Department of
Electrical Engineering

Syllabi for:

M. Tech. in Electrical Engineering
(Power System)
Effective from 2012-13

Indian School of Mines
Dhanbad-826004
Jharkhand, India
Core Course Syllabi
(Effective from 2012-2013 Academic Session)

I- SEMESTER

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Name of Course</th>
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<td>1.</td>
<td>AMC51101</td>
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I-SEMESTER
ADVANCED NUMERICAL METHODS AND APPLIED STATISTICS
AMC51101 L-T-P: 4-0-2


Section B: Applied Statistics – Review of binomial, negative binomial, Poisson, normal and log normal distribution. Test of significance of mean, variance, correlation and regression coefficients; \( \chi^2 \) test of goodness of fit; attributes and contingency table; F tests, tests of proportions, tests of significance under large sample approximation. Non-parametric tests: Wald-Wolfowitz run tests, tests of randomness, median tests, sign tests, Mann-Whitney Wilcoxon U-tests. Time series analysis, introduction to reliability and life testing experiments in engineering problems. One way and two-way analysis of variance, Completely Randomized Design (CRD), Randomized block Design (RBD), Latin Square Design (LSD).

MSC51153 (R)  MANAGEMENT PRINCIPLES AND PRACTICES  L-T-P: 3-1-0

money, capital budgeting techniques, replacement analysis, cost concepts, cost volume profit analysis, characteristics and life cycle of a project. Project cost estimates, job costing. Introduction to marketing management – concept and practice.

**EEC51101 GENERALIZED THEORY OF ELECTRICAL MACHINES**  L-T-P: 3-0-0

Principles of electromagnetic energy conversion; Energy state functions; Modelling of electromechanical systems; Matrix methods and use of generalised circuit theory of machines; Kron’s primitive machine; Reference frames; Different methods of transformation; Impedance, torque and motional impedance matrix; Development of basic performance equations and analysis of different rotating machines such as dc, induction and synchronous machines; Short circuit and block diagram representation of dc machine; Steady state equivalent circuit of induction motor; Dynamics and transients in electric machines; Operational equivalent circuit, operational impedances, time constants, steady state operation, phasor and block diagram representation of synchronous machine; Short circuit studies on alternators; Relevant computer techniques for machine analysis, Modelling of special electrical machines.

**Elective-I & Elective-II**

**EEE51101 POWER SYSTEM OPERATION AND CONTROL**  L-T-P: 3-0-0


**EEE51102 POWER SYSTEM TRANSIENTS**  L-T-P: 3-0-0

Origin and nature of transients and surges; Surge parameters of plants; Equivalent circuit representations; Lumped and distributed circuit transients.
Line energization, and de-energization transients; Earth and earth wire effects; Current chopping in circuit breakers; short line fault condition and its relation to circuit breaker duty; Trapped charge effects; Effect of source and source representation in short line fault studies; Control of transients; Lightning phenomena; Influence of tower footing resistance and earth resistance; Travelling waves in distributed parameter multi-conductor lines, parameters as a function of frequency.
Simulation of surge diverters in transient analysis; Influence of pole-opening and pole-reclosing; Fourier integral and Z-transform methods in power systems transients; Bergeron methods of analysis and the use of the EMTP package.
Insulation coordination: over voltage limiting devices, dielectric properties, breakdown of gaseous insulation, tracking and erosion of insulation, high current arcs, metallic contacts.
EEE51103  ADVANCED POWER SYSTEM PROTECTION  L-T-P: 3-0-0

Basic principles – CTs, PTs, static relays, modern circuit breakers; Protection of power transformer, alternators, transmission lines, cables, reactors and capacitors; Protection of motors, rectifiers and thyristors; HVDC protection; Relay coordination; Numerical relaying algorithms; Travelling wave relays; Adaptive relaying.

EEE51104  SOFT COMPUTING TECHNIQUES  L-T-P: 3-0-0

Neural Networks: Overview of biological Neuro-system, Mathematical models of neurons, ANN architecture, Learning rules; Learning paradigms - Supervised, Unsupervised and Reinforcement learning; ANN training algorithms - perceptions, Training rules, Delta, Back propagation algorithm; Multilayer perceptron model; Applications of artificial neural networks; Competitive learning networks; Kohonen self organizing networks; Hebbian learning; Hopfield networks; Associative memories; Boltzman machine; Fuzzy Logic: Introduction to Fuzzy logic; Classical and Fuzzy sets: Overview of classical sets, Membership function, Fuzzy rule generation; Operations on Fuzzy sets: Compliment, Intersections, Unions, Combinations of operations, Aggregation operations; Fuzzy arithmetic: Fuzzy numbers, Linguistic variables, Arithmetic operations on intervals and numbers, Lattice of Fuzzy numbers, Fuzzy equations; Fuzzy logic: Classical logic; Genetic Algorithms; Evolution Strategies; Evolutionary Programming; Genetic Programming; Selecting, crossover, mutation, schema analysis, analysis of selection; Markov & other stochastic models; Simulated Annealing; Tabu Search; Ant Colony based optimization.

EEE51105  OPTO ELECTRONICS  L-T-P: 3-0-0

Principles of operation of photodiode, PIN diode, APD, Photo transistor and photo detectors, CCD, Opto-coupler, Injection and recombination at pn-junction, LED; Lasers-theory, types, characteristics; Polarization, induced optical effects – Kerr effect and Pockel effect – applications; Interference, interferometers, Ring resonators; Fiber Optics – basic characteristics, sensors - basic principle and operational details; Electrooptic and magneto-optic effect - applications, Fiber optic Gyro; Holography: principles, holographic recording and readout devices, its application; Optical signal processing, Fiber Bragg grating (FBG) - principles and applications; Introduction to Photonic-crystal fiber (PCF).

EEC51201  ELECTRICAL MACHINE LAB  L-T-P: 0-0-3

Experiments on electrical machines.

EEC51202  POWER SYSTEM LAB  L-T-P: 0-0-3

Experiments on power system topics
II- SEMESTER

<table>
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<tr>
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II-SEMESTER

**EEC52101**  ADVANCED CONTROL SYSTEMS  L-T-P: 3-0-0

Introductory matrix algebra and linear vector space; State space representation; Linearization; Solution of state equations; Evaluation of state transition matrix; Similarity transformation and invariance of system properties due to similarity transformations; Minimal realization of transfer function; Discretization of a continuous time state space model; Controllability and controllable canonical form; Pole assignment by state feedback using Ackermann’s formula; Controllable canonical form; Linear Quadratic Regulator (LQR) problem and algebraic Riccati equation; Observability and observable canonical forms; Design of full order observer using Ackermann’s formula; observable canonical form; Duality; Observer based controller design; Reduced order observer design; Internal stability of a system; Stability in the sense of Lyapunov; Solution of Lyapunov type equation.

**EEC52102**  INSTRUMENTATION  L-T-P: 3-0-0

Measurement of voltage, current, phase angle, frequency, active power and reactive power in power plant applications; Introduction and design of signal conditioning circuits for various resistive, capacitive, inductive and piezoelectric transducer; Instrumentation amplifiers and isolation amplifiers; Temperature measurement -RTD, thermocouple, thermistors, radiation pyrometer; Optical instrumentation for electrical and mechanical quantities related to electrical machines and power system applications; High energy arc ignition system and flame monitoring; Measurement techniques for water quality parameters, conductivity; Vibration transducer, magnetostrictive transducers, pressure and flow transducers, torque transducers; position and speed transducers; DP transmitters, smart and intelligent transmitters; Steam turbine instrumentation, flue gas analyser, hydrogen purity meter; Introduction to feedback transducers; SCADA.
Design aspects of power electronic devices like UPS, SMPS, power factor converters, motor control, lighting, AC to DC converters, DC to DC converters, inverters; Drive circuits for power devices. Magnetics for switched mode converters, thermal design for switched mode converters, current mode control, controller designs, switched mode power supply circuits, regulation in isolated SMPS, magnetic amplifiers.

Elective-III & Elective-IV

EEE52101 HVDC TRANSMISSION AND FACTS L-T-P: 3-0-0

General aspects of DC transmission; Converter circuits and their analysis; DC link controls, faults and abnormal operation and protection; Mechanism of active and reactive power flow control; Basic FACTS controllers: SVC, STATCOM, TCSC, TCPAR, UPFC; Modelling of FACTS controllers; System static performance improvement with FACTS controllers, System dynamic performance improvement with FACTS controllers.

EEE52102 POWER SYSTEM STABILITY L-T-P: 3-0-0

Detailed machine modelling, Modelling of turbine-generator and associated systems, Excitation systems and PSS, Transient stability and small-signal stability for large systems, SSR and system modelling for SSR studies; Voltage stability: P-V and Q-V curves, static analysis, sensitivity and continuation method; Dynamic analysis, local and global bifurcations, control area, margin prediction, stability of AC-DC systems.

EEE52103 POWER SYSTEM OPTIMIZATION L-T-P: 3-0-0

Economic load dispatch in thermal and hydro-thermal system, reactive power optimization, optimal power flow; Linear programming and non-linear programming techniques to optimal power flow problems; Security constrained optimization; Unit commitment and maintenance scheduling, Interchange evaluation, Minimum emission dispatch.

EEE52104 DATA COMMUNICATION AND MANAGEMENT L-T-P: 3-0-0

Introduction to communication systems: Significance and impact on distributed industrial control and automation; Analog and digital communication - Modulation and demodulation (AM, FM, PSK, FSK, PCM); Transmitters and receivers; Noise and bandwidth factors; Synchronization; Communication media; Digital signal formats; Error detection; Correction and recovery; Switching techniques; Overview of analog and digital telephone systems: Basic configuration and standards, Digital PBX for voice and data communication; Wireless communication: Radio, Microwave and Satellite communication; Application in telemetry; Power line carrier communications: Interface equipment and communication standards; Local area computer networks: Basic topologies, Layered architecture, Access techniques (CS/CD); LAN technology: Ethernet, media, interface equipment, application, networking support in UNIX; Client Server computing.
16 bit microprocessor-8086 processor, architecture, Bus Interface unit and execution unit, segmentation of memory, instruction set, assembly language programming, Interrupt-software and hardware, priority of the interrupts; Standard peripherals and its interfacing. Coprocessor, its internal architecture, its handshaking signals for main processor. Data formats, stack registers, coprocessor instruction set; Bus Interface: ISA bus, the extended ISA and VESA local bus, PCI bus, Parallel Printer Interface (LPT), Universal Serial Bus (USB), Accelerated Graphics Port (AGP); Microprocessor based control: temperature / pressure / flow / speed control - a case study; 32-bit processor (80386 and higher processor), architecture, memory management unit, real address mode and virtual address mode, protected mode of operation, 32 bit processor flags, privilege levels, paging mode of operation; Pentium processor, its architecture, memory bank, data bus and its interfacing with 32 bit memory, new instructions, System timing, burst cycle method of memory read, Intel chipset for Pentium processors; Asynchronous and synchronous data format and data transfer, modems and its interfacing. Pin out descriptions of 8051, Memory organization, Register Banks, special function registers, External Memory: External code memory access, External data memory access, Address decoding, Addressing modes of 8051, Instructions types.

Experiments on control and instrumentation. Use of software like MATLAB, LABVIEW, etc.

Experiments on simulation based power system. Use of software like MATLAB, ETAP, etc.