DEPARTMENT OF ELECTRICAL ENGINEERING

Syllabus for
M. Tech. Power Electronics & Drives

MEE-101 Advance Microprocessors and Applications

Max. Marks: 100 **(Credit=5)** **L T P**
3 1 2

UNIT I **(9 Lecture)**

Introduction to Microprocessors and Microcontrollers:

Review of basics microprocessor,architecture and instruction set of a typical 8-bit microprocessor.Overview of 16 bit and 32 bit microprocessors, arithmetic and I/O coprocessors. Architecture, register details, operation, addressing modes and instruction set of 16 bit 8086 microprocessor, assembly language programming, introduction to multiprocessing, multi-user, multitasking operating system concepts, Pentium-1,2,3 and 4 processors, Motorola 68000 processor.Concepts of micro controller and microcomputer, microcontroller (8051/8751) based design, applications of microcomputer in on line real time control

UNIT II **(9 Lecture)**

Input/Output,Memory Interfacing:

Parallel and series I/O, Interrupt driven I/O, single and multi-interrupt levels, use of software polling and interrupt controlling for multiplying interrupt levels, programmable interrupt controller, DMA controller, programmable timer/counter, programmable communication and peripheral interface, synchronous and asynchronous data transfer, standard serial interfaces like Rs.232. Types of Memory, RAM and ROM interfacing with timing considerations, DRAM interfacing

UNIT III **(9 Lecture)**

Programmable Support Chips:

Functional schematic, operating modes, programming and interfacing of 8255, 8251, 8259 and 8253 with microprocessor

UNIT IV **(9 Lecture)**

Analog Input & Output:

Microprocessor compatible ADC and DAC chips, interfacing of ADC and DAC with microprocessor, user of sample and hold circuit and multiplexer with ADC.

Microprocessor Applications:

Design methodology, examples of microprocessor applications.

Lists of experiments

1. Simple arithmetic operations: Multi precision addition / subtraction / multiplication / division.
2. Programming with control instructions: Increment / Decrement, Ascending Descending order, Maximum / Minimum of numbers, Rotate instructions, Hex /ASCII / BCD code conversions
3. Interface Experiments: A/D Interfacing, D/A Interfacing, Traffic light controller.

4. Interface Experiments: Simple experiments using 8255, 8254/8253, 8251,8279
5. Programming with 8086-experiments including BIOS/DOS calls: Keyboard control, Display, File Manipulation.
6. Programming practice on MACRO assembler and simulator tools.
7. Demonstration of basic instructions with 8051 Micro controller execution, including Conditional jumps, looping, Calling subroutines, Stack parameter testing
8. Parallel port programming with 8051 using port 1 facility: Stepper motor and D / A converter.
9. Programming Exercise on RAM direct addressing and Bit addressing
10. Study of Microcontrollers with flash memory.

Books/References

1. "Advanced Microprocessors," Y. Rajshree, New Age International Publication, 2008.
2. "Advanced Microprocessors," A. K. Rai and K. M. Bhurchandi, Tata McGraw Hill, 2006.

MEE-102 Electric Drives & Traction

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Basic drive components, classification and operating modes of electric drive, nature and types of mechanical loads, review of speed-torque Characteristics of electric motors and load, joint speed-torque characteristics, plugging, dynamic and regenerative braking of dc and ac motors.

UNIT II **(9 Lecture)**

Equation of motion, equivalent system of motor-load combination, stability considerations, electro-mechanical transients during starting and braking, calculation of time and energy losses, optimum frequency of starting.

UNIT III **(9 Lecture)**

Electric traction services, duty cycle of traction drives, calculations of drive rating and energy consumption, desirable characteristics of traction drive and suitability of electric motors, control of traction drives. Losses in electric drive system and their minimization energy, efficient operation of drives, load equalization.

UNIT IV **(9 Lecture)**

Heating and cooling of electric motors, load diagrams, classes of duty, reference to Indian Standards, estimation of rating of electric motors for continuous, short time and intermittent ratings. Servo motor drive, stepper motor drive, linear induction motor drive, permanent magnet motor drive. Selection criteria of electric drive for industrial applications, case studies related to steel mills, paper mills, textile mills and machine tool etc.

Books/References

1. "Electric Drives," N. K. De, Prentice Hall of India, 2006.
2. "Utilization of Electric Power," R. K. Rajput, Laxmi Publication, 2013.

3. "Utilization of Electric Powers," N. V. Suryanarayana, New Age Publication, 1994.

MEE-103 Power Converter –I

Max. Marks: 100 **(Credit=5)** **L T P**
3 1 2

UNIT I **(9 Lecture)**

Power Semiconductor Devices: Structure, Characteristics, ratings and protection of SCR, triac and Gate Turn Off Thyristor.

UNIT II **(9 Lecture)**

Line Commutated Converters: Single and three phase fully controlled and half controlled converters, performance characteristics, effect of source inductance, discontinuous current operation, inverter operation, power factor improvement techniques, sequence control, 12-pulse converters, dual converter, triggering circuits.

UNIT III **(9 Lecture)**

AC Voltage Controllers: Single phase AC voltage controllers feeding resistive and resistive-inductive loads, sequence control, three phase AC voltage controllers.

UNIT IV **(9 Lecture)**

Cyclo-Converter: Single phase and three phase cyclo-converters, circulating and non-circulating current operations, performance characteristics, control of harmonics, voltage and frequency control, control circuit.

Lists of Experiment

1. Study of 1-phase AC to DC controlled converter (half controlled and full controlled).
2. Study the of 3- phase AC to DC full controlled converter.
3. Study of a Triac based single phase ac regulator and determine of Thyristor switching characteristics and pulse transformer characteristics.
4. Study of Thyristors based dc to dc converter (dc chopper).
5. Study of a 3 phase PWM inverter with fixed output frequency and study of a non –PWM type inverter with 120-degree conduction of switches.
6. Study of an inverter fed adjustable speed drive for a 3 phase induction motor.
7. Study of a Thyristor based dc-drive with closed loop speed control.
8. MOSFET based dc to dc converter (buck, boost and buck-boost types with non-isolated output voltage)
9. Study of an industrial type fly-back dc to dc converter with isolated and regulated voltage.
10. Study of a single phase PWM AC to DC converter.

Books/References

1. "Power Electronics," P. C. Sen, Tata McGraw Hill, 1987.

2. "Power Electronics," R. S. Ananda Murthy and V. Nattarasu, Pearson India publication, 2010.
3. "Fundamental of Electrical Drives," G. K. Dubey, Alpha Science, 2001.

MEE-104 Modeling, Simulation & Evolutionary Techniques

Max. Marks: 100 **(Credit=5)** **L T P**
3 1 2

UNIT I **(9 Lecture)**

Modeling: Model classification, Mathematical, physical and analog models, Estimation of model parameters.

UNIT II **(9 Lecture)**

Simulation: Experimental nature of simulation, steps involved in simulation studies, Validation of simulation models, computer simulation of continuous & discrete systems.

UNIT III **(9 Lecture)**

Evolutionary Techniques I: Neural networks, Fuzzy logic systems and their applications.

UNIT IV **(9 Lecture)**

Evolutionary Techniques II: Genetic algorithms, Hybrid systems and their applications.

Lists of Experiment

1. Single phase fully controlled converter using R and RL load using MATLAB / SIMULINK
2. Three phase fully controlled converter using R and RL load using MATLAB / SIMULINK
3. Single phase AC voltage regulator using MATLAB / SIMULINK
4. Formation of Y bus matrix by inspection / analytical method using MATLAB Software
5. Formation of Z bus using building algorithm using MATLAB Software
6. Gauss Seidal load flow analysis using MATLAB Software
7. Newton Raphson method of load flow analysis using MATLAB Software
8. Fast decoupled load flow analysis using MATLAB Software
9. Fault analysis using MATLAB Software
10. Economic dispatch using MATLAB Software

Books/References

1. "Neural Networks, Fuzzy Logic and Genetic Algorithms," S. Rajsekaran and G. A. V. pai, Prentice Hall of India, 2013.
2. "Fundamental of Artificial Neural Network and Fuzzy Logic," Rajesh Kumar, University Science Press, 2009.

MEE-105 Power Converter –II

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Power Semiconductor Devices: Structure, characteristics and ratings of Power Transistor, MOSFET, Insulated Gate Bipolar Transistor (IGB) and MOS – Controlled Thyristor (MCT), drive and snubber circuits.

UNIT II **(9 Lecture)**

DC-DC Converters: Review of chopper fundamentals, step down chopper with resistive and resistive-inductive loads with continuous and discontinuous current operations, step up chopper, commutation techniques, impulse commutated and resonant pulse choppers, multiquadrant and multiphase choppers.

UNIT III **(9 Lecture)**

DC-AC Inverters: Single phase and three phase voltage source and current source inverters, commutation methods, voltage and frequency control, harmonics reductions.

UNIT IV **(9 Lecture)**

Resonant Inverters: Classification, series and parallel resonant inverters, load resonant inverters, zero voltage switching and zero current switching resonant inverters, resonant dc link inverters.

Books/References

1. "Power Electronics," M. H. Rashid, Pearson Printice Hall, 2009.
2. "Fundamental of Electrical Drives," G. K. Dubey, Alpha Science, 2001.

Program Electives PE1 & PE2

MEE-151 Power System Planning & Optimization

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNITI **(9 Lecture)**

Introduction to restructuring of power industry, Key issues and challenges facing power industries, Ancillary services management, deregulation effect.

UNIT II **(9 Lecture)**

Electricity pricing mechanism in competitive electricity market, Fundamental of Economics, cost criteria.

UNIT III **(9 Lecture)**

Concepts of FACTS devices& Controllers, General aspects -HVAC and HVDC links –comparison economic, technical performance reliability-limitation-properties of thyristor converter circuits, custom Power and custom power park.

UNIT IV **(9 Lecture)**

Automatic generation control -Review of load frequency control (LFC) and Economic Dispatch control (EDC), Reactive Power management, optimal power flow control,

Books/References

1. "Electric Power Applications of Optimization," James A. Momoh, Marcel Dekker, 2001.
2. "Optimization of Power System Operation," Jizhog Zhu, Wiley, 2009.
3. "Power system Optimization," D. P. Kothari, J. S. Dhillon, PHI Publication, 2011.

MEE-152 Power Semiconductor Controlled Drives

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Solid state controlled electric Drive-Concept, elements and salient features, power converter motor system, closed loop control of electric drives, sensing of speed and current, performance parameters.

UNIT II **(9 Lecture)**

Control of D.C. separately and series excited motor drives using controlled converters (single phase and three phase) and choppers, static Ward-Leonard control scheme, solid state electric braking schemes, closed loop control of solid state DC drives.

UNIT III **(9 Lecture)**

Operation of induction and synchronous motor drives from voltage source and current source inverters slip power recovery, pump drives using AC line controllers, self-controlled synchronous motor derives, brushless DC motor drive, switched reluctance motor drive.

UNIT IV **(9 Lecture)**

Function of microprocessor in electric drive control, salt features of microprocessor control microprocessor based control scheme for D.C. induction and synchronous motor drives, applications.

Books/References

1. "Power Semiconductor Drives," S. Sivanagaraju, M. Balasubba Reddy and A. M. Prasad, Prentice Hall of India,2009.
2. "Fundamental of Electric Drives," G. K. Dubey, Alpha Scinece, 2001.

MEE-153 System Reliability

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Reliability: Definition and basic concepts, Failure data, failure modes and reliability in terms of hazard rates and failure density function. Hazard models and bath tub curves.Applicability of Weibull distribution.

UNIT II **(9 Lecture)**

Reliability calculation for series, parallel, parallel-series and K-Out-M systems. Use of redundancy and system reliability improvement methods.

UNIT III **(9 Lecture)**

Maintenance: Objectives, Types of maintenance, preventive, condition based and reliability centered maintenance.Terotechnology and total productive maintenance. (TPM). Maintainability:Definition, basic concepts, Relationship between reliability, maintainability and availability: corrective maintenance time distributions and maintainability demonstration.

UNIT IV **(9 Lecture)**

Design considerations for maintainability. Introduction to life testing-estimation of parameters for exponential and Weibell distributions, component reliability and MIL standards.

Books/References

1. "Power Distribution System Reliability," Ali A. Chowdhary and Don O. Koval, Wiley, 2009.
2. "Reliability and Safety Engineering," A. K. Verma and S.A Durga, Springer, 2010.

MEE-154 Operation Research

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Linear Programming: Graphical LP solution, simplex method, Big M method, two phase method, degeneracy, alternate optima, unbounded optimal solutions, infeasible solutions, duality and sensitivity analysis- dual simplex method, primal dual computations

Transportation Problems: Determination of starting solution iterative computations of lanation.

UNIT II **(9 Lecture)**

Integer Programming: Branch and bound method, zero-one implicit enumeration algorithm,cutting plane algorithm**.**

Probabilistic Decision Making: Decision making under risk, probabilistic dynamic programming.

UNIT III **(9 Lecture)**

Inventory Models: Static EOQ models, EOQ with price breaks, multi-item EOQ with storage limitation, dynamic EOQ models.

Game Theory: Optimal solution of two person zero sum game, solution of mixed strategy games.

UNIT IV **(9 Lecture)**

Queueing Theory: Role of exponential distribution, pure birth and death models, generalized Poission queuing model, specialized Poission queues.

Project Scheduling by CPM/PERT: Network representations, critical path computations, construction of time schedule.

Books/References

1. "Operations Research," R. Panneerselvan, Prentice Hall of India, 2006.
2. "Operations Research," P. SarkarIyer, Tata McGraw Hill, 2008.

MEE-155 Fuzzy, ANN and AI Systems

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Fuzzy System:

Basics: Fuzzy sets and systems, basic concepts, fuzzy sets and crisp sets, fuzzy set theory and operations, fuzzy entropy theorem, fuzzy and crisp relations, fuzzy to crisp conversions.

Fuzzy Associative Memories: Representation of fuzzy sets, membership functions, basic principle of interface in fuzzy logic, fuzzy IF-THEN rules, fuzzy inference engines, fuzzification /defuzzification.

Applications: Fuzzy control system design and its elements, fuzzy logic controller, applications of fuzzy control in electric drive, power system, measurement and instrumentation.

UNIT II **(9 Lecture)**

Neural Networks:

Basics: Simple neuron, nerve structure and synapse, concept of neural network multilayer nets, auto-associative and hetero-associative networks; neural network tools (NNTs), artificial neural network (ANN) and traditional computers.

Neural Dynamics: Neurons as functions, neuronal dynamic systems, signal functions, activation models.

UNIT III **(9 Lecture)**

Synaptic Dynamics: Learning in neural nets, Unsupervised and supervised learning, signal hebbian learning, competitive learning, differential, hebbian learning, differential competitive learning, single layer perception models, the back propagation algorithm.

Applications: Applications in load flow study, load forecasting, detection of faults in distribution system and steady state stability, neural network simulator, applications in electric drive control.

UNIT IV **(9 Lecture)**

Artificial Intelligent:

Introduction to Artificial Intelligence, Foundations and History of Artificial Intelligence, Applications of Artificial Intelligence,Knowledge Representation & Reasoning, Machine Learning, Pattern Recognition.

Books/References

1. "Artificial Intelligence," Ela Kumar, I. K. International, 2008.
2. "Neural Networks, Fuzzy Logic and Genetic Algorithms," S. Rajsekaran and G. A. V. pai, Prentice Hall of India, 2013.

MEE-156 Robotics & Automation

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Robotics: Brief History, Types of robots, Overview of robot subsystems, resolution, repeatability and accuracy, Degrees of freedom of robots, Robot configurations and concept of workspace.

UNIT II **(9 Lecture)**

Introduction, direct & inverse kinematics of robot arm dynamics: LE formulation, equation of motion; Robot controller design approaches: computed torque, variable structure, and adaptive control;

UNIT III **(9 Lecture)**

Image processing fundamentals for robotic applications, image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features. applications of robotics etc.

UNIT IV **(9 Lecture)**

Automation: Introduction to automation**,** Types of production, Functions of Manufacturing, Organization and Information Processing in Manufacturing, Production concepts and Mathematical Models, Automation Strategies, industrial automation and applications, Mechatronics systems.

Books/References

1. "Control in Robotics and Automation," B. K. Ghosh, Hing Xi, T. J. Tan, Academic Press, 1999.
2. "Robotics and automation Hand book," Thomos R. Kurfess, Taylor and Francis, 2005.

MEE-157 FACTS Controllers & Devices

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Fundamentals of ac power transmission, transmission problems and needs, emergence of FACTS-FACTS control considerations, FACTS controllers.

UNIT II **(9 Lecture)**

Principles of shunt compensation – Variable Impedance type & switching converter type- Static Synchronous Compensator (STATCOM) configuration, characteristics and control,

UNIT III **(9 Lecture)**

Principles of static series compensation, TCSC and TSSC, applications, Static Synchronous Series Compensator(SSSC), Interline power flow controller(IPFC),

UNIT IV **(9 Lecture)**

UPFC -Principles of operation and characteristics, independent active and reactive power flow control, comparison of UPFC with the controlled series compensators and phase shifters Generalized Unified Power Flow Controller (GUPFC), unified power flow conditioners,

Books/References

1. "FACTS: Controller in Power Transmission and Distribution," K. R. Padiyar, Anshan Publication, 2009.
2. "Understanding FACTS: Concept and Technology of FACTS," N. G. Hingorani and L. Gyuayi, Wiley, 2000.

MEE-158 Modeling and Simulation of Power Electronic Circuits

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Simulation Tools: General overview and understanding of SPICE/PSPICE and MATALB SIMULINK softwares.

UNIT II **(9 Lecture)**

Modeling of Power Electronic Drives: Criteria for switch selection, modeling of Diode, SCR, Power Transistor, MOSFET for ac and dc circuits using SPICE/PSPICE and MATLAB SIMULANK softwares,

UNIT III **(9 Lecture)**

modeling of and IGBT for ac and dc circuits using SPICE/PSPICE and MATLAB SIMULANK softwares, simulation of driver and snubber circuits.

UNIT IV **(9 Lecture)**

Simulation of Power Electronic Circuits: Simulation and design of converters, choppers, ac voltage controllers, inverters and cyclo-converters.

Books/References

1. "Power Electronics,"M. D. Singh and K. B. Khanchandani, Tata McGraw Hill, 2007.
2. "Power Electronics Handbook," M. H. Rashid, B. H, 2011.

Program Electives PE3 & PE4

MEE-159 New and Renewable Energy Resources

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Various no-conventional energy resources; Introduction, availability, classification, relative merits and demerits. Theory of solar cells, solar cell materials, solar cell power plant, limitations.Solar radiation, flat plate collectors and their materials, applications and performance, focusing of collectors & their materials, applications and performance, solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

Geothermal Energy: Resources of geothermal energy, thermodynamics of geothermal energy conversion-electrical conversion, non-electrical conversion, environmental considerations.

UNIT II **(9 Lecture)**

Magneto-hydrodynamics (MHD): Principle of working of MHD power plant, performance and limitations. **Fuel Cells:** Principle of working of various type of fuel cells and their working, performance and limitations.

Thermo-electrical and thermionic conversions: Principle of working, performance and limitations.

UNIT III **(9 Lecture)**

Wind Energy: Wind power and its sources, site selection criterion, momentum theory, classification of rotors, wind characteristics, performance and limitations of energy conversion systems.

Bio-mass: availability of bio-mass and its conversion theory.

UNIT IV **(9 Lecture)**

Ocean ThermalEnergy Conversion (OTEC): Availability, theory and working principle, performance and limitations.

Wave and Tidal Wave; Principle of working, performance and limitations, waste recycling plants.

Books/References

1. "Renewable Energy: Sources and Methods," Anne Maczulak, Library of Congress, 2010.
2. "Advanced Renewable Energy Sources," G. N. Tiwari and R. K. Mishra, RSC Publication.
3. "Advances in Renewable Energy Technology," ShivajiHaribaPewar and L. A. Ekal, Narosa Publishing House, 2003.

MEE-160 Electric Power Quality

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Power Quality Problems and Monitoring: Introduction, Surges, voltage sag and swell,over voltage, under voltage outage, voltage and phase angle imbalances electrical noise harmonics frequency deviation monitoring.

UNIT II **(9 Lecture)**

Solution to Power Quality Problems: Design,measures to minimize the frequency and duration of the outage in the distribution system. Voltage regulators.

UNIT III **(9 Lecture)**

Harmonic filters power conditioners uninterruptible power suppliers emergency and standby power systems ,applications of power conditioners .

UNIT IV **(9 Lecture)**

Minimization of disturbances at Customer Site Power quality related standards, standard test waveforms, power distribution system design, measures to minimize voltage disturbances.

Books/References

1. "Electrical Power System Quality," R. C. Dugan and M. F. McGranaghar, Tata McGraw Hill, 2008.
2. "Electrical Power Quality," J. B. Dixit and AmitYadav, University Science Press, 2010.

MEE-161 Power System Instrumentation

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Measurement of large currents and voltages, current and voltage transformers, design equations and operational characteristics, error compensation schemes,

UNIT II **(9 Lecture)**

Protective CTs and PTs, overload and transient performance, standard specification of instrument transformers.

UNIT III **(9 Lecture)**

DC current transformers, measurement of power and energy, torque equation of induction type energy meter, parasitic torques and their minimization, IS specifications, analog and digital KVAr meters.

UNIT IV **(9 Lecture)**

Tele-metering, remote terminal units, data acquisition systems, tri-vector meters, event and disturbance recorders.

Books/References

1. "Electrical Power System Technology," S.W. Fardo and Dale R. Patrick, Library of Congress, 2009.
2. "Power System Instrumentation," RamNath, Genius Publication.

MEE-162 Digital Signal Processing

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**
Review of discrete time signals and systems. Sampling of CT signals: aliasing, pre-filtering, decimation and interpolation, A/D and D/A conversion, quantization noise;

UNIT II **(9 Lecture)**
Z-transforms; Filter design techniques, Structure and design procedure for digital filters, IIR & FIR filters; DFT Computation,

UNIT III **(9 Lecture)**
Fourier analysis of signals using DFT, Finite register length effects. DSP hardware implementation & applications; FFT analysis,

UNIT IV **(9 Lecture)**
Wavelet transform, windowing: Hamming, Hanning, Kahair etc.

Books/References

1. "Digital Signal Processing," Dr.Shiala D. Apte, Wiley India, 2009.
2. "Digital Signal Processing," S. Salivahanan and C. Ganapriya, Tata McGraw Hill, 2011.

MEE-163 HVDC Systems

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**
General aspects of DC transmission, multi terminal DC transmission, introduction to AC-DC system interaction,

UNIT II **(9 Lecture)**
converter circuits and their analysis, DC link controls, Mechanism of active and reactive power flow control;

UNIT III **(9 Lecture)**
Basic FACTS controllers: SVC, STATCOM, TCSC, TCPAR.

UNIT IV **(9 Lecture)**
System performance improvement with HVDC link controllers, Harmonics in DC link system.

Books/References

1. "HVDC Power Transmission Systems," K. R. Padiyar, New Age Publication, 2005.
2. "HVDC and FACTS Controllers," V. K. Sood, K. Luver, Academic Press, 2004.

MEE-164 Energy Management

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Introduction, Definition and Objective of Energy Management, General Principles of Energy Management, Energy Management Skills, Energy Management Strategy. Energy Conservation Technology, General principles of Energy Auditing and Survey Instrument, Energy System Economics, Policies and Laws.

UNIT II **(9 Lecture)**

Energy Management Approach, Understanding Energy Costs, Bench marking, Energy performance, Matching energy usage to requirements, Maximizing system efficiency, Optimizing the input energy requirements, Fuel and Energy substitution.

UNIT III **(9 Lecture)**

Energy & Power supply technology and systems in residential and tertiary sector, transport and, industrial sectors,

UNIT IV **(9 Lecture)**

Electrical utilities technology and operation, Total Energy Systems,Energy efficiency,energy efficient devices etc.

Books/References

1. "Energy Engineering and Management," Amlan Chakrabarti, Printice Hall of India, 2011.
2. "Indian Industry: Energy Management," R. M. Gedam, Anmol Publication, 1999.

MEE-165 Power System Dynamics & Control

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Dynamic stability: basic concepts of small oscillations in single and multi-machine systems, analysis with V-R and governor control loops and system stabilization,

UNIT II **(9 Lecture)**

Power System Operation and Control. Stability Problems faced by Power Systems. Impact on Power System Operation and Control. Transient stability, swing curve for single and multiple machine system, V-R and governor effects,

UNIT III **(9 Lecture)**

Transient Stability Program.Small Signal Analysis Program. EMTP Programs. Real-Time Simulators. Liapunov's direct method for quick evaluations,

UNIT IV **(9 Lecture)**

Single Machine Infinite Bus System. Multi-machine Systems. Stability of Relative Motion. Frequency Stability: Centre of Inertia Motion. Concept of Load Sharing: Governors. Single Machine Load Bus System: Voltage Stability. Torsional Oscillations. Stability problems of HVDC link.

Books/References

1. "Power System Dynamics: Stability and Control," K. R. Padiyar, Anshan Publication, 2004.
2. "Power System Stability and Control," P. Kundur, Tata McGraw Hill, 2008.

MEE-166 Special Electric Machines

Max. Marks: 100 **Time: 3 hours** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Generalized AC and DC machines, Poly-phase AC Machines, Two Phase AC Servomotors: Construction, torque-speed characteristics, Schragemotors.

UNIT II **(9 Lecture)**

Stepper Motors: Principle of operation, variable reluctance, permanent magnet and hybrid stepper motors, characteristics, drive circuits and applications. Switched Reluctance Motors: Construction; principle of operation; torque production, modes of operation, drive circuits.

UNIT III **(9 Lecture)**

Permanent Magnet Machines: Types of permanent magnets and their magnetization characteristics, demagnetizing effect, permanent magnet dc motors, sinusoidal PM motors, brushless dc motors and their important features and applications, PCB motors.

UNIT IV **(9 Lecture)**

Single phase synchronous motor; construction, operating principle and characteristics of reluctance and hysteresis motors; introduction to permanent magnet generators. Single Phase Commutator Motors, Universal and Repulsion motors.

Books/References

1. "Generalized Theory of Electrical Machines," P. S. Bhimbra, Khanna Publication, 1987.
2. "Special Electrical Machines," K. Venkatanam, Universities Press, 2005

Syllabus
M. Tech. Control & Instrumentation

MEE-201 Advance Control Systems

Max. Marks: 100 **(Credit=5)** **L T P**
3 1 2

UNIT I **(9 Lecture)**

Advance Control Analysis: Dynamic system modeling, State space model of dynamical system in continuous time and discrete time; Solution of continuous time state equation- similarity transformation; Cayley Hamilton approach and inverse Laplace approach; Solution of discrete time state equation.

UNIT II **(9 Lecture)**

Controllability and Observability: General concepts, controllability and observability test for continuous time and discrete time system; test for continuous and discrete time systems; Stabilizabilty and detectability definition and tests; Loss of controllability and observability due to sampling; Controllable and observable canonical forms.

UNIT III **(9 Lecture)**

Controller Design: Pole placement technique; Ackerman's approach and linear quadratic regulator for continuous time and discrete time systems;

UNIT IV **(9 Lecture)**

Observer Design: Full order and reduced order observer designs.

Lists of Experiments

1. To obtain the moment of inertia and then develop the transfer function of the given DC Motor for (a) Armature controlled case and (b) Field controlled case. Draw the relevant block diagrams.
2. To conduct experiments on the given amplidyne for (a) To obtain the transfer function (b) To obtain the load characteristics under different levels of compensation (c) To obtain the characteristics of a metadyne.
3. To design a Lag-Lead compensator and to obtain the characteristics by simulation using MATLAB® Verify the performance using experiments with the compensator circuit made of passive elements.
4. To set up a system for closed loop voltage regulation for a dc separately excited generatorusing amplidyne and to obtain its characteristics
5. To conduct experiments on the Level Process Control Station and to study the working of a level control loop.
6. To set up a closed loop feedback control system using the FEEDBACK® MS150 DC Modular Servo System-with velocity (rate) feedback temperature controller using PID.
7. To set up an open loop control system using Micro-processor for controlling the stepper motor
8. To design a Lead compensator and to obtain the characteristics by simulation using MATLAB®.
9. Verify the performance using experiments with the compensator circuit made of passive elements.
10. Effect of P, PD, PI, PID Controller on a second order systems.

11. Programmable logic controller – Study and verification of truth tables of logic gates, simple Boolean expressions and application of speed control of motor?

Books/References

1. "Modern Control System Theory," M. Gopal, New Age International Publishers, 2005.
2. "Advanced Control Systems," B. N. Sarkar, Printice Hall of India, 2013.

MEE-202 Optimal Control

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**
Dynamic system optimization, Optimal system performance indices, Finite & Infinite horizon problems

UNIT II **(9 Lecture)**
Calculus of variations, constrained and unconstrained minimization, Euler equation, Hamiltonian,

UNIT III **(9 Lecture)**
Optimality principle, Potryagin's principle,Dynamic programming, Matrix Riccati Equation; Hamilton Jacobi Bellman (HJB), Linear Quadratic Regulator(LQR), constrained and unconstrained input;

UNIT IV **(9 Lecture)**
Linear quadratic Gaussian (LQG),State estimator, Kalman filter, discrete and continuous-time.

Books/References

1. "Optimal Control Systems,"DesineniSubharam Naidu, CRC Press, 2003.
2. "Optimal Control," F. L. Lewis, D. L. Varbie and V. L. Syramos, John Wiley, 2012.

MEE-203 Advance Measurement & Instrumentation Technology

Max. Marks: 100 **(Credit=5)** **L T P**
3 1 2

UNIT I **(9 Lecture)**
Functional elements of measurement systems, Performance characteristics (static/dynamic) of measurement system, Concept of generalized measurement system. Generalized static stiffness and input-output impedance, Error analysis, uncertainty, Histogram, normal distribution, Standards & Echelon labs.

UNIT II **(9 Lecture)**
Analog measuring instruments, general features, design of sprigs, pivot/jewel, Ammeters, voltmeters, wattmeter, frequency meter, energy meters. Measurement of parameters R, L & C.Transfer function and frequency response of zero, first and second order measurement system.

UNIT III **(9 Lecture)**

Classification of Instrumentation Transducer. Analog/digital, active/passive, Variable Resistance transducers. Measurement of non-electrical parameters: displacement, velocity, acceleration, pressure, force, temperature, humidity, moisture level control/monitoring, Potentiometers, strain gauges, Special Transducers: Piezoelectric, Electromagnetic transducers, Smart Sensors.

UNIT IV **(9 Lecture)**

Analog Signal Conditioning techniques: DAQ, Telemetry, Bridge amplifier, carrier amplifiers, charge amplifiers and impedance converters, modulation - demodulation, dynamic compensation, linearization, multiplexing and de-multiplexing. Digital interfacing techniques.Signal Display/Recording systems. Graphic display systems, storage oscilloscope, LED, LCD, Recorders. Microprocessor based measurement & instrumentation schemes.

Lists of Experiments

1. Measurement of Power and Power Factor of three phase balance inductive load by two wattmeter method.
2. Measurement of speed using Strobometer.
3. Study of Inductive type transducer and use it as an electrical balance and find the weight of given sample.
4. Study of LVDT experimental set up and use it as transducers and take reading of linearity of output variation versus input variation.
5. Calibration of single phase induction type Energy meter with the help of Single phase wattmeter and stopwatch.
6. Measurement of low resistance using Kelvin's Double Bridge.
7. To study AC and DC signal conditioning system.
8. Measurement of speed of given Shunt Motor by Magnetic pick up and photo-electric pick up and verify it by tachometer.
9. Study of analog signal conditioning techniques.
10. Study of different types display devices.

Books/References

1. "Measurement and Instrumentation," Alan S. Morris and R. Langari, Academic press, 2012.
2. "Measurement Systems," E. O. Deoblin, Tata McGraw Hill, 2001.
3. "Principle of Measurement Systems," John P. Bentley, Pearson, 2009.

MEE-204 Nonlinear Systems & Adaptive Control

Max. Marks: 100 **(Credit=4)** **L T P**
3 10

UNIT I **(9 Lecture)**

Nonlinear Control Systems: Nonlinear models, equilibrium points, linearization of nonlinear models, separable nonlinearities; Describing function analysis, describing function of common nonlinearities; Feedback linearization.

UNIT II **(9 Lecture)**

Stability Analysis:Stability concepts, describing function method; Phase plane analysis of nonlinear systems;

UNIT III **(9 Lecture)**

Lyapunov Stability Analysis: stability definition in the sense of Lyapunov Stability of continuous and discrete time linear systems; Stability of nonlinear systems; Lyapunov stability and instability theorems; Lyapunov's direct method for continuous and discrete time systems; Lyapunov function for nonlinear systems.

UNIT IV **(9 Lecture)**

Adaptive Control:adaptive systems, Model Reference Adaptive Control (MRAC), Self-Tuning Regulator (STR), dual control; System identification; model predictive control; sliding mode control; H-infinity control; Bang-Bang control system,Applications.

Books/References

1. "Nonlinear and Adaptive Control with Application," A. Astolfi, D. Kargiannis, R.Ortega, Springer, 2008.
2. "Nonlinear System: Analysis Stability and Control," Shamkar. Sastry, Springer, 1999.

MEE-251 Biomedical Engineering

Max. Marks: 100 **Time: 3 hours** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Introduction to Bio-medical engineering and its development, anatomy and physiology. Biopotentials, Transducers and Electrodes: Different types of transducers and their selection for Biomedical applications, Electrode theory, Different types of electrode Hydrogen Calomel, Ag-Agcl, Ph, Po2 Pco2 electrodes, selection criteria of electrodes.

UNIT II **(9 Lecture)**

Cardiovascular system and measurement: The heart and other cardio vascular systems, Measurement of Blood pressure, Blood flow, Cardiac output and cardiac rate, Electrocardiography, Phonocardiography, Plethysmography, Cardiac pace-maker, defibrillator.

UNIT III **(9 Lecture)**

Measurement of electrical Activities in Muscles: Electromyography, Organization of brain: Electroencephalograph and their interpretation, Respiratory system measurement: Respiratory mechanism, Measurement of gas volume, flow rate carbon dioxide & oxygen concentration in inhaled air, Spirometers.

UNIT IV **(9 Lecture)**

Computer application in bio medical engineering, Medical Imaging: Ultra sound Imaging, Radiography, MRI, Electrical tomography & applications.

Biotelemetry: Transmission and reception aspects of biological signals via long distances. Telemedicine. Aspects of patient care monitoring, prevention against shock hazards.

Books/References

1. "Principle of Biomedical Engineering," S. V. Madihally,Libraray of Congress, 2010.
2. "Introduction to Biomedical Engineering," J. Enderle and J. Bronzine, Academic Press, 2012.

MEE-252 Digital Control Systems

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Review of Z-transform. Computation of time response of Discrete Data system.BillnearTransformation.W-plane, prewarping, inverse transformation.

UNIT II **(9 Lecture)**

Design of discrete controllers. Z-domain compensation, w-plane compensation, state variable back deadbeat controller,

UNIT III **(9 Lecture)**

Sampled data version of PID controllers.Effect of Data Digitization.Effect of finite word size, limit cycle determination.

UNIT IV **(9 Lecture)**

State Variable Analysis of Digital Control Systems.

Books/References

1. "Digital Control Systems," P. N. Parakevopoulos, Prentice Hall, 1996.
2. "Digital Control and State Variable methods," M. Gopal, Tata McGraw Hill, 2006.

MEE-253 Bio-Medical Signal Processing

Max. Marks: 100 **(Credit=4)** **L T P**
3 1 0

UNIT I **(9 Lecture)**

Basic neurology, Cardiac system, Lead systems and electrodes, ECG normal & abnormal, ECG lead positioning, inverse cardiograph,

UNIT II **(9 Lecture)**

ECG signal conditioning & processing, EEG recording & electrode, EMG signal conditioning & processing,

UNIT III **(9 Lecture)**

Generation of cochlear potentials and Evoked response, noise & interference in bio electric signals.Filtering techniques, active & passive filters,

UNIT IV **(9 Lecture)**

ECG Data compression, Telemetry, Bioinformatics Telemedicine. Speech & audio signal processing.

Books/References

1. "Biomedical Signal Processing," D. C. Reddy, Tata McGraw Hill, 2005.
2. "Biomedical Signal Processing," M. Kay, Academic Press, 1994.

MEE-254 Digital Image Processing

Max. Marks: 100 **(Credit=4)**

L	T	P
3	1	0

UNIT I **(9 Lecture)**

Introduction: Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels; Image Transforms: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Walsh Transform, Slant Transform, Hotelling Transform;

UNIT II **(9 Lecture)**

Image Enhancement: Enhancement by point processing Spatial filtering, Enhancement in the frequency domain, Color Image Processing;

UNIT III **(9 Lecture)**

Image Segmentation: Discontinuity detection, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion for segmentation;

UNIT IV **(9 Lecture)**

Representation and Description: Boundary description, Regional description; Image Compression: Redundancies and their removal methods, Fidelity criteria, Image compression models, Source encoder and decoder, Error free compression, Lossy compression; Morphological Image Processing: Dilation and Erosion, Opening and Closing, Some basic morphological algorithms, Extensions to gray level images.

Books/References

1. "Digital Image Processing and Analysis," B. Chand and D. D. Majumdar, Prentice Hall of India, 2006.

2. “Fundamentals of Digital Image of Processing,” A. K Jain, Prentice Hall, 1989.