various tasks in electrical engineering using software.

SYLLABUS OF VII & VIII SEMESTER B.E (ELECTRICAL ENGG.) (C.B.C.S.)

SEMESTER SEVENTH

7EE01 / 6EPO3 ELECTRICAL ENERGY DISTRIBUTION &UTILIZATION

Course Outcomes:

After completing this course, Students will be able to:

1. Demonstrate the knowledge of distribution substation
2. Compare different power distribution systems
3. Describe elements of distribution Automation system
4. Select proper electrical drive for industrial applications
5. Explain the workingof electric traction system
6. Describe an illumination system & electric heating

Unit I: Substation: Selection & location of site, classification, major equipment ,graphical symbols for various apparatus & circuit elements ,key diagram for 33/11kV substation along with selection & specification of substationequipment, types of bus-bar arrangements, substation earthing. Introduction to Gas Insulated Substation (GIS).

Unit II: Power distribution system -I: Primary and secondary distribution, types of conductors in Distribution system, comparison of distribution systems radial, parallel and ring main, economics of feeder design.

Unit III: Power distribution system - II: Methods for reduction of line losses in distribution system. Introductionto High Voltage Distribution System (HVDS). Distribution Automation: Need for distribution automation, feederautomation, and communication requirements for Distribution automation, Remote terminal unit (RTU).Introduction to SCADA systems.

Unit IV: Electrical Drives: Concept, types, selection criterion for electrical drive. Types of duties, rating calculations for these duties. Heating and cooling. Industrial applications: Textile mill, Cement mill, Sugar mill.

Unit V: Traction System: Requirement, speed- time curves. General features, types, Quadrantal diagram of speed torque characteristics of traction motors. Control of traction motors: Series-Parallel control. Different accessories fortrack electrification –overhead wires, conductor rail system, current collector-pantograph

Unit VI: Illumination: Street lighting: Principle, illumination level, mounting height of lamps, spacing, types oflamps. Flood lighting: Flood lighting calculations, waste light factor, Depreciation factor, Utilization factor. LED:Working principle, advantages & applications.

b) Electric Heating:Resistance& Induction heating & its applications.

Text Books:

1. S.K.Pillai, "A First Course on Electrical Drives", New Age International Publication
2. J.B.Gupta, "A Course in Power System", S.Chand Publication.

Reference Books:

1. M.V.Deshpande, "Electrical Power System Design", TMH Publishing Company Ltd
2. S.Sivanagaraju & S.Satyanarayana, "Electric Power Transmission & Distribution" Pearson Publication
3. P. S. Satnam&P.V.Gupta, "Substation design & Equipment" Dhanpat Rai Publication.
4. J.Upadhyay&S.N.Mahendra : Electric Traction by Allied Publishers Ltd
5. J.B.Gupta :Utilization of Electric Power & Electric Traction by S.K.Kataria& Sons, New Delhi.
6. H.Pratap :Art& Science of Utilization of Electrical Energy by Dhanpat Rai& Company Ltd.
7. H Pratap, "Modern Electric Traction" Dhanpat Rai& Sons Ltd
8. Dr.M.K.Khedkar&Dr.G.M.Dhole : A Textbook of Electrical Power Distribution Automation by University Science Press
9. S.L.Uppal: Electrical Wiring, Estimating and Costing by Khanna Publishers.

7EE02 DIGITAL SIGNAL PROCESSING

Course Outcomes: After successful completion of this course, students will be able to:

1. Analyze the discrete time signals in time domain.
2. Analyze the discrete time systems using DTFT and DFT.
3. Apply the concept of Bandpass sampling.
4. Design the structures of different types of digital filters.
5. Analyze the frequency response of various digital filters.
6. Apply the knowledge of multi-rate signal processing.

Unit I:

Introduction to DSP, Frequency domain description of signals &systems, Discrete time sequences systems, Linearity unit sample response, Convolution, Time invariant system, Stability criteria for discrete time systems, Solutions of linear difference equations.

Unit II:

Fourier Transform: Introduction to Fourier transform of Discrete Time Signal and its properties, Inverse Fourier transform, DFT and its properties, Circular convolution, Linear convolution from DFT, FFT, decimation in time and frequency algorithm.

Unit III:

Sampling of Bandpass signals, Representation of Bandpass signals, sampling of Bandpass signals, discrete time processing of continuous time signal; Analog to digital conversion-sample and hold, quantization and coding, analysis of quantization errors, oversampling of A/D converter; Digital to Analog conversion sample and hold, first order hold, linear interpolation with delay, oversampling of D/A converter.

Unit IV:

Filter categories, Direct form I, Direct form II, Cascade and parallel structure for IIR and FIR Filter, Frequency sampling structures for F.I.R. filter, Steps in Filter Design, Design by Pole Zero Placements, FIR filter design by Windowing Method, Rectangular, Triangular and Blackman window

Unit V:

Analog filter types, Butter worth, Elliptic filter, Specification and formulae to Decide to filter order, Methods to convert analog filter into IIR digital, Mapping of differential, Impulse Invariant, Bilinear, Matched Z transformation.

Unit VI:

Multirate DSP and Introduction to DSP Processor, Decimation by a factor D, interpolation by a factor I, sampling rate conversion by a rational factor I/D, Filter Design & Implementation for sampling rate conversion, Multi stage Implementation of sampling rate conversion. General Architecture of DSP, Case Study of TMS320C67XX.

Books Recommended:

Text Books:

1. J. G. Proakis and D. G. Manolakis, “Digital Signal Processing: Principles, Algorithm and Applications”, (4th Edition), Prentice Hall, 2007

2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems - Filter Banks – Wavelets”, (1st Edition), John Wiley and Sons Ltd, 1999.

Reference Books:

1. S. K. Mitra, “Digital Signal Processing”, 3rdEdition, TMH Edition.

2. Ifaeachor E.C, Jervis B. W., “Digital Signal Processing: A Practical Approach”, Pearson Publication
3. S. K. Mitra, “Digital Signal Processing: A Computer Based Approach”, McGraw Hill, 2011.

7EE03 ENTREPRENEURSHIP AND PROJECT MANAGEMENT

Course Outcomes:

After successful completion of this course, students will be able to:

1. Understand the concept of entrepreneurship and its role in economic development.
2. Understand the concept of entrepreneur and Entrepreneurial models
3. Compare the various business models and select the most suitable.
4. Identify & formulate the project report and Source of finance for a project.
5. Understand the concept & planning of Project Management
6. Estimate the cost, time & resources for the project work.

Unit I:

Entrepreneurship: Introduction to Entrepreneurship, Meaning and concept of entrepreneurship, Need of Entrepreneurship, Types of Entrepreneurships-Social, For Profit, Not for Profit, the Evolution history of entrepreneurship development, role of entrepreneurship in economic development, Institutions/agencies for entrepreneurship development, future Scope of entrepreneurship, Entrepreneurial Ecosystem.

Unit II:

Entrepreneur: Entrepreneur: Who? Why? How? the Attributes, skills/traits required to be an entrepreneur; Creative and Design Thinking, types of entrepreneurs. Myths and Realities about entrepreneurs, the entrepreneurial decision process, and skill gap analysis, and Entrepreneurial models, entrepreneurial success stories, Pitching for Start-ups, Marketplace, Marketspace.

Unit III:

Business Model & Business Organization: Types of Business Models; its importance, Business Plan: Importance, Guidelines and Contents, Specimen of a B-Plan and Feasibility Studies, pre- requisites from the perspective of investor. The importance and diversity of business model, components of an effective business model Canvas, Various form of business organization-sole proprietorship, partnership, corporations, Limited Liability Company.

Unit IV:

Project Management: Basic concepts & Planning: Life Cycle of a Project. The Steps in managing a Project.International Standards (PMI, IPMA). Different types of projects: industrial, research and more. The role of the Project Manager.Terms of the Project Contract.Project Planning.Goals and

Objectives of the Project.Owners and Stakeholder. The Work Breakdown Structure (WBS) to plan a project.

Unit V:

Project identification & Evaluation: Selection - project formulation – contents of a project report - planning commission, guidelines for formulating a project - specimen of a project report. Source of finance for a project - Institutional finance supporting projects, project evaluation - objectives - types - methods.

Unit VI:

Time and Cost Management: Estimation of Time, Costs and Resources. Scheduling Project Work.Critical Path Method (CPM).Resource balancing. Defining Project Risks. Process to establish the project risk plan. Contingency Reserves. Risk Matrix Analysis. Project Control and Evaluation.

BOOKS RECOMMENDED:

Text Books:

1. S. S. Khanka, "Entrepreneurial Development", S. Chand and Company Limited, New Delhi, 2001.
2. Dr. C. B. Gupta, Dr. N.P. Srinivasan, "Entrepreneurial Development", Sultan Chand & Sons.

Reference Books:

1. S. Choudhury, "Project Management", Tata McGraw Hill Education Private Limited, 2009.
2. Denis Lock, "Project Management", Gower Publishing Company, USA.

7EE04 PROFESSIONAL ELECTIVE-III

(i) WIND AND SOLAR SYSTEMS

Course Outcomes:

After successful completion of this course, students will be able to:

1. Understand the energy scenario and the consequent growth of the power generation from renewable energy sources.
2. Understand the basic physics of wind and solar power generation.
3. Understand the power electronic interfaces for wind and solar generation.
4. Understand the issues related to the grid-integration of solar and wind energy systems.

Unit I:

Physics of Wind Power: History of wind power, Indian and Global statistics, Wind physics, Betz limit, Tip speed ratio, stall and pitch control, Wind speed statistics-probability distributions, Wind speed and power-cumulative distribution functions.

Unit II:

Wind Generator Topologies: Review of modern wind turbine technologies, Fixed and Variable speed wind turbines, Induction Generators, Doubly-Fed Induction Generators and their characteristics, Permanent-Magnet Synchronous Generators, Power electronics converters. Generator - Converter configurations, Converter Control.

Unit III:

The Solar Resource: Introduction, solar radiation spectra, solar geometry, Earth Sun angles, observer Sun angles, solar day length, Estimation of solar energy availability.

Unit IV:

Solar Photovoltaic: Technologies-Amorphous, mono crystalline, polycrystalline, V-I characteristics of a PV cell, PV model, array, Power Electronic Converters for Solar Systems, Maximum Power Point Tracking (MPPT) algorithms. Converter Control.

Unit V:

Network Integration Issues: Overview of grid code technical requirements. Fault ride-through for wind farms - real andreactive power regulation, voltage and frequency operating limits, solar PV and wind farmbehaviour during grid disturbances. Power quality issues. Power system interconnectionexperiences in the world. Hybrid and isolated operations of solar PV and wind systems.

Unit VI: Solar Thermal Power Generation:

Technologies, Parabolic trough, central receivers, parabolic dish, Fresnel, solar pond, Elementary analysis.

Books Recommended:

Text Books:

1. T. Ackermann, “Wind Power in Power Systems”, John Wiley and Sons Ltd., 2005.
2. S. P. Sukhatme, “Solar Energy: Principles of Thermal Collection and Storage”, McGraw Hill, 1984.

References Books:

1. G. M. Masters, “Renewable and Efficient Electric Power Systems”, John Wiley and Sons, 2004.
2. H. Siegfried and R. Waddington, “Grid integration of wind energy conversion systems”, John Wiley and Sons Ltd., 2006.
3. G. N. Tiwari and M. K. Ghosal, “Renewable Energy Applications”, Narosa Publications, 2004.
4. J. A. Duffie and W. A. Beckman, “Solar Engineering of Thermal Processes”, John Wiley & Sons, 1991.

7EE04 PROFESSIONAL ELECTIVE - III

(ii) VLSI DESIGN

Course Outcomes:

1. Identify the various IC fabrication methods.
2. Express the Layout of simple MOS circuit using Lambda based design rules.
3. Apply the Lambda based design rules for subsystem design.
4. Differentiate various FPGA architectures. CO5: Design an application using Verilog HDL.
5. Concepts of modelling a digital system using Hardware Description Language

Unit-I : VLSI and Moore’s Law. CMOS technology. Hierarchical design. The VLSI design process. IP-based design. Fabrication methods.Transistor structures. Characteristics of transistors and wires. Design rules. Layout design. Reliability.

Unit-II : Combinational logic. Static logic gates. Basic Gate Layout. Delay and power consumption .Alternate gate structures: switch, domino. Wire delay models. Design-for-yield. Gates as IP.

Unit III : Combinational Logic Networks: Layouts for logic networks. Delay through networks. Logic and interconnect design. Power consumption and power optimization. Switch logic networks. Combinational logic testing.

Unit-IV: Sequential Machines: Latches and flip-flops. structures and Clocking disciplines. Performance analysis. Sequential system design. Power optimization. Verification and testing of FSMs

Unit-V : Subsystems Design: Pipelines and data paths. Adders. Multipliers. Memory. PLAs.FPGAs. Image sensors. Buses and networks-on-chips. Data paths.

Unit-VI: Floor planning: Floor planning styles and methodology. Global routing. Clock distribution. Power distribution. Packaging and pads. Register-transfer design. Pipelining. High-level synthesis.

Text Book: Wayne Wolf: "Modern VLSI Design", Prentice-Hall.

Reference Books:

1. Vai M.M. "VLSI Design", CRC Press.
2. Weste N, Eshraghian, "Principles of CMOS VLSI Design" Pearson Education.
3. Chandrasetty V A "VLSI Design", Springer.
4. Esteban Tlelo-Cuautle and Sheldon X.-D. Tan, "VLSI Design", InTech, Croatia

7EE04 PROFESSIONAL ELECTIVE-III -

(iii) Computer Architecture & Organization

Course Outcomes:

1. Differentiate Von Neumann, Harvard, and CISC and RISC architectures. Analyze the performance of machines with different capabilities.
2. Illustrate binary format for numerical and characters. Validate efficient algorithm for arithmetic operations.
3. Construct machine level program for given expression on n-address machine. Analyze and calculate memory traffic for a program execution. Design an efficient data path for an instruction format for a given architecture.
4. Explain the importance of hierarchical memory organization. Able to construct larger memories. Analyze and suggest efficient cache mapping technique and replacement algorithms for given design requirements. Demonstrate hamming code for error detection and correction.
5. Understand the need for an interface. Compare and contrast memory mapping and IO mapping techniques. Describe and Differentiate different modes of data transfer. Appraise the synchronous and asynchronous bus for performance and arbitration.
6. Understand the structure and read write mechanisms for different storage systems. Illustrate and suggest appropriate use of RAID levels. Assess the performance of IO and external storage systems.
7. Classify parallel machine models. Illustrate typical 6-stage pipeline for overlapped execution. Analyse the hazards and solutions

Unit I: Introduction and overview of computer Architecture :

Introduction to computer systems - Overview of Organization and Architecture –Functional components of a computer -Registers and register files-Interconnection of components Organization of the von Neumann machine and Harvard architecture-Performance of processor

Unit II: Data Representation and Computer Arithmetic:

Fixed point representation of numbers-algorithms for arithmetic operations: multiplication (Booths, Modified Booths) - division (restoring and non-restoring) - Floating point representation with IEEE standards and algorithms for common arithmetic operations- Representation of non-numeric data (character codes).

Unit III: Fundamentals of Computer Architecture:

Introduction to ISA (Instruction Set Architecture)-Instruction formats- Instruction types and addressing modes- Instruction execution (Phases of instruction cycle)- Assembly language programming-Subroutine call and return mechanisms-Single cycle Data path design-Introduction to multi cycle data path-Multi cycle Instruction execution.

Unit IV Memory System Organization and Architecture:

Memory systems hierarchy-Main memory organization-Types of Main memory-memory interleaving and its characteristics and performance- Cache memories: performance considerations. Virtual memories, address translation, memory management requirements.

Unit: V Interfacing and Communication:

I/O fundamentals: handshaking, buffering-I/O techniques: programmed I/O, interrupt-driven I/O, DMA- Interrupt structures: vectored and prioritized-interrupt overhead- Buses.

Unit: VI Device Subsystems:

External storage systems-organization and structure of disk drives: Electronic- magnetic and optical technologies- RAID Levels- I/O Performance. Performance Enhancements -

Classification of models - Flynns taxonomy of parallel machine models (SISD, SIMD, MISD, MIMD),Computer Peripherals: Input-output devices like video displays, online storage device, graphics input devices, Printers, scanner.

Text Book(s) :

1. David A. Patterson and John L. Hennessy Computer Organization and Design-The Hardware/Software Interface 5th edition, Morgan Kaufmann, 2013.

2. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer organization, McGraw Hill, Fifth edition, Reprint 2011.

Reference Book:

1. W. Stallings, Computer organization and architecture, Prentice-Hall, 8th edition, 2013 Mode of Evaluation: CAT / Assignment / Quiz / FAT / Project / Seminar

7EE05 PROFESSIONAL ELECTIVE-IV

(i) ARTIFICIAL INTELLIGENCE

Course Outcomes: After successful completion of this course, students will be able to:

1. To understand and communicate fundamentals of Artificial Neural Networks and Systems.
2. To understand and present various learning methods and architectures of neural network.
3. To understand and describe fuzzy logic and genetic algorithm fundamentals and be able to solve problems.
4. To apply AI techniques to solve electrical engineering problems along with inter disciplinary problems.

Unit I: Introduction: Biological Neurons and their artificial models, introduction to neural computing Components of neuron, input and output weight, threshold, weight factors, transfer Functions, concepts of supervised and unsupervised learning.

Unit II: Supervised Learning: Single Layer network, perceptron, Linear Separability, Training algorithm and limitations Multilayer Network: Architecture of feed forward network, learning rule, generalized Delta rule, learning function. Back propagation algorithm.

Unit III: Unsupervised Learning: Introduction, Counter propagation networks, Korhonen's self-organizing maps, Hopfield's networks.

Unit IV: Introduction to Fuzzy: Uncertainty in information, basic concepts of Fuzzy sets, operations on fuzzy sets, properties. Fuzzy relations: operations, properties, value assignments.

Unit V: Membership Functions: Features, fuzzification, membership value assignments, Fuzzy Rule based Systems, Graphical technique of inference. Defuzzification: Lambda-cuts for Fuzzy sets and Fuzzy relations, Defuzzification methods.

Unit VI: Genetic Algorithm (GA): Introduction to genetic algorithm, workingprinciple, coding of variables, Fitness function. GA operators, similarities & differences between GAs and Traditional methods; Unconstrained and constrained optimization using Genetic Algorithm, real coded GA, Advanced GA, global optimization using GA.

Books Recommended:

Text Books:

1. J.M. Zurada, “Introduction to Artificial Neural Network”, Jaico Publishing House.
2. T J Ross, “Fuzzy Logic with Engineering Application”, Wiley Publication.

Reference Books:

1. G. J. Khir and T. A. Folger, “Fuzzy sets, Uncertainty and Information”, PHI Publication.
2. Koska Bart, “Neural Network & Fuzzy systems”, Prentice Hall of India Pvt Ltd, New Delhi.
3. MeherotraKishan, Mohan C. K., Ranka Sanjay, “Elements of Artificial Neural Networks”, Penram International Publishing (India) Pvt. Ltd.
4. D. E. Goldberg, “Genetic Algorithm in Search Optimization and Machine Learning”, Addison-Wesley Longman Publishing Co., US.
5. Kalyanmoy Deb, “Optimization for Engineering Design Algorithms and Examples”, Prentice Hall of India, New Delhi.

7EE05 PROFESSIONAL ELECTIVE-IV
(ii) ELECTRICAL DRIVES & CONTROL

Course Outcomes: After successful completion of this course, students will be able to:

1. Explain the basic Concept of electrical drives
2. Demonstrate various modern speed, torque control techniques of DC drives
3. Demonstrate various modern speed, torque control techniques of AC drives.

Unit I: Introduction to Electrical Drives: Overview of electrical drive, comparison of DC & AC drive, components of load torque. Stability of an electrical drive.Introduction to frame of references (synchronous and rotating), Park and Clark transformation.

Unit II: DC Drive Control: Introduction to Four quadrant operation of dc drive, reviewof principle of operation of the chopper, four quadrant chopper circuit operation. Steady state analysis of chopper-controlled DC motor drive: continuous and discontinuous current conduction. Closed loop speed controlled separately excited dc motor drive.

Unit III: AC Drive Control: Review of basic principle of operation, speed control of induction motor: Impact of rotor resistance of the induction motor torque--speed curve. Review of slip energy

recovery scheme. Closed loop control of slip energy recovery-controlled induction motor drive. Power electronic based rotor side control of slip ring Induction motor.

Unit IV: Scalar Control of Induction Motor: overview of three-phase voltage source inverter, generation of three- phase PWM signals, sinusoidal modulation, space vector theory, conventional space vector modulation, voltage fed inverter control: open loop v/f control, close loop speed control with v/f control and slip regulation.

Unit V: Vector Controlled Drive: Review of DC drive analogy, equivalent circuit and phasor diagram, principles of vector control, direct or feedback vector control, flux vector estimation, indirect or feed forward vector control, vector control of line side PWM rectifier, statorflux-oriented vector control, vector control of current Fed inverter drive.

Unit VI: Direct Torque & Flux Control (DTC): Torque expression with stator & rotor fluxes, control strategy of DTC, Adaptive control: self-tuning control, Model Referencing adaptive control (MRAC), sliding mode control: Control Principle, sliding trajectory control of vector drive.

Books Recommended:

Text Books:

1. Bimal K. Bose, “Modern Power Electronics and AC Drive”,Pearson Education.
2. VedamSubrahmanyam, “Electric Drives: Concepts & Applications”, Tata McGraw Hill Publishing Co Ltd.
3. Austin Hughes and Bill Drury, “Electric Motor and Drives: Fundamentals, Types and Applications”, Newnes, Oxford.

Reference Books:

1. S. K. Pillai, “A First Course on Electrical Drives”, New Age International Publishing Co. Ltd.
2. Gopal. K. Dubey, “Fundamentals of Electrical Drives”, CRC Press
3. R. Krishnan, “Electric Motor Drives: Modeling, Analysis & Control”, Prentice Hall of India Pvt Ltd.
4. M. D. Singh & K. B. Khanchandani, “Power Electronics”, Tata McGraw Hill Publishing Co Ltd.
5. G. K. Dubey, “Power Semiconductor Controlled Drives”, Prentice Hall.
6. Dr. P. S. Bimbhra, “Generalized theory of Electrical Machine”, Khanna Publishers

7EE05 PROFESSIONAL ELECTIVE – IV:
(iii) DIGITAL CONTROL SYSTEMS

Course Outcomes:

1. Discretize the continuous system
2. Analyze the response of the system.
3. Analyze the stability of the system.
4. controllability/ observability of a system
5. Discretize the analog controller/ compensator
6. Design the state feedback control law.
7. Design the estimator for the given system.
8. Design a component or a product applying all the relevant standards with realistic constraints

Unit:I Introduction: Overview of design approaches, continuous versus digital control, sampling process, Sample and hold device, A/D, D/A conversion.Calculus of difference equations.Z-transform. Pulse transfer function

Unit:II Stability Analysis of discrete systems: location of poles, Jury's stability criterion, stability analysis through bilinear transforms. State variable analysis: State equations of discrete data systems – State transition equations – Relationship between state equation and transfer functions - Characteristic equations – Eigen value – Eigen vector.

Unit: III: State Space Representation: Diagonalization of Matrix – Jordan canonical form – Methods of computing state transition matrix – State diagram – Decomposition of discrete data transfer function. Controllability and observability of linier time invariant discrete data systems.

Unit: IV Design of Digital Control Systems: Classical Method: Digital PID controllers and frequency domain compensation design.

Unit: V: State Feedback Design: State variable methods - Pole placement design, Observer design and the discrete linear regulator problem.

Unit:VI: Microprocessor Based Digital Control

-Selection of processors ,Mechanization of control algorithms. Iterative computation via parallel, direct, canonical, cascade realization. Case studies.

Text Books:

1. K. Ogata, “Discrete-time control systems”, Pearson, 2015.

2. G. F. Franklin, J. D. Powell and M Workman, ‘Digital Control of Dynamic Systems’ PHI (Pearson), 2008.

7EE06 ELECTRICAL ENERGY DISTRIBUTION & UTILIZATION - LAB

- Student should perform minimum eight practical based on syllabus.

7EE07 DIGITAL SIGNAL PROCESSING – LAB.

- Student should perform minimum eight practical based on syllabus.

7EE08 ENTREPRNEUURSHIP & PROJECT MANAGEMENT - LAB.

Student will carry out minimum eight assignments based on syllabus. List of assignments is given below for reference.

List of Assignments:

1. Undertake SWOT analysis to arrive at your business idea (Product / services).
2. Undertake self-assessment test to discover your Entrepreneurial traits.
3. Undertake the market survey to identify the need of market.
4. Identify Business opportunity for you.
5. Carry out the survey of industries of your stream and prepare the report.
6. Arrange the Visit to industries/firms of your product/service stream to study their business model.
7. Visit the banks and other financial Institutions to enquire about various funding scheme for set up the new business.
8. Compile the information of government agencies and financial agencies which provide loan/financial support to establish the business.
9. Prepare a report of technological and financial feasibility of chosen product/service.
10. Prepare a marketing strategy for chosen product/service.
11. Prepare a short term & long-term goal of your business.
12. Prepare a business plan for your chosen product/services.
13. Arrange a discussion session with successful entrepreneur to discuss on your business plan.
14. Study the stories of successful entrepreneur.
15. Prepare a DPR (Detail Project Report) of chosen product /services.

7EE09 PROJECT & SEMINAR

Seminar:

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for 50 marks.

Project:

The objective of the project is to enable the students to work in groups of not more than six members in each group on a project involving analytical, experimental, design or combination of these in the area of Electrical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. On completion of the work, a project report should be prepared and submitted to the department. The evaluation is based on continuous internal assessment by an internal assessment committee for 75 marks. The university examination, which carries a total of 75 marks, will be a Viva Voce examination at the end of VIII Semester, conducted by a committee of one external examiner appointed by the University and one internal examiner/Guide.

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EIGHTH SEMESTER

8EE01 EMBEDED SYSTEMS

Course Outcomes:

After completing this course, the students will be able to:

6. Acquire a basic knowledge about fundamentals of microcontrollers
7. Acquire a basic knowledge about programming and system control to perform a specific task.
8. Acquire knowledge about devices and buses used in embedded networking.
9. Develop programming skills in embedded systems for various applications.
10. Acquire knowledge about Life cycle of embedded design and its testing.

Unit-I : Introduction: Embedded systems design, embedded system architecture, embedded systems model, An Overview of Programming Languages and Examples of Their Standards, Standards and Networking, Multiple Standards-Based Device Example: Digital Television (DTV).

Unit-II: Embedded Hardware Building Blocks and the Embedded Board:

Powering the hardware, Instruction Set Architecture (ISA) architecture model, internal processor design and its performance.

Unit-III: Memory: ROM, RAM and auxiliary memory, Memory Management of External Memory, Performance of memory .I/ O: Managing Data: Serial vs. Parallel I/O, Interfacing the I/O Components, I/O performance.Buses: arbitration, timing and performance.

Unit-IV: Device Drivers: Device Drivers for Interrupt-Handling, Memory Device Drivers, On-board Bus Device Drivers, Board I/O Driver. Embedded OS: Multitasking and Process Management, Memory Management.

Unit-V: Embedded OS: I/O and File System Management, OS Standards: POSIX, OS Performance Guidelines. Middleware: meaning and examples. Application layer software: meanings and examples.

Unit-VI: Embedded system design & implementation:
Defining the System-Creating the Architecture and Documenting the Design, Stages in creating an Embedded System Architecture. Implementing the Design. Quality Assurance and Testing of the Design.

Text Book: Tammy Noergaard "Embedded Systems Architecture" Elsevier Newnes Publication.
Reference Books:

1. Rajkamal , "Embedded Systems, Architecture, Programming & Design" TMH.
2. Jane W. S. Liu 'Real Time Systems", Pearson Education
3. Vahid&Givargis "Embedded System Design" John Wiley & Sons P Ltd.
4. Peter Marwedel "Embedded Systems Design" Springer, Netherland.

8EE02 POWER SYSTEM PROTECTION

Course Outcomes:
After successful completion of this course, the students will be able to:

1. Explain the need, desirable features & main components of protection system.
2. Design the various protection scheme for transmission line
3. Develop the protection scheme for Alternator, Transformer, Motors &Busbar
4. Demonstrate the knowledge of static relays & Numerical relays
5. Select the proper type & rating of circuit breaker and fuses for various applications.

Unit I: Circuit Interruption, Circuit breaker control circuit, Fault clearing process, Autoreclosure, Arc phenomenon- maintenance, properties and interruption theories; AC circuit breakers- current

interruption, transient recovery voltage (TRV), rate of rise of TRV, factors affecting TRV, ratings; Inductive and Capacitive current interruptions, current chopping.

Unit II: A. Fuses Types, Constructional features, operation, Characteristics and Applications B. Circuit Breaker (Part – I) Air break, Air blast, Bulk oil and minimum oil-types, constructional features, operation and application.

Unit III: Circuit Breaker (Part – II) SF6,Vacuum, Miniature, Earth leakage and Moulded Case – types, Constructional features, operation and application; Testing, Installation and Maintenance.

Unit IV: A. Relaying Principle Components, Essential features, Characteristics, Terminology, CT's and PT's, Relay classification. B. Electromagnetic Relays, Overcurrent, Directional, Distance and Differential – types, constructional features, operation, characteristics and application.

Unit V: Protection of Transmission Lines Relaying schemes – overcurrent, earth fault, directional, distance and differential; Parallel feeders and ring mains protection, three stepped protection ,Carrier current relaying, Overload and Power swing.

Unit VI: A. Other Power System Elements Protection Transformers, Motors, Generators and Buses. B. Static Relaying Basic concepts, equipment's, comparators, Characteristics realization – overcurrent, directional, differential and distance relay. Microprocessor based relay introduction.

Text Book: Sunil S. Rao – "Switchgear and Protection" Khanna Publications New Delhi.

Reference Books:

1. R. T. Lythall – "Switchgear Handbook" J and P Newness Butterworth, London.
2. C. R. Mason – "The Art and Science of Protective Relaying"
3. A. R. Van and C Warringtan – "Protective Relaying ,Vol 1 and 2," Chapman Hall, London.
4. Geosonoviz – "High Voltage Circuit Breakers"
5. V. A. Slabikov – "Generation Protection and Switchgear" CIT, Coimbatore.
6. Badri Ram and B. N. Vishwkarma – "Power System Protection and Switchgear" Tata Mc-Graw Hill Publishing Company Limited, New Delhi.
7. B. Ravindranath and M Chander – "Power System Protection and Switchgear" Wiley Eastern Ltd, New Delhi.

8EE03 PROFESSIONAL ELECTIVE - V

(i) BIOMEDICAL ELECTRONICS

Course Outcomes:

After completing this course, the students will be able to:

1. Understand the electronic devices and theory of operation in the medical area.
2. Learn to design, test, and analyze electronic circuits using oscilloscopes and other electronic test equipment.
3. Apply knowledge of engineering and science to interpret data.
4. Apply knowledge of engineering and science to understand the principle of biomedical electronic circuits.
5. Understand how to apply, measure circuit performance, and solve problems in the areas of biomedical signals.

UNIT-I: introduction to biomedical engineering:

Physiological system of heart, Man instrument system, Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Bio-potential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory : skin contact impedance measurement of skin con tact impedance, motion artefacts, nearest equation Nearest Equation.

UNIT-II: Biomedical Recorder And Measurement:

Biomedical recorders for EEG, ECG, EMG, Blood pressure variation as a function of time, relationship of heart soundsto a function of the cardio vascular system, Measurement of Blood Pressure (Direct & Indirect), Blood flow, Heart sound.

UNIT-III: Medical Imaging System:

Instrumentation for diagnostics X-ray , X- ray basics properties , X-ray machine , Special imaging technique. Ultrasonic imaging system : Physics of Ultrasound, Biological effect of ultrasound. Ultrasonic A-scan, M-scan, B- scan, Real-time ultrasonic imaging systems.

UNIT-IV: Therapeutic Equipments:

Need of Physiological and electro therapy equipment. Cardiac pacemaker machine, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy : short wave, microwave, ultrasonic.

UNIT-V: Patient Care and Monitoring and Safety:

System concepts, Bedside patient monitors, central monitors, Average reading heart monitor, Intensive care monitoring, Ambulatory monitoring. Biotelemetry: Single channel and Multichannel biotelemetry, telephonic data transmission. PATIENT SAFETY : Electric shock hazards, leakage

current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards. Telemedicine.

UNIT-VI: Computers In Biomedical Engineering:
Computerized Axial Tomography (CAT), Computerized Aided ECG analysis, Computerized patient monitoring system. Computerized Catheterization.

Text Books:

1. Khandpur R.S. : "Handbook of Biomedical Instrumentation", TMH, New Delhi.
2. Cromwell L. &Weibell F.J.: "Biomedical Instrumentation and Measurement", Prentice Hall of India.

Reference Books:

1. Dr.Lele R.D. : "Computer Applications of Medicine", Tata Mc-Graw Hill, New Delhi.
2. Webstar J.G. : "Medical Instrumentation", IIIed., John Wiley & Sons.
3. Carr and Brown : Biomedical Equipment Technology.

8EE03/6EP04 PROFESSIONAL ELECTIVE-V

(ii) PROCESS CONTROL SYSTEMS

Course Outcomes: After Completing this course student will be able to:

1. Explain the various Electronic Instruments for measurement of electrical parameters.
2. Analyse the different signals
3. Demonstrate the signal counting, recording and working of digital readout devices.
4. Demonstrate the Various techniques of A/D and D/A conversions.
5. Apply various signal processing tools as per requirement
6. Develop ladder diagrams &programmes for PLC

Unit I: Electronics Instruments for Measurement of Electrical Parameters Advantages of Electronic Instruments, Electronic Voltmeters Electronic Multi-meter, differential volt meter, Digital voltmeter, Q meter,vector impedance meter, vector voltmeter.

Unit II: Signal Generation and Analysis Signal generators, Function generators. Wave analyzer HarmonicDistortion Analysers, Spectrum Analysis.

Unit III: Signal Counting and Recording Decade counting Assembly, Binary counter, Decimal counter, Decade counter with digital display, universal counter, Digital readout devices, storage type CRO, Servo type X-Y recorder.

Unit IV: Signal conditioning and Conversions. Frequency characteristics of various types of signals, active filters bandpass, low pass and high pass filters using op Amps. Various techniques of A/D and D/A conversions.
Modulation and demodulation PCM techniques, phase locked loop.

Unit V: Signal Processing Pulse times, triggered delayed sweeps, discrete pulse delay circuits, pulses sequencing, analog multiplexers and de-multiplexers, digital multiplexing sample and hold circuits, serial and parallel digital data conversion. Signal transmission, Analog and digital telemetry techniques, MODEM and UART, keyboard and character generators, tape recorder

Unit VI: Introduction to Processor and Processor based Techniques. Introduction to PLC, PLC architecture, programming; ladder diagram and examples, micro controller based instrumentation
Text Books:

1. H.S. Kalsi– Electronic Instrumentation, - Tata Mc-Graw Hill Publishing Company, New Delhi.
2. Cooper, Helfrick– Electronic Instrumentation and Measurement Techniques, A Prentice Hall of India, New Delhi.

Reference Books: -

1. B.R.Gupta -Electronics and Instrumentation – Wheeler Publishing.
2. Rangan, Sharma & Mani – "Instrumentation – devices & Systems" Tata Mc-Graw Hill Publishing Company, New Delhi.
3. R.P. Jain-Digital Electronics, Tata Mc-Graw Hill Publishing Company, New Delhi.
4. Microprocessors and Digital Systems, by:D.V.Hall, TMH Publishing Company, New Delhi.
5. Shoen Beck- Electronic Communication, Prentice Hall of India Pvt. Ltd. New Delhi.
6. B. Ram- fundamental of Microprocessors, Dhanpat Rai & Sons, New Delhi.
7. A.K. Sawhney– A Course in Electrical & Electronics Instrumentation, Dhanpat Rai& Sons, New Delhi

8EE03 PROFESSIONAL ELECTIVE-V
(iii) DIGITAL IMAGE PROCESSING

Course Outcomes:
After completing this course, the students will be able to:

1. Review the fundamental concepts of a digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Evaluate the techniques for image enhancement and image restoration.
4. Categorize various compression techniques.

5. Interpret Image compression standards.
6. Interpret image segmentation and representation techniques.

UNIT-I : Introduction to digital image processing :

Digital Image Fundamental, Elements of Visual Perception, Simple Image Model, Sampling and Quantization, Basic Relationships between Pixel Imaging Geometry, Gray scale image representation.

UNIT-II: Image Transforms:

Introduction to the Fourier Transform, DFT, Properties of Two Dimensional Fourier Transform, FFT, Hadamard, Harr DCT, Slant Transform.

UNIT-III: Image Enhancement:

Basic Techniques, Enhancement by point processing, Spatial Filtering, Enhancement in Frequency domain, histogram based processing, homo-morphic filtering.

UNIT-IV: Image Restoration:

Degradation model, Diagonalisation concept, Algebraic approach to Restoration. Inverse filtering, Weiner (CNS) filtering Restoration in Spatial domain, Basic morphological concept, morphological principles, binary morphology, Basic concepts of erosion and dilation.

UNIT-V: Image Compression:

Fundamentals, Image compression models, Elements of Information theory, Lossy and predictive methods, vectorquantization, runlength coding, Hauff coding, and lossless compression, compression standards.

UNIT-VI: Image Segmentation:

Detection of discontinuities, Edge Linking and boundary detection, Thresholding, Regional oriented Segmentation.

Text Books :

1) Gonzaler and Woods: “Digital Image Processing”, Addison / Wesley.

2) Milan Sonka, Vaclav Hlavac, Roger Boyle: “Image processing Analysis and Machine Vision” , Book / Cole 2nd Edition.

Reference Books:

1) A. K. Jain: “Digital Image Processing”, PHI

2) William K. Pratt : “Digital Image Processing”, 3rd ed. , John Wiley and Sons Publi.

8EE04 PROFESSIONAL ELECTIVE-VI

(i) ROBOTICS

Course Outcomes: After completing this course, the students will be able to:

1. Learn about knowledge for the design of robotics.
2. Understand robot kinematics and robot programming.
3. Understand application of Robots.
4. Learn about force and torque sensing.

UNIT I: Introduction:

Brief History, Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.

UNIT II: Rigid Motion and Homogeneous transformation:

Position definitions. Coordinate frames. Different orientation descriptions.Free vectors. Translations rotations and relative motion, Composition of rotation, rotation with respect to fixed frame and current frame, parameterisation of rotation, Euler Angele, roll, pitch, yaw, axis/angle representation, Homogeneous transformation

UNIT III: Forward Kinematics:

Link coordinate frames, Denavit-Hartenberg convention. Assignment, of coordinate frame, Joint and end effector Cartesian space. Calculation of DH parameters and forward kinematic equation of different configuration of manipulator, Planner elbow manipulator, Cylindrical three link, SCARA, Spherical Wrist and other configuration.

UNIT IV: Velocity Kinematics:

Forward kinematics transformations of position Translational and rotational velocities.Velocity Transformations. Singularity, The Manipulator Jacobian.

UNIT V: Robot Dynamics:

Lagrangian formulation, general expression for kinetic and potential energy of n-link manipulator, Newton-Euler equations of motion. Derivation of equations of motion for simple cases: two-link.

UNITVI: Trajectory Planning& Programming: Trajectory planning and avoidance of obstacles. Trajectory for point to point motion, Cubic polynomial trajectory, Quintic polynomial, LSPB(Linear segment with parabolic blend)Minimum time trajectory, Trajectories for Paths Specified by Via Points. Robot languages, computer control and Robot software.

Text Books:

1. M.W. Spong, S. Hutchinson, and M. Vidyasagar, Robot Modeling and Control, Wiley, .2nd revise edition, 2012
2. J.J. Craig, Introduction to Robotics: Mechanics and Control, Pearson Education, 4th Edition, 2017
3. M.P. Groover, et.al., Industrial Robots: Technology, Programming and applications, McGraw Hill, 2nd Indian edition, 2012.

Reference Books:

1. Robot Manipulators: Modeling, Performance Analysis and Control. by Etienne Dombre; Wisama Khalil, Somerset : Wiley, 2013.
2. M O Tokhi, A K M Azad, Flexible robot manipulator :modelling, simulation and control 2nd edition, 2017.
3. Ashitava Ghosal. 'Robotic fundamental Concept and Analysis', Oxford University Press, 11th impression 2015.

8EE04/8EP04 PROFESSIONAL ELECTIVE – VI

(ii) ELECTRICAL ENERGY CONSERVATION AND AUDITING

Course Outcomes:

After successful completion of this course, students will be able to:

1. Summarize Indian and global energy scenario.
2. Explain types of energy Audit and its procedure.
3. Discuss economics of energy conservation
4. Elaborate the concepts of energy conservation and management.
5. Choose Appropriate energy efficient techniques for energy conservation
6. Apply the understanding of energy conservation and management for industrial applications.

Unit I: Energy Scenario: Various forms of energy: Primary and secondary energy, commercial and non- commercial energy, renewable and non-renewable. Indian and global energy scenario, energy needs of growing economy, energy pricing, electricity billing and tariff. Energy sector reforms: In coal, oil, natural gas and electricity. Functions and Responsibilities of CERC& SERC. Energy Conservation Act-2001, Indian electricity Act 2003 and its features.Electricity (Amendment) Bill, 2020 – Key Highlights. Energy and environmental Impacts.

Unit II: Energy Audit: Definition, energy audit, need, types of energy audit: Preliminary and detailed energy audit. Energy audit instruments. Procedure for carrying out energy audit.Data Analysis-

Energy production relationship, specific energy consumption, Sankey (energy flow) diagram, CUSUM Technique, Bench marking, energy performance.

Unit III: Economics of Energy conservation: Cost factors, Budgeting, Standard costing and Sources of capital, Cash flow diagram and activity chart, Simple Payback period analysis, Time value of money, Net present value method, and internal rate of return method. Profitability index for benefit cost ratio.

Unit IV: Energy Conservation & Management: Definition and necessity of energy conservation. Review of electric motors, types, losses, motor efficiency, factors affecting motor Performance, transformer types & its losses. Rewinding and motor replacement issues. Definition and Objective of Energy Management, concept of Supply Side Management (SSM) and Demand Side Management (DSM), methods of implementing demand side management and advantages to consumer, utility and society. Energy strategy for the future.

Unit V: Energy Efficient Techniques in Electrical Systems: Review of power factor improvement and its benefit, selection and location of capacitors. Power factor penalties and incentives in tariff for demand control. Recommendations for energy conservation: Maximum demand controllers, automatic power factor controllers, Variable Speed Drives, Energy efficient transformers. Soft starting of motors.

Unit VI: Energy Conservation in Industrial Applications: Energy conservation opportunities in motive power (Motors and drive system)- Energy efficient motors, Heating Ventilation and Air Conditioning (HVAC), Illumination system, Pumps and Pumping systems, thermal power stations, Utility Industries: Transmission & Distribution Sector. Cogeneration & Waste heat recovery systems. Energy Audit Case Study of energy intensive industry.

BOOKS RECOMMENDED:

Text Books:

1. “Energy Audit and Conservation”, TERI.
2. S. C. Tripathy, “Utilization of Electrical Energy and Conservation”, Mc. Graw Hill, 1991.

Reference Books:

1. “Success stories of Energy Conservation”, BEE, New Delhi. (www.beeindia.gov.in)
2. Thumman, “Energy Conservation and Audit”, Fairmont Press.
3. Sonal Desai, “Handbook of Energy Audit”, Mc. Graw Hill.
4. Guide books for National Certification Examination for Energy Manager/Energy.
5. Auditors Books, General Aspects (available online).

8EE04/8EP04 PROFESSIONAL ELECTIVE – VI

(iii) ELECTRIC AND HYBRID VEHICLES

Course Outcomes:

After successful completion of this course, students will be able to:

1. Understand the models to describe hybrid vehicles and their performance.
2. Understand the different possible ways of energy storage.
3. Understand the different strategies related to energy storage systems.

Unit I: Introduction: Conventional Vehicles: Basics of vehicle performance, vehicle power sourceCharacterization, transmission characteristics, mathematical models to describe vehicle performance.

Unit II: Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Unit III: Hybrid Electric Drive: Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Unit IV: Electric Trains: Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis. Electric Propulsion unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

Unit V: Energy Storage: Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive system: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems.

Unit VI: Energy Management Strategies: Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison ofdifferent energy management strategies, implementation issues of energy managementstrategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

BOOKS RECOMMENDED:

Text Books:

1. C. Mi, M. A. Masrur and D. W. Gao, “Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives”, John Wiley & Sons, 2011.
2. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”, Springer, 2015.

Reference Books:

1. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design”, CRC Press, 2004.
2. T. Denton, “Electric and Hybrid Vehicles”, Routledge, 2016.

8EE05 EMBEDDED SYSTEMS LAB

- Student should perform minimum eight practical based on syllabus.

8EE06 POWER SYSTEM PROTECTION LAB

- Student should perform minimum eight practical based on syllabus.

8EE07 PROJECT & SEMINAR

Seminar:

Each one of the students will be assigned a Seminar Topic in the current and frontier areas. The student has to conduct a detailed study/survey on the assigned topic and prepare a report. The student will make an oral presentation followed by a brief question and answer session. The Seminar (presentation and report) will be evaluated by an internal assessment committee for 50 marks.

Project:

The objective of the project is to enable the students to work in groups of not more than six members in each group on a project involving analytical, experimental, design or combination of these in the area of Electrical Engineering. Each project shall have a guide. The student is required to do literature survey, formulate the problem and form a methodology of arriving at the solution of the problem. On completion of the work, a project report should be prepared and submitted to the department. The evaluation is based on continuous internal assessment by an internal assessment committee for 75 marks. The university examination, which carries a total of 75 marks, will be a Viva Voce examination at the end of VIII Semester, conducted by a committee of one external examiner appointed by the University and one internal examiner/Guide.

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