M.TECH. ELECTRICAL ENGINEERING
(1ST SEMESTER)
TOTAL CONTACT HRS. = 22, TOTAL CREDITS = 21

Course		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int**	**Ext**	**Total**	
MELE1-101/ MELE3-103	Advance Power System Analysis & Design	**4**	**0**	**0**	**40**	**60**	**100**	**4**
MELE1-102	Modern Control Theory	**4**	**0**	**0**	**40**	**60**	**100**	**4**
MELE1-103/ MELE2-373/ MELE3-159	Applied Instrumentation & Measurement	**4**	**0**	**0**	**40**	**60**	**100**	**4**
MELE1-104/ MELE3-104	Power Systems Software Lab	**0**	**0**	**2**	**60**	**40**	**100**	**1**
Departmental Elective-I (choose any one)		**4**	**0**	**0**	**40**	**60**	**100**	**4**
MELE1-156	Energy Management and Energy Auditing							
MELE1-157	Microprocessors & Embedded Control							
MELE1-158	Non-Conventional Energy Resources							
MELE1-159	Wind Energy and Small Hydro Energy Station							
Departmental Elective-II (choose any one)		**4**	**0**	**0**	**40**	**60**	**100**	**4**
MELE1-160	EHVAC & HVDC Transmission System							
MELE1-161	Digital Signal Processing & Applications							
MELE1-162	Adaptive Control System							
MELE1-163	Discrete Time Control Systems							
Total 5 Theory & 1 Lab. Courses		**20**	**0**	**2**	**260**	**340**	**600**	**21**

(2nd SEMESTER)
TOTAL CONTACT HRS. = 22, TOTAL MARKS = 600, TOTAL CREDITS = 21

Course		Contact Hrs.			Marks			Credits
Code	**Name**	**L**	**T**	**P**	**Int**	**Ext**	**Total**	
MELE1-205/ MELE3-101	Power System Operation and Control	4	0	0	40	60	100	4
MELE1-206/ MELE3-266	Advance Electrical Machines	4	0	0	40	60	100	4
MELE1-207/ MELE3-102	Power Electronic Devices & Controllers	4	0	0	40	60	100	4
Departmental Elective-III (Choose any one)		4	0	0	40	60	100	4
MELE1-264	Power System Modelling & Dynamics							
MELE1-265/ MELE3-265	Customized Power Devices							
MELE1-266	Advanced Electrical Machine Design							
MELE1-267/ MELE3-267/ MELE2-267	Artificial Intelligent Techniques							
Open Elective (Choose any one)		4	0	0	40	60	100	4
MELE1-208/ MELE3-208	Simulation Lab	0	0	2	60	40	100	1
Total 4 Theory & 1 Lab. Courses		**20**	**0**	**2**	**260**	**340**	**600**	**21**

LIST OF OPEN ELECTIVES OFFERED BY ELECTRICAL ENGINEERING DEPARTMENT TO OTHER DEPARTMENTS

Sr. No.	Course Code	Title
1	MELE0-F91	Advance Electrical Machines
2	MELE0-F91	Load Forecasting and Load Management
3	MELE0-F93	Neural Networks & Fuzzy Logic
4	MELE0-F94	Engineering Optimization

ADVANCED POWER SYSTEM ANALYSIS AND DESIGN

Subject Code: MELE1-101/MELE3-103 L T P C Duration: 45 Hrs.
4 0 0 4

UNIT-1

1. Load Flow (8 Hrs.)

Network modeling – Conditioning of Y Matrix – Load Flow-Newton Rapson method- Decoupled – Fast decoupled Load flow -three-phase load flow.

UNIT-2

2. DC Power Flow (9 Hrs.)

Single phase and three phase -AC-DC load flow - DC system model – Sequential Solution Techniques – Extension to Multiple and Multi-terminal DC systems – DC convergence tolerance – Test System and results.

UNIT-3

3. Fault Studies (9 Hrs.)

Analysis of balanced and unbalanced three phase faults – fault calculations – Short circuit faults – open circuit faults.

4. System Optimization (12 Hrs.)

Strategy for two generator systems – generalized strategies – effect of transmission losses - Sensitivity of the objective function- Formulation of optimal power flow-solution by Gradient Method-Newton's method.

UNIT-4

5. State Estimation (7 Hrs.)

Method of least squares – statistics – errors – estimates – test for bad data – structure and formation of Hessian matrix – power system state estimation.

RECOMMENDED BOOKS:

1. J.J. Grainger and W.D. Stevenson, 'Power System Analysis', Tata McGraw Hill, New Delhi, **2003**.
2. J. Arrillaga and C.P. Arnold, 'Computer Analysis of Power Systems', John Wiley and Sons, New York, **1997**.
3. M.A. Pai, 'Computer Techniques in Power System Analysis', Tata McGraw Hill, New Delhi, **2006**.

MODERN CONTROL THEORY

Subject Code: MELE1-102/ L T P C Duration: 44 Hrs.
4 0 0 4

UNIT-1

1. Mathematical Preliminaries (12 Hrs.)

Fields, Vectors and Vector Spaces – Linear combinations and Bases – Linear Transformations and Matrices – Scalar Product and Norms – Eigen-values, Eigen Vectors and a Canonical form representation of Linear operators – The concept of state – State Equations for Dynamic systems – Time invariance and Linearity – Non-uniqueness of state model – State diagrams for Continuous-Time State models.

UNIT-2

2. State Variable Analysis (10 Hrs.)

Linear Continuous time models for Physical systems– Existence and Uniqueness of Solutions to Continuous-Time State Equations – Solutions of Linear Time Invariant Continuous-Time State Equations – State transition matrix and its properties. General concept of controllability – General concept of Observability – Controllability tests for Continuous-Time Invariant Systems – Observability tests for Continuous-Time Invariant Systems – Controllability and Observability of State Model in Jordan Canonical form – Controllability and Observability Canonical forms of State model.

UNIT-3

3. Non Linear Systems (8 Hrs.)

Introduction – Non Linear Systems - Types of Non-Linearties – Saturation – Dead-Zone - Backlash – Jump Phenomenon etc.; Singular Points – Introduction to Linearization of nonlinear systems, Properties of Non-Linear systems – Describing function–describing function analysis of nonlinear systems – Stability analysis of Non-Linear systems through describing functions. Introduction to phase-plane analysis, Method of Isoclines for Constructing Trajectories, singular points, phase-plane analysis of nonlinear control systems.

UNIT-4

4. Stability Analysis (7 Hrs.)

Stability in the sense of Lyapunov, Lyapunov's stability and Lypanov's instability theorems - Stability Analysis of the Linear continuous time invariant systems by Lyapunov second method – Generation of Lyapunov functions – Variable gradient method – Krasooviski's method. State feedback controller design through Pole Assignment – State observers: Full order and Reduced order.

5. Optimal Control (7 Hrs.)

Introduction to optimal control - Formulation of optimal control problems – calculus of variations – fundamental concepts, functional, variation of functional – fundamental theorem of theorem of Calculus of variations – boundary conditions – constrained minimization – formulation using Hamiltonian method – Linear Quadratic regulator.

RECOMMENDED BOOKS:

1. M. Gopal 'Modern Control System Theory', New Age International, **1984.**
2. K. Ogata 'Modern Control Engineering', Prentice Hall, **1997.**
3. I.J. Nagarath and M. Gopal, 'Control Systems Engineering', New Age International (P) Ltd.
4. M. Gopal, 'Digital Control and State Variable Methods', Tata Mc Graw-Hill Companies, **1997**.
5. H. Zak, 'Systems and Control by Stains Law', Oxford Press, **2003**.
6. Kuo, 'Digital Control Systems', 2nd Edn., Oxford University Press, **2003**.

APPLIED INSTRUMENTATION & MEASUREMENT

Subject Code: MELE1-103 **L T P C** **4 0 0 4** **Duration: 40 Hrs.**

UNIT-1

1. Transducers (10 Hrs.)

Classification of Transducers including analog and digital transducers, Selection of Transducers, Static and Dynamic response of transducer System, Measurement of length & thickness, linear Displacement, Angular Displacement, force, weight, torque, Moisture, Level, Flow, pH & Thermal Conductivity, Measurement of Frequency, Proportional, Geiger Muller & Scintillation Counters.

UNIT-2

2. Telemetry (8 Hrs.)

Basic Principles, Proximity & remote Action Telemetry systems, Multiplexing; Time Division and frequency division.

UNIT-3

3. Display Devices (10 Hrs.)

Various types of Display Device, Digital Voltmeters, Dual Slope DVMS, Digital encoders, Analog and Digital encoders, Analog and Digital Data Acquisition System, A/D Converter. Fiber Optic

Technology for data transmission, Supervisory Control and Data Acquisition Systems (SCADA), Q-meter. Electrical noise in control signals, its remedial measures.

UNIT-4

4. Virtual Instrumentation (12 Hrs.)

Introduction to Virtual Instrumentation, conventional vs. Virtual instrumentation, advantages and basic representations. Introduction to Lab view. Applications of virtual instrumentation in various fields like Industrial applications, defense, Medical.

RECOMMENDED BOOKS:

1. W.D. Cooper & A.D. Helfrick, 'Electronic Instrumentation and Measurement Techniques', PHI.
2. B.C. Nakra and K.K. Chaudhary, 'Instrumentation Measurement Analysis', Tata McGraw-Hill.
3. Hermann, K.P. Neubert, 'Instrument Transducers'.
4. pH Mansfleld, 'Electrical Transducers for Industrial Measurement'.
5. Mani Sharma, Rangan,'Instrumentation systems'.
6. Borden & Thgnel, 'Principles & Methods of Telemetry'.
7. Foster, 'Telemetry Method'.
8. Sanjay Gupta & Joseph John, 'Virtual Instrumentation Using Lab VIEW', TMG; Tata McGraw Hills, **2005**.
9. Robert H. Bishop, 'Learning with Lab VIEW 7 Express', Pearson Education, **2005**.
10. Related IEEE/IEE Publications.

POWER SYSTEM SOFTWARE LAB

Subject Code: MELE1-104	L T P C 0 0 2 1	Duration: Hrs.

Development of algorithms & flowcharts and digital simulation of the following using ETAP/MATLAB Software package:

1. Z-bus and Y-bus formulation
2. Load flow studies
3. Fault analysis
4. Transient stability studies
5. Economic load dispatch

ENERGY MANAGEMENT & ENERGY AUDITING

Subject Code: MELE1-156	L T P C 4 0 0 4	Duration: 40 Hrs.

UNIT-1

1. Energy Scenario (9 Hrs.)

Energy needs of growing economy, Long term energy scenario, Energy pricing, Energy sector reforms, Energy and environment: Air pollution, Climate change, Energy security, Energy conservation and its importance, Energy strategy for the future, Energy conservation Act- 2001 and its features.

UNIT-2

2. Energy Management and Audit (9 Hrs.)

Definition, Energy audit- need, Types of energy audit, Energy management (audit) approach-understanding energy costs, Bench marking, Energy performance, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments.

3. Data Gathering (6 Hrs.)
Level of responsibilities, energy sources, control of energy and uses of energy get Facts, figures and impression about energy /fuel and system operations, Past and Present operating data, Special tests, Questionnaire for data gathering.

UNIT-3

4. Analytical Techniques (5 Hrs.)
Incremental cost concept, mass and energy balancing techniques, Inventory of Energy inputs and rejections, Heat transfer calculations, Evaluation of Electric load characteristics, process and energy system simulation.

UNIT-4

5. Evaluation of Saving Opportunities (5 Hrs.)
Determining the savings in rupees' Noneconomic factors, Conservation opportunities, estimating cost of implementation.

6. Energy Audit and Instruments (6 Hrs.)
The plant energy study report- Importance, contents, effective organization, report writing and presentation, Instruments for Audit and Monitoring Energy and Energy Savings, Types and Accuracy.

RECOMMENDED BOOKS:

1. W.R. Murphy, G. Mckay, 'Energy Management', Butterworths.
2. C.B. Smith, 'Energy Management Principles', Pergamon Press.
3. I.G.C. Dryden, 'Efficient Use of Energy', Butterworth Scientific.
4. A.V. Desai, 'Energy Economics', Wiley Eastern.
5. D.A. Reay, 'Industrial Energy Conservation', Pergammon Press.
6. W.C. Turner, 'Energy Management Handbook', John Wiley and Sons, A Wiley Interscience
7. Publication.
8. 'CIBSI Guide – User's Manual', U.K.
9. 'CRC Handbook of Energy Efficiency', CRC Press.

MICROPROCESSORS AND EMBEDDED CONTROL

Subject Code: MELE1-157 | **L T P C** **4 0 0 4** | **Duration: 42 Hrs.**

UNIT-1

1. Overview (9 Hrs.)
Microprocessor 8086, Architecture, PIN Diagram, BIU and EU, memory addressing, Clock generator 8284, buffers and latches, maximum and minimum modes.

UNIT-2

2. Addressing Modes (10 Hrs.)
Addressing modes of 8086, Assembly language Programming, Assemblers and Procedures, Macros, Interrupts. Interfacing of 8086: IC 8155 (Static RAM with ports and timers), 8755 (EPROM with I/O ports), 8251A (USART), 8255 A, 8253/8254,8257 and 8259 controllers.

UNIT-3

3. Microcontroller (10 Hrs.)
Introduction to microcontrollers, Architecture, Pin Diagram, I/O ports, Internal RAM and registers, Interrupts, addressing modes, memory organization and external addressing, Instruction set. Interfacing with LCD, ADC, DAC, Stepper motor, Key Board and sensors.

UNIT-4

4. Embedded Systems (13 Hrs.)

Introduction, Classification, Processors, Hardware units, Software embedded into systems, applications and products of embedded systems, Structural Units in processor, Memory Devices, I/O Devices, Buses, Interfacing of Processor memory and I/O devices. Case Study of an embedded system for a smart card.

RECOMMENDED BOOKS

1. Mazidi, Mazidi & McKinlay, 'The 8051 Microcontroller and Embedded Systems using Assembly and C', PHI.
2. Myke Predko, 'Programming and Customizing the 8051 Micro-controller', Tata McGraw-Hill edn.
3. R.A. Gaonkar, 'Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)', Penram Publishing India.
4. K. Shibu, 'Embedded Systems', Tata McGraw Hill Publishing, New Delhi, **2009**.
5. Barry B. Brey, 'The Intel Microprocessors 8086/8088, 8086, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4, Architecture, Programming and Interfacing', Prentice Hall of India Private Limited, New Delhi, **2003**.
6. John Peatman, 'Design with Microcontroller', McGraw Hill Publishing Co Ltd, New Delhi.

NON-CONVENTIONAL ENERGY RESOURCES

Subject Code: MELE1-158 | **L T P C** **4 0 0 4** | **Duration: 41 Hrs.**

UNIT-1

1. Introduction to Energy Sources (5 Hrs.)

World Energy Futures, Conventional Energy Sources, Non-Conventional Energy Sources, Prospects of Renewable Energy Sources.

UNIT-2

2. Solar Energy (10 Hrs.)

Introduction to Solar Radiation and its measurement, Introduction to Solar Energy Collectors and Storage. Applications of Solar Energy: Solar, Thermal Electric Conversion Systems, Solar Electric power Generation, Solar Photo-Voltaic, Solar Cell Principle, Semiconductor Junctions, Conversion efficiency and power output, Basic Photovoltaic System for Power Generation.

UNIT-3

3. Wind Energy (9 Hrs.)

Introduction to wind energy Conversion, the nature of the wind, Power in the wind. Wind data and energy estimation, Site Selection Considerations, Basic Components of a Wind Energy Conversion System, Classification of WEC Systems, Schemes for Electric Generation using Synchronous Generator and Induction Generator, Wind energy Storage.

UNIT-4

4. **Direct Energy Conversion Processes (11 Hrs.)**

Magneto Hydro Dynamic Power Generation: Principles of MHD power generation, Open Cycle Systems, Closed Cycle Systems, Voltage and power output, Materials for MHD generators. Basic principles of thermo-electric power-generation, Seebeck, Peltier, Thomson effects, Thermo-Electric power generator, Analysis, materials. Thermionic emission and work function, Basic thermionic generation. Classification of Fuel Cells, Types, Advantages, Electrodes, Polarization. The basic Nuclear Function and Reactions Plasma Confinement, Thermo Nuclear Function Reactions.

5. Energy from Biomass (6 Hrs.)

Biomass conversion technologies, photosynthesis, Bio-gas generation, types of bio-gas plants. Biomass as a Source of Energy: Method for obtaining energy from Bio-mass, Biological Conversion of Solar Energy.

RECOMMENDED BOOKS:

1. G.D. Rai, 'Non-Conventional Sources of Energy', Khanna Publishers.
2. David Boyles, 'Bio Energy', Elis Horwood Ltd.
3. N.K. Bansal and M. Kleemann, M. Heliss, 'Renewable Energy Sources and Conversion Technology, Tata McGraw Hill, **1990**.
4. R.A. Coombie, 'Direct Energy Conversion', Pitman.
5. O.P Vimal and P.D. Tyagi, 'Bio Energy Spectrum', Bio Energy and Wasteland Development Organization.

WIND ENERGY AND SMALL HYDRO POWER STATION

Subject Code: MELE1-159	L T P C 4 0 0 4	Duration: 40 Hrs.

UNIT-1

1. Wind Energy (12 Hrs.)

Introduction, general theory of wind machines, basic laws and concepts of aerodynamics, Micro-siting, Description and performance of the horizontal–axis wind machines. Introduction to blade design, Description and performance of the vertical–axis wind machines, generation of electricity by wind machines and case studies.

UNIT-2

2. Hydro Power Plant (10 Hrs.)

Overview of micro mini and small hydro, site selection and civil works. Penstocks and turbines, speed and voltage regulation, investment issues,

UNIT-3

3. Tariffs (8 Hrs.)

Study of load management and tariff scheme, distribution and marketing issues related to power generation.

UNIT-4

4. Hybrid Power System (10 Hrs.)

Wind and hydro based stand-alone / hybrid power systems, control of hybrid power systems, wind diesel hybrid systems

RECOMMENDED BOOKS:

1. J.F. Manwell, J.G. McGowan and A.L. Rogers, 'Wind Energy Explained – Theory, Design and Application', John Wiley & Sons, Ltd., **2002**.
2. O.L. Martin Hansen, 'Aerodynamics of Wind Turbines', Earthscan, **2008**.
3. Fernando D. Bianchi, Hernan De Battista and Ricardo J. Mantz, 'Wind Turbine Control Systems- Principles, Modelling and Gain Scheduling Design', Springer, **2007.**
4. Adam Harvey, Andy Brown and Priyantha Hettiarachi, 'Micro-Hydro Design Manual: A Guide to Small-Scale Water Power Schemes', ITDG, **1993**.
5. Maria Laguna, 'Guide on How to Develop a Small Hydropower Plant', ESHA, **2004**.
6. 'Good & Bad of Mini Hydro Power', edited by Roman Ritter, GTZ, **2009**.

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EHVAC AND HVDC TRANSMISSION SYSTEM

Subject Code: MELE1-160 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-1

1. Overview (6 Hrs.)
Comparison of EHV AC and DC transmission, description of DC transmission systems, modern trends in AC and DC transmission.

2. EHV AC Systems (8 Hrs)
Limitations of extra-long AC transmission, Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line, Reactive Power planning and control, traveling and standing waves, EHV cable transmission system.

UNIT-2

3. Static Var System (6 Hrs.)
Reactive VAR requirements, Static VAR systems, SVC in power systems, design concepts and analysis for system dynamic performance, voltage support, damping and reactive support.

4. HVDC System (7 Hrs.)
Converter configurations and their characteristics, DC link control, converter control characteristics; Monopolar operation, converter with and without overlap, smoothing reactors, transients in DC line, converter faults and protection, HVDC Breakers.

UNIT-3

5. Corona and Interference (7 Hrs.)
Corona and corona loss due to EHV AC and HVDC, Radio and TV interference due to EHV AC and HVDC systems, methods to reduce noise, radio and TV interference.

6. Harmonic Filters (5 Hrs.)
Generation of harmonics, Design of AC filters, DC filters.

UNIT-4

7. Power Flow Analysis in AC/DC Systems (6 Hrs.)
Component models, solution of DC load flow, per unit system for DC quantities, solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems, Multi terminal systems.

RECOMMENDED BOOKS:

1. K.R. Padiyar, ‘HVDC Power Transmission Systems’, Wiley Eastern Ltd., New Delhi.
2. E. Kimbark, ‘Direct Current Transmission’, Vol-I, John-Wiley and Sons, NY.
3. J. Arrillaga, ‘HVDC Transmission’, IEE Press, London.
4. R.D. Begamudre, ‘EHV AC Transmission Engineering’, Wiley Eastern Press.

DIGITAL SIGNAL PROCESSING AND APPLICATIONS

Subject Code: MELE1-161 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-1

1. Introduction (10 Hrs.)
Limitations of analog signal processing, Advantages of digital signal processing and its applications; Some elementary discrete time sequences and systems; Basic elements of digital signal processing such as convolution, correlation and autocorrelation, Concepts of stability, causality, linearity, difference equations. DFT and its properties; Linear Periodic and Circular

convolution; Linear Filtering Methods based on DFT; Fast Fourier Transform algorithm using decimation in time and decimation frequency techniques; Goertzel algorithm.

UNIT-2

2. Z Transform (6 Hrs.)

Introduction, Z-Transform, Region of convergence; Inverse Z Transform methods, properties of Z transform.

UNIT-3

3. Design of Digital Filters (12 Hrs.)

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Linear Phase FIR filters; Design methods for FIR filters; IIR filter design by Impulse Invariance, Bilinear Transformation, Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects: Fixed point and Floating point representations, Effects of coefficient unitization, Effect of round off noise in digital filters, Limit cycles.

UNIT-4

4. DSP Processors (10 Hrs.)

Architectures of ADSP and TMS series of processor. Digital Signal Processing Principles, Algorithms and Application.

RECOMMENDED BOOKS:

1. Alan V. Oppenheim, Ronald W. Schafer, 'Discrete-Time Signal Processing', John R. Back, Prentice Hall.
2. S. Salivahan, A. Vallavaraj, Gnanpiya, 'Digital Signal Processing', Tata McGraw Hill.
3. S.K. Mitra, 'Digital Signal Processing - A Computer based Approach', Tata McGraw Hill.
4. Jervis, 'Digital Signal Processing‖', Pearson Education India.
5. 'Introduction to Digital Signal Processing', 1st Edn., Johny R. Johnson, Prentice Hall, **2006.**

ADAPTIVE CONTROL SYSTEM

Subject Code: MELE1-161 | **L T P C** | **Duration: 40 Hrs.**
4 0 0 4

UNIT-1

1. Introduction to Adaptive Control (6 Hrs.)

Development of adaptive control problem-The role of Index performance (IP) in adaptive systems-Development of IP measurement process model.

UNIT-2

2. System Response Identification (10 Hrs.)

Identification by Cross Correlation - Synthesis techniques for flat spectrum Pseudo random signals - Quasi Linearization-Impulse Response Expansion-Identification using matched filter, Adaptive control using steepest Descent.

3. Perturbation Systems (5 Hrs.)

Single and Multi-dimensional adaptive systems – Stability Analysis of Sinusoidal perturbation adaptive controllers – Formulation of signal synthesis system.

UNIT-3

1. Self-Tuning Regulators (Str) and Model Reference Adaptive Systems (10 Hrs.)

Introduction - Pole Placement Design-Indirect Self-tuning regulators - Continuous Time Self-Tuners - Direct self-tuning regulators - Linear quadratic self - Tuning regulators - Adaptive predictive control. The MIT rule – Determination of Adaptation Gain – Design of MRAS using Liapunov theory – BIBO Stability – Applications to Adaptive control- Model Free Adaptive Control.

UNIT-4

4. Gain Scheduling (9 Hrs.)

Principle-Design of Gain Scheduling Controllers - Nonlinear Transformations of second Order Systems Applications of Gain Scheduling. Case study - ABB Adaptive Controllers, Satt Control ECA40, The First Control Adaptive Controller.

RECOMMENDED BOOKS:

1. Karl J. Astrom and Bjorn Wittenmark, 'Adaptive Control', 2nd Edn., Pearson Education Inc., New Delhi, **2008**.
2. Shankar Sastry and Marc Bodson, 'Adaptive Control – Stability, Convergence and Robustness', Prentice Hall, Englewood Cliffs, New Jersey, **1989**.
3. L. Ljung, 'System Identification: Theory for the User', Prentice Hall, Englewood Cliffs, **1999**.
4. V.V. Chalam, 'Adaptive Control Systems – Techniques and Applications', Marcel Dekker Inc., New Jersey, **1987**.
5. Kumpathi S. Narendra, Romeo Ortega and Peder Dorator, 'Advances in Adaptive Control', IEEE Press, New Jersey, 1991.
6. Petros A. Loannov and Jing Sun, 'Robust Adaptive Control', Prentice Hall Inc.

DISCRETE TIME CONTROL SYSTEMS

Subject Code: MELE1-163 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-1

1. Introduction (7 Hrs.)

Configuration of the basic Digital Control Systems, types of sampling operations, Sample and Hold operations, Sampling theorem, Basic discrete time signals.

UNIT-2

2. Analysis of Digital Control Systems (9 Hrs.)

Z-Transforms, Properties of Z-Transform, Inverse Z-Transforms, Pulse Transfer Function, Difference equations, Z-Transform method for solving the difference equations, Block diagram and signal flow graph analysis, Time response of digital control systems.

UNIT-3

3. Stability Methods (8 Hrs.)

Mapping between s-plane and z-plane, stability methods: Modified Routh Criterion, Jury's method, modified Schur-Cohn criterion.

4. Models of Digital Control Systems (5 Hrs.)

Digital temperature control System, Digital position control system, stepping motors and their control.

UNIT-4

5. Control Systems Analysis Using State Variable Methods (8 Hrs.)

State variable representation, conversion of state variable models to transfer function and vice-versa, Eigen values and Eigen vectors, Solution of state equations, Concepts of controllability and observability.

6. State Variable analysis of Digital Control Systems (8 Hrs.)

State variable description of digital control systems, conversion of state variable models to pulse transfer function and vice versa, solution of state difference equations, controllability and observability.

RECOMMENDED BOOKS:

1. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw-Hill.
2. K. Ogata, 'Discrete Time Control Systems', Pearson Education, Singapore, Thomson Press India.

3. B.C. Kuo, ‘Digital Control Systems’, Prentice Hall.
4. I.J. Nagrath & Gopal, ‘Control System Engineering’, John Wiley & Sons.
5. K.K. Aggarwal, ‘Control System Analysis and Design’, Khanna Publishers.

POWER SYSTEM OPERATION AND CONTROL

Subject Code: MELE1-205/MELE3-101 **L T P C**
4 0 0 4

Course Objectives:

- To impart learning about the power system controls namely load frequency and AVR control for both single-machine infinite bus system and multi machine systems.
- To learn optimal system operation through optimal generation dispatch, unit commitment, hydro-thermal scheduling and pumped storage plant scheduling and their implementation through various classical methods

Learning Outcomes:

- Understanding about the power system controls namely load-frequency and AVR control for both single-machine infinite bus system and multi machine systems,
- Student will understand the optimal system operation through optimal generation dispatch, unit commitment, hydro-thermal scheduling and pumped storage plant scheduling and their implementation through various classical methods.

CONTENTS:

Unit-1

INTRODUCTION: Characteristics of power generation units (thermal, nuclear, hydro, pumped hydro), variation in thermal unit characteristics with multiple valves, Economic dispatch with and without line losses, lambda iteration method, gradient method, Economic dispatch without line losses, economic dispatch with line losses, Newton Raphson method, base point and participation factors.

Unit-2

TRANSMISSION LOSSES: Coordination equations, incremental losses, penalty factors, B matrix loss formula (without derivation), methods of calculating penalty factors.

UNIT COMMITMENT: constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.

Unit-3

HYDRO THERMAL CO-ORDINATION: Introduction to long range and short range hydro scheduling, Types of short range scheduling problem, Scheduling energy. The short term hydro-thermal scheduling problems and its solution by Lambda-Gamma iteration method and gradient method

GENERATION WITH LIMITED ENERGY SUPPLY: take or pay fuel supply contract, composite generation production cost function, gradient search techniques.

Unit-4

OPTIMAL POWER FLOW FORMULATION: gradient and Newton method, linear programming methods.

AUTOMATIC GENERATION CONTROL: load frequency control, single area system, multi-area system, tie line control, automatic voltage control.

RECOMMENDED BOOKS:

1. D.P. Kothari and J.S. Dillon, ‘Power System Optimization’, Prentice-Hall of India Pvt. Ltd. New Delhi, **2011.**
2. G.L.K. Kirchmayer, ‘Economic Operation of Power Systems’, John Willey & Sons, N.Y., **2004.**
3. A.J. Wood, B.F. Wollenberg, ‘Power Generation Operation and Control’, **1998.**

4. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Tata Mc Graw-Hill Publishing Company Ltd., New Delhi, **1999.**

ADVANCED ELECTRICAL MACHINES

Subject Code: MELE1-206 **L T P C**
4 0 0 4

Objectives:

- To give a systematic approach for modelling and analysis of all rotating machines under both transient and steady state conditions.

Learning Outcomes:

- The students will be able to analyse all types of electrical machines.
- Students attain complete knowledge about electromagnetic energy conversion and time response analysis of reference frame theories for modelling of machines.

Contents

Unit-1

POLYPHASE SYNCHRONOUS MACHINES: Mathematical: Basic Synchronous machine parameters, Voltage, Flux linkage and inductance relations, Park's transformation – its physical concept, equations of performance.

BALANCED STEADY STATE ANALYSIS: Phasor equations and phasor diagrams, Power-angle characteristics, cylindrical rotor and Salient pole machines, Short circuit ratio

Unit-2

TRANSIENT ANALYSIS & MACHINE DYNAMICS: Three phase short-circuits, Armature and field transients, Transient torque, Sudden reactive loading and Unloading. Transient Analysis-a qualitative approach, Reactance and Time –Constants from equivalent circuits, Measurement of reactance, Transient Power-angle characteristics, The basic electromechanical equation, Linearized analysis, Large Angular/oscillation, Non-linear analysis.

Unit-3

TRANSFORMERS & ITS TRANSIENTS: Multi-Circuit Transformers: General theory, Equivalent circuits, Three winding transformer as a multi-circuit transformer, Determination of parameters. In-rush current phenomena, Qualitative approach, Analytical approach, In-rush current in 3-phasetransformers.

Unit-4

EXCITATION PHENOMENA IN TRANSFORMERS: study of excitation and its effect on transformer performance, Harmonics in: Single phase transformers, three-phase transformers, Disadvantages of harmonics, Suppression of harmonics.

UNBALANCED OPERATION OF THREE-PHASE TRANSFORMERS: Single-phase load on three-phase transformers, Single-Phasing in 3-phase transformers, Effect of using tertiary winding.

RECOMMENDED BOOKS

1. B. Edikins 'Generalized Theory of Electrical Machines'.
2. Concordia, 'Synchronous Machines'.
3. E.W. Kim Bark, 'Power System Stability', Vol. III., Wiley.
4. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', **2010.**
5. E.W. Kimbark., 'Power System Stability', Vol. III, **1998**.
6. A. Draper, 'Electrical Machines', **2011.**
7. 'Magnetic Circuits and Transformer', MIT Staff, **2004.**

POWER ELECTRONIC DEVICES AND CONTROLLERS

Subject Code: MELE1-207/MELE3-102 L T P C
4 0 0 4

Course Objectives:

- Learn the physics of device operation, static and dynamic characteristics, ratings, protection, operating limitations and safe operating area
- Know about the design issues of drive circuits and their usage
- Understanding the different types of inverters and cyclo-converters

Learning Outcomes:

- Knowledge of power semiconductor devices and their Gate and base drive circuits
- Develop skills to utilize the different PWM schemes
- Know about the different types of power converters and their applications

CONTENTS:

UNIT-1

REVIEW OF SEMICONDUCTOR DEVICES: Conduction Process in semiconductors, pn Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, Gate Turn Off Thyristor (GTO), VI characteristics, Dynamic characteristics, ratings, protection.

UNIT-2

POWER MOSFET AND IGBT: Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area.

EMERGING DEVICES AND CIRCUITS: Power junction Field effect transistor (FET), Integrated Gate-Commutated Thyristor (IGCT), Field Control Thyristor, Metal oxide semiconductor (MOS) Control Thyristor etc. Power ICs, New semiconductor materials.

UNIT-3

SNUBBER CIRCUITS: Types of Snubber circuits, needs of Snubber circuit with diode, thyristor and transistors, Turn-off Snubber, over voltage snubber, turn on snubber, Snubber for bridge circuit configurations, GTO Snubber circuit.

UNIT-4

GATE AND BASIC DRIVE CIRCUITS: Design Consideration, De-coupled drive circuits, electrically isolated drive circuits, cascade connected drive circuits, Power device protection in drive circuits, circuit layout considerations.

Recommended Books:

1. Mohan, Undeland and Robbins, 'Power Electronics: Converters, Applications and Design', John Wiley and Sons.
2. M.H. Rashid, 'Power Electronics Handbook', Elsevier Press (Academic Press Series).
3. D. Finney, 'The Power Thyristor and its Applications', McGraw Hill, New York.
4. C.W. Lander, 'Power Electronics', McGraw Hill Book Co., U.K.
5. M.H. Rashid, 'Power Electronics - Circuits, Devices and Applications', PHI, India.

SIMULATION LAB

Subject Code: MELE1-208/MELE3-208 P T L C
0 0 2 1

LIST OF EXPERIMENTS

1. Introduction to MATLAB and its basic commands.
2. MATLAB program to simulate Ferranti effect.

3. MATLAB program to model transmission lines.
4. MATLAB program to solve load flow equations by Gauss-Seidel method.
5. MATLAB program to find optimum loading of generators neglecting transmission losses.
6. MATLAB program to find optimum loading of generators with penalty factors.
7. MATLAB program to solve swing equation using point-by-point method.
8. Simulink model of single area load frequency control with and without pi controller and without pi controller in Simulink.
9. Simulink model for two area load frequency control.
10. Simulink model for evaluating transient stability of single machine connected to infinite bus.
11. Gauss Seidel load flow analysis using MATLAB Software.
12. Newton Raphson method of load flow analysis using MATLAB Software.
13. Fast decoupled load flow analysis using MATLAB Software.
14. Fault analysis using MATLAB Software.
15. Economic dispatch using MATLAB Software.

POWER SYSTEM MODELLING AND DYNAMICS

Subject Code: MELE1-264 **L T P C**
4 0 0 4

Objectives:

- This course aims to give basic knowledge about the dynamic mechanisms behind angle and voltage stability problems in electric power systems, including physical phenomena and modelling issues.

Learning Outcomes:

At the end of this course,

- Will be able to solve the reactive power problems in power system
- Students will be able to analyse and understand the electromagnetic and electromechanical phenomena taking place around the synchronous generator.

UNIT-I

Static Model of Power System Components:

Generator, single circuit & multi-circuit transmission line, regulating & phase shifting transformer, VAr compensators and Loads for balanced and unbalanced conditions. Formulation of Admittance and Impedance Matrices for balanced and unbalanced conditions, their modifications, Sparcity and Optimal ordering,

UNIT-II

TRANSIENT STABILITY ANALYSIS

Review of numerical integration methods: Euler and Fourth Order Runge-Kutta methods, Numerical stability and implicit methods, Interfacing of Synchronous machine (variable voltage) model to the transient stability algorithm (TSA) with partitioned –explicit and implicit approaches – Interfacing SVC with TSA-methods to enhance transient stability.

UNIT III

UNIFIED ALGORITHM FOR DYNAMIC ANALYSIS OF POWER SYSTEMS

Need for unified algorithm-numerical integration algorithmic steps-truncation error-variable step size –handling the discontinuities-numerical stability-application of the algorithm for transient. Mid-term and long-term stability simulations.

UNIT IV

TRANSMISSION, GENERATION AND LOAD ASPECTS OF VOLTAGE STABILITY ANALYSIS

Review of transmission aspects –Generation Aspects: Review of synchronous machine theory – Voltage and frequency controllers –Limiting devices affecting voltage stability –Voltage-reactive power characteristics of synchronous generators –Capability curves – Effect of machine limitation on deliverable power –Load Aspects –Voltage dependence of loads –Load restoration dynamics – Induction motors –Load tap changers –Thermostatic load recovery –General aggregate load models.

Recommended Books:

1. R. Ramnujam,'Power System Dynamics Analysis and Simulation', PHI, Learning Private Limited, New Delhi, **2009.**
2. P. Kundur, 'Power System Stability and Control', McGraw-Hill, **1993**.
3. J.D. Grainger, 'Power System Analysis', Tata McGraw Hill Publishing Company, **2008**.
4. L.P. Singh, 'Advanced Power System Analysis and Dynamics', 3rd Edn., Wiley Eastern, New Delhi, **2012.**

CUSTOMIZED POWER DEVICES

Subject Code: MELE1-265 **L T P C**
4 0 0 4

Course Objectives

- To study of advances in Power Electronics Industry led to rapid development of Power Electronics controllers for fast real and reactive power control and to introduce these advancements.

Learning Outcomes

- Upon successful completion of this course, students will be able to select suitable FACTS device for the enhancement of power transfer capability and to control the power flow in an efficient manner.

Contents

UNIT-I

Static Power Frequency Changers

Fundamental Ideas: Historical Background, Basic Operational features and Operating Principles. Mathematical Representation (output voltage and Input Current) of Static Frequency Changers. Synthesis of the Output Voltage Waveform, Control of the Output Voltage (PWM, Amplitude Dependent Frequency Modulation, Phase Shift). Unwanted Components of Output Voltage, Analysis of the Input Current. Extra basal Components of the Input Current. Control Circuit Principles: Implementation of Modulating Functions. End Stop Control, Control of UDFFC, NCC and CDFFC. Forced Commutation of Frequency Changers: Fundamental Principles of Hard and Soft Commutation, Points of Connection of Commutating Circuits. Some Basic Commutating Circuits. Application of Static Frequency Changers: Speed Control of AC Machines, Constant Frequency Power Supplies and Static VAR Generators.

UNIT-II

Compensators and Power Flow Controllers:

Static shunt compensators, Static series compensators, Static Voltage and phase angle regulators, Principle of operation of Controllers, Control and characteristics, Model of IPFC for power flow and optimum power flow studies. FACTS Controller interactions –SVC–SVG interaction -co-ordination of multiple controllers using linear control techniques –Quantitative treatment of control coordination

UNIT-III

Power Quality Improvement:

Harmonic filters: passive, Active and hybrid filters –Custom power devices: Network reconfiguring Devices, Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC –control strategies: P-Q theory, Synchronous detection method –Custom power park –Status of application of custom power devices.
Difference in role of FACTS devices in transmission and distribution networks

UNIT-IV

Recent Trends:

Application of basic active filters, multilevel and multipulse converters and Z-source inverter in various FACTS and FACDS devices for improving the performances of transmission system net work and distribution system network, respectively.

Recommended Books:

1. Y.H. Song and A.T. Johns, 'Flexible AC Transmission Systems', IEEE Press, **1999**.
2. N.G. Hingorani and L. Gyragyi, 'Understanding FACTS (Concepts and Technology of Flexible AC Transmission System)', Standard Publishers & Distributors, **2001**.
3. R.M. Mathur and R.K. Verma, 'Thyristor based FACTS Controllers for Electrical Transmission Systems', IEEE Press, **2002**.

ADVANCED ELECTRICAL MACHINES DESIGN

Subject Code: MELE1-266 **L T P C**
4 0 0 4

Objectives:

- To give a systematic approach for modelling and analysis of all rotating machines under both transient and steady state conditions.

Learning Outcomes:

1. Develop the basic elements of generalized theory and derive general equations for voltages and currents applicable to all types of rotating machines, to deal comprehensively with their steady-state, dynamic and transient analysis.
2. Obtain the voltage and torque equations for a symmetrical induction machine in terms of machine variables and transform these equations by applying reference-frame theory to Analyse the dynamic performance of the machine.
3. Apply Park‟s transformation to transform the time varying synchronous machine equations to a time-invariant set of equations and study the dynamic performance.
4. Linearize the nonlinear equations of induction and synchronous machines to study the dynamic behaviour of small displacements about the operating point.

CONTENTS:

UNIT-I

Introduction: Design of Machines, Factors, limitations, Modern trends. Materials: Conducting, magnetic and insulating materials. Calculations of mmf for air gap and teeth, real and apparent flux densities, iron losses, field form, leakage flux, specific permanence. Modes of heat dissipation, Temperature gradients, types of enclosures, types of ventilation, conventional and direct cooling, amount of coolants used, Ratings.

UNIT-II

Transformer and DC Machine

Transformer: Magnetic circuit, core construction and design, winding types, insulation, Loss allocation and estimation, Reactance, Temperature rise.

D C Machine:
No. of poles and main dimensions, armature, windings, Magnetic circuit and Magnetisation curve, Commutator and brushes.

UNIT-III

AC Machine

Induction Machine-3 phase: Rating specifications, standard frame sizes, Main dimensions' specific loadings, Design of stator windings, Rotor design –slots and windings, calculations of equivalent circuit parameters.
Synchronous Machine: Main dimensions, Magnetization characteristic, Field winding design.

UNIT-IV

Computer Aided Design of Electrical Machines

Analysis and synthesis approaches, design algorithms, Introduction to optimization techniques, Implementing computer program for design of three phase induction motor.

Recommended Books:

1. A.K. Sawhney, 'A Course in Electrical Machine Design', Dhanpat Rai & Co.
2. A.E. Clayton & N.N. Hancock, 'The Performance and Design of Direct Current Machines', CBS Publishers and Distributors.
3. E.S. Hamdi, 'Design of Small Electrical Machine', John Wiley and Sons, **1994**.
4. M. Ramamoorty, 'Computer Aided Design of Electrical Equipment', Eastern Press Private Limited, **1989**.
5. M.G. Say, 'Design and Performance of Machines', CBS Publications, **1981**.

ARTIFICIAL INTELLIGENT TECHNIQUES

Subject Code: MELE1-267/ MELE2-267/ MELE3-267	**L T P C** **4 0 0 4**

Learning Objectives:

- To apply artificial neural networks in various electrical and electronics engineering applications.
- To expose students to fuzzy methods of analysing problems which involve incomplete or vague criteria rather than crisp values.
- To investigates requirements analysis, logical design, and technical design of components for fuzzy systems development.

Learning Outcomes:

- The students acquire the skills required to innovate and build, smart and intelligent applications in electrical and electronics engineering.
- They will understand review of Neural Networks: models of a neuron, various activation functions, Threshold function, piecewise – linear function, stochastic model of a neuron, feedback.
- They will be able to take up fuzzy systems approach to solve applications in engineering.

Contents

UNIT I

NEURAL NETWORKS (9 hours)

Neural Networks – biological neurons – Artificial neurons – activation
function – learning rules – feed forward networks – supervised & Unsupervised learning – perceptron network- linear separability – back propagation networks Algorithms-Radial basis function networks.

UNIT II

ASSOCIATIVE MODELS AND CONTROL SCHEMES IN NN (9 hours)

Auto & hetero associative memory – bi-directional associative memory – Self organizing feature Maps-Hopfield Networks-Neural Networks for non – linear system – Schemes of Neuro control – System identification – forward model and – Inverse model – Case studies.

UNIT III

FUZZY LOGIC AND GENETIC ALGORITHM (9 hours)

Fuzzy set - Crisp set – vagueness – uncertainty and imprecision – fuzzy set – fuzzy operation-properties – crisp versus fuzzy relations – fuzzy relations –fuzzy Cartesian product and composition – composition of fuzzy Relations-Fuzzy to crisp conversion –structure of fuzzy logic controller – database – rule base – Inference engine.

GA: Working principles – terminology – Importance of mutation – comparison with traditional methods – constraints and penalty function – GA operators – Real coded GAs.

UNIT IV

APPLICATIONS (9 hours)

Applications of Neural network, Fuzzy system & Genetic algorithms for power systems and power electronics Systems-Designing of controllers using Simulation Software, NN tool box & Fuzzy Logic Toolbox.

Recommended Books:

1. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill International Edition, USA, **1997**.
2. Awrence Fausatt, 'Fundamentals of Neural Networks', Prentice Hall of India, New Delhi, **1994**.
3. Simon Haykin, 'Neural Networks – A Comprehensive Foundation', Pearson Education Asia, **2002**.

ADVANCED ELECTRICAL MACHINES

Subject Code: MELE-1292 **L T P C**
4 0 0 4

Learning Objectives:

- To give a systematic approach for modelling and analysis of all rotating machines under both transient and steady state conditions.

Learning Outcomes:

- The students will be able to model all types of rotation machines including special machines.
- They will have complete knowledge about electromagnetic energy conversion and application of reference frame theories for modelling of machines.

Contents

Synchronous motor analysis taking armature resistance into account, vector diagrams, power circle and excitation circle—diagrams. Performance calculations under various operating conditions. The equation of motion or 'swing' equation for synchronous motors and generators.

Solutions of linearized swing equation, small oscillations of synchronous machines. Hunting of synchronous motors, elements of large oscillation of synchronous machines, concept of transient stability.

Starting of synchronous motors with the help of damper windings, George's phenomenon. Brushless excitation of synchronous generators and motors.

Synchronous-induction motor: Slip-ring induction motor run as synchronous motor. Different types of motor excitation. Starting and running characteristics-combined synchronous motor and induction motor circle diagrams, performance calculation, design features.

Concept of negative sequence and zero sequence reactances of synchronous machines. Inverter operation of induction motors, space and time harmonies and their effects on the performance of induction motors.

Induction generators; Operation from bus-bars, self-excitation equivalent circuits and performance—its utility in wind power generation.

A.C. commutator machines: General construction. Derivation of generalized expressions: (a) Transformer e.m.f. and rotational e.m.f's in phase windings; (b) Transformer and rotational e.m.f's in commutator windings, uncompensated and compensated series motor: vector diagrams, circle diagram, operational characteristics and design features.

Variable reluctance and fractional and sub-fractional h.p. motors: Different types of reluctance and stepper motors, permanent magnet motors, derivation of performance equations. Control schemes and performance.

Recommended Books:

1. P.S. Bimbhra, 'Generalized Theory of Electrical Machines'.
2. E.W. Kimbark, 'Power System Stability', Vol. III.
3. A. Draper, 'Electrical Machines'.
4. 'Magnetic Circuits and Transformer', MIT Staff.

LOAD FORECASTING AND LOAD MANAGEMENT

Subject Code: MELE1-293 **L T P C**
4 0 0 4

Learning Objectives:

- To give a systematic approach for load management and forecasting.
- To analysis of all trend coming related to recent case studies conditions.

Course Outcomes:

- The students will acquire skills of load related energy management and tariff structure.
- They will have complete knowledge about annual and monthly peak demands.

UNIT-I

Load Forecasting:

Classification and characterization of loads, Approaches to load forecasting,
Forecasting methodology, Energy forecasting, Peak demand forecasting, Nonweather sensitive forecast and Weather sensitive forecast, Total forecast, Annual and monthly peak demand forecasts, Applications of state estimation to load forecasting.

UNIT-II

Load Management:

Introduction to Load management, Electric energy production and delivery system structure (EEPDS), Design alternatives for EEPD systems, Communication/control techniques
for load management, Tariff structure and load management, principles of macro and microeconomics and energy pricing strategies, Assessing the impacts of load management.

UNIT-III

Energy Demand Forecasting:

Static and dynamic analysis of energy demand, Elements of energy demand forecasting, Methodologies and models for energy demand forecasting, Techno economic approach in energy demand forecasting. Energy auditing, Energy management, Power Pools and Energy Banking.

UNIT-IV

Trends and Case Studies:

Energy management strategy, Symbiotic relation between information, Energy models and decision making, Case studies like industrial energy forecasting, Transportation energy forecasting, Residential, Commercial and agricultural energy forecasting.

Recommended Books

1. J. Martino, 'Technological Forecasting for Decision Making', Elsevier Press, **1972**.
2. C.W. Gellings and P.E. Penn Well, 'Demand Forecasting in the Electric Utility Industry', Fairmount Press, **1992**.
3. S. Makridakis, 'Forecasting Methods and Applications', John Wiley and Sons, **1997**.
4. R.G. Brown, 'Smoothing, Forecasting and Prediction of Discrete Time Series', PHI Int., **1963.**

NEURAL NETWORKS & FUZZY LOGIC

Subject Code: MELE1-294 **L T P C**
4 0 0 4

Learning Objectives:

- To apply artificial neural networks in various electrical and electronics engineering applications.
- To expose students to fuzzy methods of analysing problems which involve incomplete or vague criteria rather than crisp values.
- To investigates requirements analysis, logical design, and technical design of components for fuzzy systems development.

Learning Outcomes:

- The students acquire the skills required to innovate and build, smart and intelligent applications in electrical and electronics engineering.
- They will understand review of Neural Networks: models of a neuron, various activation functions, Threshold function, piecewise – linear function, stochastic model of a neuron, feedback.
- They will be able to take up fuzzy systems approach to solve applications in engineering.

Contents

Review of Neural Networks: models of a neuron, various activation functions: Threshold function, piecewise – linear function, stochastic model of a neuron, feedback.

Network Architecture: Single layer feed forward network, multiplayer feed forward network, recurrent network, knowledge representation.

Learning Processes: Memory Based Learning Hebbian Learning, Competitive Learning, Boltzmann Learning, learning with a teacher, learning without a teacher, adaptation, single layer perceptions, multi-layer perceptions.

Introduction to fuzzy logic: membership function, rule generation, fuzzy concept, fuzzification, defuzzification, time dependent fuzzy logic, temporary fuzzy logic, fuzzy artificial neural network, neuro fuzzy control, fuzzy neural nets, Fuzzy Based ABS system, applications.

Recommended Books

1. Simon Haykin, 'Neural Networks'.
2. Eleine Rich, Kevin Knight, 'Artificial Intelligence'.
3. Stamatios V. Kartalopoulos, 'Understanding Neural Networks and Fuzzy Logic'.
4. Hungenahally Jain, 'Neural Intelligent System'.

ENGINEERING OPTIMIZATION

Subject Code: MELE1-295 **L T P C**
4 0 0 4

Objectives:
- To learn essential optimization techniques for applying to day to day problems.
- To study of genetic algorithms with relation to application in power system.
- To acquire knowledge of dynamic programming.

Learning Outcome:
- After learning the techniques, they can apply to engineering and other problems.
- They can get skills to optimize the variety of programming.

Contents

UNIT I

INTRODUCTION

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

UNIT II

LINEAR PROGRAMMING and NON LINEAR PROGRAMMING

Simplex method of solving LPP, revised simplex method, duality, Constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

Steepest descent method, conjugates gradient method, Newton's Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.

UNIT III

DYNAMIC PROGRAMMING (DP)

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm.

UNIT IV

GENETIC ALGORITHM

Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

Recommended Books:

1. D.A. Pierre, 'Optimization Theory with Applications', Wiley Publications, **1969**.
2. H.A. Taha, 'Operations Research, An Introduction', 7th Edn., Pearson Education Edition, Asia, New Delhi, **2002**.
3. 3.S.S. Rao, 'Optimization –Theory and Applications', Wiley-Eastern Limited,**1984**.