EEC- 501 Electrical Machine-II

Unit I - **Basics of Synchronous Machine**: Construction, working principal, types of prime movers, excitation system, polyphase distributive winding, coil span and winding factors , integral and fractional slot windings, emf equation, harmonics and their elimination, armature reaction, synchronous reactance and impedance, equivalent circuit of alternator, relation between generated voltage and terminal voltage, voltage regulation of alternators using synchronous impedance, MMF, ZPF and A.S.A method.

Unit II - **Synchronous Machine- I**: Salient pole machines, two reaction theory equivalent circuit model and phasor diagram, determination of Xd and Xq by slip test, power angle equation and characteristics, synchronizing of alternator with infinite busbar, parallel operation and load sharing, synchronizing current, synchronizing power and synchronizing torque coefficient, synchroscopes, phase sequence indicator; effect of varying excitation and mechanical torque.

Unit III - Synchronous machine-II: Synchronous motor operation, starting and stopping of synchronous motor, pull in & pull out torque, motor under load power and torque, reluctance torque, effect of excitation, effect of armature reaction, power factor adjustment, V curves, inverted V curves, super synchronous and sub synchronous motors, hunting and damper winding, efficiency and losses.

UNIT IV- Short Circuit Ratio: SCR and its significance, short circuit oscillogram, determination of various transient, sub transient, steady reactances and time constants, expression of transient and sub transient reactances w.r.t self and mutual inductances of various winding, short circuit current, equivalent circuit.

Unit V- Special Electrical machines: PM brushless DC motors, switched reluctance motor, linear induction motor, stepper motors**,** their constructional features, principle of operation, applications.

References:

1. P.S. Bimbhra, Generalised Theory of Electrical Machines.
2. D.P. Kothari and I.J. Nagrath, 'Electric Machines', Tata McGraw Hill Publishing Company Ltd, 2002.
3. Electrical Engineering by JB Gupta, SK Kataria & sons, New Delhi
4. Fitzgerald, C.Kingslay, S.D. Umans, Electric machinery ,5th Ed., McGraw Hills, 1992
5. Electrical Machines, Ashfaq Hussain ,2014

List of Experiments :(Extendable)

1. Study of torque step rate characteristic of a stepper motor.
2. Study of characteristic of switched reluctance motor.
3. To determine regulation of alternator using mmf and zpf methods.
4. To synchronise alternator with infinite bus bar.
5. To plot V and inverted V curves for a synchronous motor.
6. To find Xd and Xq of salient pole synchronous machine by slip test.

EEC- 502 Power Electronics

Unit-I Power Electronic Devices: Power diodes, power transistors, GTO, triac, diac, power MOSFET, IGBT, LASCR, fast recovery diode, schottey diode, construction, principle , operation & characteristics of SCR, two transistor analogy, turn on & off of SCR, commutation techniques (Class A,B,C,D,E,&F Commutation), UJT, ramp triggering, SCR rating & protection, snubber circuit, heating, cooling & mounting of SCR, series and parallel operation of SCR, String efficiency.

Unit-II Rectifier: Single phase half wave & full wave uncontrolled and controlled rectifier circuit with resistive, resistive & inductive load (continuous & non continuous conduction), & RLE loads, average load voltage and load current, active and reactive power, effect of free wheeling diode and source inductance, comparison of mid point & bridge rectifier circuits.

Unit-III Inverter: Series and parallel inverter, voltage source & current source inverter, Single phase and three phase bridge inverter, Self cumulated inverters, Mc- murray & MC murray bed ford inverters, Voltage control of single phase and three phase bridge inverter, Harmonics & their reduction.

Unit-IV Chopper: Chopper operation, Step up & step down choppers, chopper configuration (A, B, C, D, & E), steady state analysis, current & voltage commutation of chopper circuits, Jones & Morgens chopper.

Unit-V AC voltage controllers: AC voltage controllers using SCRs & traics, single phase full wave controller with R and RL load, RMS load voltage, load current and input power factor, three phase AC voltage controller, Dual converter, Switched mode voltage regulator, buck, Boost, & Chuck regulators, Single phase & three phase cyclo convertor.

References:

1. M.H. Rashid, Power Electronics Circuits, Devices and Applications, Pearson
    a. Education, Singapore, 1993.
2. M Ramsmoorthy, An Introduction to transistor and their application, Affiliated East-West Press.
3. P.C. Sen, Power Electonics, TMH.
4. M.D. Singh, K.B. Khanchandani, Power Electronics, TMH, Delhi, 2001.
5. Chakravarti A., Fundamental of Power Electronics and Drives, Dhanpat Ray & Co.
6. P.S. Bhimbhra, Power Electonics, Khanna Pub.
7. Vedam Subramanyam, Power Electronics New Age International Revised II ed. 2006.

List of Experiments (Extendable):

1. To study V-I characteristics of SCR.
2. To study UJT trigger circuit for half wave and full wave control.
3. To study single-phase half wave controlled rectified with R load (ii) L load with and without freewheeling diode.
4. To study single phase (i) fully controlled (ii) half controlled bridge rectifiers with resistive and inductive loads.
5. To study single-phase ac voltage regulator with resistive and inductive loads.
6. To study single phase cyclo-converter.
7. To study triggering of (i) IGBT (ii) MOSFET (iii) power transistor.
8. To study three-phase fully/half controlled bridge rectifier with resistive and inductive loads.

EEC- 503 Control System

Unit I - Control System & Classification : Differential equations of systems, linear approximation, laplace transform and transfer function of linear system, model of physical system (electrical, mechanical and electromechanical), block diagram, signal flow graph, mason's gain formula, return difference and return ratio, error detectors, servomotor, tachogenerator, servo amplifier, magnetic amplifier, rotating amplifier.

Unit II - Time Domain Analysis: Representation of deterministic signals, first order system response, s- plane root location and transient response, impulse & step response of second order systems, performance characteristics in time domain, derivative & integral control, steady state response, error constant, error coefficients, stability, Routh Hurtwitz criterion.

Unit III - Frequency Domain Analysis: Frequency response bode plot, polar plot, Nicol's chart, closed loop frequency response, frequency domain performance characteristics, and stability in the frequency domain, Nyquist criterion.

Unit IV - Root Locus Method: Basis theory and properties of root loci, procedure for the construction of root loci, complete root locus diagram, design and compensation of feed back control system, approaches to compensation, cascade compensation networks and their design in the frequency domain, simple design in s- plane.

Unit V - State Variable Methods: Introduction to state variable concepts, state variable description of linear dynamic systems, representation in matrix forms, block diagram & signal flow graph representation of state equations, transfer matrix from state equations, transition matrix, general solution for linear time invariant state equations, adaptive control systems.

References:

1. Ogata K, "Modern Control Engineering ", Prentice Hall
2. Modern Control Engineering,B S Mankey
3. Nagarath & Gopal," Control System Engineering," Wiley Eastern
4. Bakshi & Goyal. Feedback control system, Technical publication.

List of Experiment (Extendable):

1. To determine speed torque characteristics of armature controlled D.C. servomotor.
2. To determine the speed torque characteristics and relationship between torque speed and control windings voltage by AC servomotor.
3. To obtain the step response transient characteristics of first order electric system and to measure system parameters.
4. To plot the nyquist plot of a given transformer function using matlab.
5. To plot the bode plot of a given transformer function using matlab.

EEC-504(A) Neural Network

Unit-I Neural Network & Learning Process: Basic concept, neural network advantages, models of a neuron, neural network as directed graph, network architectures, artificial intelligence and neural network, learning processes, error correction learning, memory based learning, Hebbian learning, competitive learning, Boltzman learning, learning tasks, adaptation, statistical learning theory.

Unit-II Perceptrons : Single layer perceptrons, adaptive filtering problem, unconstrained optimization technique, linear least squares filter, least mean square algorithm, perceptron convergence theorem, multi layer perceptron, architecture, back propagation algorithm, generalization, network pruning techniques, approximations of functions.

Unit-III Radial Basis Function Networks: Cover's theorem, interpolation problem, supervised learning, regularization theory & network, generalized radial basis function networks (RBF), estimation of the regularization parameter, approximation properties of RBF networks, comparison of RBF networks and multilayer perceptrons, Kernel regression and its relation to RBF networks.

Unit-IV Entropy Analysis: Entropy, maximum entropy, mutual information, Kullback-Leibler divergence, mutual information as an objective function to be optimized, maximum mutual information, infomax and redundancy reduction, spatially coherent and incoherent features, independent components analysis, maximum likelihood estimation.

Unit V Recurrent Networks: Recurrent network architectures, state space model, non-linear autogressive with exogenous inputs model, computational power of recurrent networks, learning algorithms, back propagation through time, real time recurrent learning, system identification, model reference adaptive control, Kalman filter, decoupled Kalman filter.

References:

1. Haykin: Neural Networks- A Comprehensive Foundation, PHI Learning.
2. Sivanandam, Sumathi and Deepa: Introduction to Neural Networks using Matlab, TMH.
3. Freeman and Skapura: Fundamentals of Neural Networks- algorithms, applications and
4. programming techniques, Pearson Education.
5. Hagan, Demuth and Beale: Neural Network Design, Cengage Learning.
6. Anderson: An introduction ro Neural Networks, PHI Learning.
7. Satish Kumar: Neural Networks, TMH.

EEC-504(B) Reliability Engineering

Unit I: Introduction to reliability and indices: Probability theory, density and distribution function of continuous and discrete random variable.

Unit -II Component reliability: Hazard function, failure laws, exponential failure law, wear in period and its importance, safety and reliability, replacement, methods of reliability improvement.

Unit -III Reliability evaluation: Evaluation of series, parallel, and series–parallel network. complex network reliability evaluation using event, space, decomposition, tie-set, cut-set, load sharing system, multi state models.

Unit -IV Evaluation methods: Markov process, state diagram, availability and unavailability function, evaluation of time dependent and limiting state probabilities, MTTF calculation. concept of frequency and durations. State enumeration method for evaluating failure frequency, MUT, MDT, frequency balance approach.

Unit -V Reliability Testing: Estimation of reliability function, failure function and MTTF from grouped and ungrouped datas, censoring and accelerations, parametric methods.

References:

1. Introduction to reliability engineering –E.E.Lewis, John Wiely and Sons, 1987
2. Reliability and maintainability engineering, C.E. Ebeling, TMH, 2006
3. Reliability Engineering : Probability Models and maintanance methods –Joel A.Nochlas,Taylor and Prancis 2005
4. Reliability evaluation of engineering system: concept and techniques-R. Billinton, R.N.Allon, Pitman, 1984

EEC-504(C) Digital Electronics

Unit-I :Number Systems : Decimal, binary, octal, Hexadecimal, Excess 3, Gray ASCII, decimal number system and conversion , binary weighted codes, signed numbers, 1s and 2s complement codes, Binary arithmetic, Boolean Algebra: Binary logic functions , Boolean laws, truth tables, associative and distributive properties, DeMorgans theorems, realization of switching functions using logic gates

Unit-II : Combinational Logic: AND, OR, NOT, XOR, XNOR, NAND, NOR, realization of boolean function using universal gates. half and full adder, half and full subtractor, series and parallel adder, BCD adders, lookahead carry generator, decoders, encoders, multiplexers and de-multiplexers. analysis and design of combination circuits, realization of various boolean functions using NAND,NOR gates and multiplexers.

Unit-III : Flip-Flops: R-S, Clocked R-S, T, D, J-K, race around problem, Master-slave J-K., state and excitation tables. shift registers and counters :synchronous and asynchronous counters, binary ripple counter, up-down counter, johnson and ring counter. analysis and design of sequential circuits

Unit-IV : Semiconductor memories: Organization and construction of RAM, SRAM, DRAM, RAMBUS ROM, PROM, EPROM, EEPROM, PAL and PLAs etc .

Unit V : Logic families: RTL, DTL, TTL, ECL, IIL, PMOS, NMOS and CMOS logic etc. Interfacing between TTL and MOS, vice-versa.

References:

1. M. Mano : Digital Logic and Computer Design, Pearson Education
2. W.H. Gothman : Digital Electronics, PHI.
3. Millman and Taub : Pulse, Digital and Switching Waveforms, MGH
4. Salivahanan and Ari Vahagan : Digital Circuits and Design, Vikas Publishing House
5. Leach and Malvino : Digital Principles and Applications, TMH

EEC-505(A) Renewable Energy Sources

Unit – I Renewable Energy Systems: Energy sources, comparison of conventional and non-conventional, renewable and non-renewable sources, statistics of world resources and data on different sources globally and in Indian context, significance of renewable sources, energy planning, energy efficiency and management.

Unit – II Wind Energy System: Wind Energy, wind mills, grid connected systems, system configuration, working principles, limitations, effects of wind speed and grid conditions. grid independent systems - wind-battery, wind diesel, wind-hydro biomass, wind operated pumps, controller for energy balance, small hydro system grid connected system, effect of hydro potential and grid condition, synchronous versus induction generator for stand alone systems, use of electronic load controllers and self excited induction generators, wave energy system: system configuration: grid connected and hybrid systems.

Unit – III Geothermal Energy: Electric energy from gaseous cells, magneto-hydro generated energy, non hazardous energy from nuclear wastes, possibilities of other modern non-conventional energy sources.

Unit – IV Energy from Oceans & Biomass Energy System: Ocean temperature difference, principles of OTEC, plant operations, system configuration, biomass engine driven generators, feeding loads in stand-alone or hybrid modes, biomass energy and their characteristics.

Unit – V: Solar Energy: Extraterrestrial solar radiation, terrestrial solar radiation, solar thermal conversion, solar photo tonic system solar cell, solar cell materials, efficiency, characteristics of PV panels under varying insulation, PV operated lighting and water pumps, characteristics of motors and pumps connected to PV panels, electric energy conservation and audit.

References:

1. John Twidell & Toney Weir, Renewable Energy Resources, E & F N Spon.
2. El-Wakil, Power Plant Technology, McGraw Hill.
3. Rai G D, Non-conventional Energy Resources, Khanna.
4. F Howard E. Jordan, "Energy-Efficient Electric Motor & their Application-II", Plenum Press, New York, USA.
5. Anna Mani, "Wind Energy Resource Survey **in** India-Ill", Allied Publishers Ltd., New Delhi,
6. S.P. Sukhatme: Solar Energy, TMH-4e,
7. Dr. A. Ramachandran, Prof B.V Sreekantan & M F.C. Kohli etc, "TERI Energy Data Directory & Year book 1994-95", Teri Tata Energy Research Institute, New Delhi,

EEC-505(B) Computer Application in Power System

Unit -I Power System Models: models of power system components, network model using graph theory, formation of Z bus, transmission line models, regulating transformer, line loadability, capability curves of alternator.

Unit- II Compensation: Control of load bus voltage using reactive power control variable, SVC & SVS, Regulated shunt compensation, series and shunt compensation, effect on loadability of transmission lines, Uniform series and shunt compensation.

Unit- III Sensitivity Analysis: Sensitivity analysis- general sensitivity relations, generation shift distribution factors, line outage distribution factors, compensated shift factors, sensitivity associated with voltage-VAR, sensitivities relating load bus voltage changes in terms of PV bus voltage changes, sensitivity relating changes in reactive power generation for changes in PV bus voltage.

Unit- IV Power System Security: Security functions, security level, contingency analysis, security control, economic dispatch using LP formulation, pre-contingency and post-contingency, corrective rescheduling.

Unit -V Stability : Voltage stability, difference between voltage and angle stability, PV curve for voltage stability assessment, proximity and mechanism, modal analysis using reduced jacobian, participation factor, effect of series and shunt compensation on voltage stability , effect of load models.

References:

1. Power Generation, Operation and Control by A.J. wood and B.F. Wollenberg John Wiley & Sons Inc.
2. 1984.
3. Computer methods in power systems analysis – by stage G.W. and E.L. Abiad A.H. Mc Graw Hill.
4. Computer Techniques in Power Systems Analysis- Pai M.A. Tata Mc Graw Hill.
5. Computer Modeling of Electrical Power Systems, Arrillaga J. Arnord C.P Harker B.J. John Wiley & Son
6. Computer Aided Power Systems Analysis Kusic G.L.- 2nd Edition, CRC Press
7. Modern Power Systems Analysis Nagrath I.J. and Kothari D.P. Tata Mc Graw Hill.
8. Power System Analysis Grainger J.J. & Stevnson W.D. Mc Graw Hill.
9. Power System Stability and control –P Kundur ,IEEE Press 1994.
10. Advance Power Systems Analysis and Dynamics Singh L.P. John Wiley

EEC-505(C) Industrial Electronics

Unit-I Power Supplies: Power supply, rectifiers (half wave, full wave), performance parameters of power supplies, filters (capacitor, inductor, inductor-capacitor, pi filter), bleeder resistor, voltage multipliers, regulated power supplies (series and shunt voltage regulators, fixed and adjustable voltage regulators, current regulator), comparison of linear and switched power supply, switch mode converter (flyback, buck, boost, buk-boost, cuk converters).

Unit-II Thyristors: Silicon controlled rectifies , constructional features, principle of operation, turn-on and turn-off methods, triggereing methods, types of commutation, thermal characteristics of SCR, causes of damage to SCR, SCR overvoltage protection circuit, seies and parrel operation of SCRs, line commutated converters (half wave rectifier with inductive and resistive load, single phase and three phase full wave rectifiers).

Unit-III Applications of OP-AMP: OP-AMP, relaxation oscillator, window comparator, rectangular to triangular pulse convertersion, Wien bridge oscillator, function generator, frequency response of OP-AMP, power supplies using OP-AMP, filters .

Unit-IV Programmable Logic Controller: Functions, applications, advantages and disadvantages of PLC over conventional relay controllers, comparison of PLC with process control computer system, selection of PLC, functional block diagram of PLC, microprocessor in PLC, memory, input and output modules (interface cards), ladder logic language, process control applications of PLC, Programming examples.

Unit-V Residential and Industrial Application Space Heating and air conditioner, high frequency fluorescent lighting, electronic timer, battery charger, switch-mode-power supply, uninterruptible power supply, static switches, induction heating, electric welding, introduction of HVDC and FACTs.

References:

1. Bishwanath Paul: Industrial Electronics and control, PHI Learning.
2. Rashid: Power Electronics- Circuits, devices and applications, Pearson Education.
3. Singh and Khanchandani: Power Electronics, TMH
4. Bhimbra: Power Electronics, Khanna Publishers.
5. Moorthi: Power Electronics, Oxford University Press.
6. Webb: Programmable Logic Controllers- Principles and Applications, PHI Learning.
7. Petruzulla: Programmable Logic Controllers, TMH.

EEC-506(A) Operating System

Unit I- Introduction: History of operating System, types of operating system: batch processing, real time, multitasking & multiprogramming, time-sharing system, operating system services, operating system structure, system call & system boots, operating system design & implementations, system protection, buffering & spooling.

Unit II- Processes Management: Process concept, process control block, systems programmer's view of processes, operating system services for process management, scheduling algorithms, first come first serve, round robin, shortest run time next, highest response ratio next, multilevel feedback queues, performance evaluation of scheduling algorithms.

Unit III Deadlock: Characterization, methods for deadlock handling, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock, process management in linux. file management:- file system, access methods, free space managements, allocation methods, directory systems, protection, organization, sharing & implementation issues, disk & drum scheduling, file system in linux & windows.

Unit IV- I/O Management: I/0 devices organization, I/0 devices organization, I/0 buffering, I/O Hardware, Kernel I/O subsystem, transforming I/O request to hardware operations, device management: path managements, sub module, procedure, scheduler, handler, interrupt service routine.

Unit V- Memory Management: Memory hierarchy, MFT & MVT, logical and physical address space, concept of swapping and paging, memory management without swapping or paging, contiguous and non-contiguous allocation, segmentation, demand paging, page replacement algorithms, allocation of frames, thrashing, demand segmentation and paging combined with segmentation, structure & implementation of page table, virtual memory, cache memory organization.

References:

1. Silberschatz ,"Operating system", Willey Pub.
2. Stuart,"Operating System Principles, Design & Applications",Cengage Learning.
3. Tannanbaum, "Modern operating system",PHI Learning.
4. Dhamdhere, "Operating System",TMH.
5. Achyut S Godbole,"Operating System", TMH.

EEC-506(B) Modelling & Simulation of Electrical System

Unit-I Choice of simulators: Power electronic circuit simulation, analysis of dynamic behaviour of electrical machines using MATLAB/SIMULINK.

Unit-II- Modelling of Power Electronic Converters: Modelling of semiconductor devices, switch realization– single quadrant and two quadrant switches, switching losses.

Unit-III DC-DC converters: Steady-state analysis of converter in continuous and discontinuous modes (CCM & DCM), and estimation of converter efficiency, development of circuit model for simulating dynamic operating conditions in CCM & DCM, Feedback control for converters.

Unit-IV Dynamic Modelling of Electrical Machines: Modelling of DC machines, modelling of three phase Induction machine, Reference frame theory – ARF, RRF, SYRF, SRF, equations of transformation, voltage equations, torque equations, analysis of steady-state operation, acceleration characteristics, effect of loading and operation with non-sinusoidal voltages.

UNIT-V Case Studies: Analytic Vs Simulation Models, advantages and disadvantages.

References:

1. R.W. Erickson, Dragan Maksimovic, Fundamentals of Power Electronics (2 e), Springer, 2005.
2. P.C. Krause, O. Wasynczuk, S.D. Sudhoff, Analysis of Electrical Machinery & Derive Systems (2e), Wiley Student Edition, 2002.

EEC-506(C) Biomedical Instrumentation

Unit I- Introduction: Origin of Bio electric signals and their characteristics. Noise coupling, powerline and other interfering sources, Artifacts, Analysis of concurrent, coupled and correlated processes.

Unit II -Bioelectric Signals: Detection of events in bioelectric signals like ECG, EEG, PCG, detection of waves, correlation & coherence analysis, few case studies.

Unit III-Measurement Systems: Specifications of instruments, static & dynamic characteristics, classification of errors, statistical analysis. Introduction to reliability, accuracy, fidelity, speed of response, linearization of technique, data acquisition system.

Unit IV-Bioelectric Amplifiers: Special features of bioelectric amplifiers, safety requirements, realization of bioelectric amplifiers, carrier amplifiers, chopper amplifiers, phase sensitive detector, isolation amplifiers, and instrumentation amplifiers.

Unit V-Patient Safety and Electro medical Equipment: Physiological effects of electrical currents, macroshock and microshock, preventive measures to reduce shock hazards, Leakage current, isolation of patient circuits, safety of electrically susceptible patients, radiation hazards and safety, shielding, open ground problem and earthing methods.

References:

1. Human Physiology- The Mechanism of Body Function By Vander, Sherman,TMH Ed.1981
2. Introduction To Biomedical Equipment Technology By Carr & Brown
3. Biomedical Instrumentation and Measurements By Cromwell, 2nd edition, PearsonEducation. 4. Handbook of Biomedical Instrumentation By R. S. Khandpur, TMH
4. Biomedical Digital Signal Processing, Tompkins, PHI
5. Biomedical Instrumentation, Arumugam.

EEC- 507 Industrial Training – I

Students must observe following points to enrich their learning in electrical engineering during industrial training:

- Industrial environment and work culture.
- Organisational structure and inter personal communication.
- Machines/ equipment/ instruments - their working and specifications.
- Product development procedures and phases.
- Project planning, monitoring and control.
- Quality control and assurance.
- Maintenance system.
- Costing system.
- Stores and purchase systems.
- Roles and responsibilities of different categories of personnel.
- Customer services.
-Problems related to various areas of Work etc.
- Layout if any

To be submitted : The students has to submit the power point presentation of minimum15 slides of the training performed(comprising of points stated above) along with the original certificate of training performed with proper seal and signature of the authorized person.