TOTAL CONTACT HRS. = 22 TOTAL CREDITS= 21								
1ST SEMESTER		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Int.	Ext.	Total	
MELE3-101	Power System operation and control	4	--	--	40	60	100	4
MELE3-102	Power Electronic Devices & Controllers	4	--	--	40	60	100	4
MELE3-103	Advanced Power System Analysis & Design	4	--	--	40	60	100	4
MELE3-104	Power System Software Lab.	--	--	2	60	40	100	1
Departmental Elective-I (Choose any one)		4	--	--	40	60	100	4
MELE3-156	EHVAC Transmission System							
MELE3-157	Fast Transients in Power System							
MELE3-158	Non-Conventional Energy Resources							
MELE3-159	Applied Instrumentation & Measurements							
Departmental Elective-II (Choose any one)		4	--	--	40	60	100	4
MELE3-160	HVDC Transmission System							
MELE3-161	Power System Communication							
MELE3-162	Smart Grid Technologies							
MELE3-163	Discrete Time Control System							
Total		20	0	2	260	340	600	21

TOTAL CONTACT HRS. = 22 TOTAL CREDITS= 21								
2ND SEMESTER		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Int.	Ext.	Total	
MELE3-205	Power System Planning	4	--	--	40	60	100	4
MELE3-206	Advanced Power System Protection	4	--	--	40	60	100	4
MELE3-207	Power System Dynamics & Stability	4	--	--	40	60	100	4
MELE3-208	Simulation Lab	--	--	2	60	40	100	1
Departmental Elective-III (Choose any one)		4	--	--	40	60	100	4
MELE3-264	Power System Reliability							
MELE3-265	Customized Power Devices							
MELE3-266	Advanced Electrical Machines							
MELE3-267	Artificial Intelligent Techniques							
Open Elective-I		4	--	--	40	60	100	4
Total		20	0	2	260	340	600	21

TOTAL CONTACT HRS. = 24 TOTAL CREDITS= 24								
3RD SEMESTER		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Int.	Ext.	Total	
Departmental Elective-IV (Choose any one)		4	--	-	40	60	100	4
MELE3-368	Energy Management and Energy Auditing							
MELE3-369	Distribution System Operation & Analysis							
MELE3-370	Digital Signal Processing & Applications							
MELE3-371	Engineering Optimization							
Departmental Elective-V (Choose any one)		4	--	--	40	60	100	4
MELE3-372	Power System Harmonics							
MELE3-373	System Modeling & Optimization							
MELE3-374	Embedded Systems							
MELE3-375	Wind Energy and Small Hydro Energy Station							
MELE3-309	Project	-	--	8	60	40	100	10
MELE3-310	Seminar	-	--	4	100	_	100	4
MELE3-311	Research Lab.	-	-	4	60	40	100	2
Total		**8**	**--**	**16**	**300**	**200**	**500**	**24**

TOTAL CREDITS= 24								
4TH SEMESTER		Contact Hrs.			Marks			Credits
Code	Name	L	T	P	Internal	External	Total	
MELE3-412	**Dissertation**	**--**	**--**	**--**	**60**	**40**	**100**	**24**

POWER SYSTEM OPERATION AND CONTROL

Subject Code: MELE3-101 **L T P C** **Duration: 40 Hrs.**
4 0 0 4

UNIT-1

1. INTRODUCTION (10 Hrs.)

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, lambda iteration method, gradient method, Newton's method, base point and participation factors.

UNIT-1I

2. TRANSMISSION LOSSES (5 Hrs.)

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

3. UNIT COMMITMENT (5 Hrs.)

Constraints in unit commitment, priority list method, Dynamic programming method and Lagrange relaxation methods.

UNIT-1II

4. HYDRO THERMAL CO-ORDINATION (5 Hrs.)

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

5. GENERATION WITH LIMITED ENERGY SUPPLY (5 Hrs.)

Take or pay fuel supply contract, composite generation production cost function, gradient search techniques.

UNIT-1V

6. OPTIMAL POWER FLOW FORMULATION (5 Hrs.)

Gradient and Newton method, linear programming methods.

7. AUTOMATIC GENERATION CONTROL (5 Hrs.)

Load frequency control, single area system, multi-area system, tie line control, automatic voltage control.

RECOMMENDED BOOKS:

1. D.P. Kothari and J.S. Dhillon, 'Power System Optimization', Prentice-Hall of India Pvt. Ltd. New Delhi.
2. G.L.K. Kirchmayer, 'Economic Operation of Power Systems', John Willey & Sons, N.Y.
3. A.J. Wood, B.F. Wollenberg, 'Power Generation Operation and Control'.
4. D.P. Kothari and I.J. Nagrath, 'Modern Power System Analysis', Tata McGraw Hill Publishing Company Ltd., New Delhi.

POWER ELECTRONIC DEVICES AND CONTROLLERS

Subject Code: MELE3-101 **L T P C** **Duration: 40 Hrs.**
4 0 0 4

UNIT-1

1. REVIEW OF SEMICONDUCTOR DEVICES (5 Hrs.)

Conduction Process in semiconductors, p-n Junction, Charge control description, Avalanche breakdown, Power diodes, Thyristors, Gate Turn Off thyristor (GTO), VI characteristics, Dynamic characteristics, ratings, protection.

2. POWER MOSFET AND IGBT (5 Hrs.)

Basic structure, I-V Characteristic, Physics of device operation, switching characteristics, operating limitation and safe operating area.

UNIT-1I

3. EMERGING DEVICES AND CIRCUITS (10 Hrs.)

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-III

4. SNUBBER CIRCUITS (10 Hrs.)

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-1V

5. GATE AND BASIC DRIVE CIRCUITS (10 Hrs.)

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.

ADVANCED POWER SYSTEM ANALYSIS AND DESIGN

Subject Code: MELE3-101	**L T P C** **4 0 0 4**	**Duration: 40 Hrs.**

UNIT-1

1. Load Flow (10 Hrs.)

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

UNIT-1I

2. DC Power Flow (10 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-I1I

3. Fault Studies (5 Hrs.)

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

4. System Optimization (5 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-IV

5. State Estimation (10 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**.

POWER SYSTEM SOFTWARE LAB.

Subject Code: MELE3-104 **L T P C**
0 0 2 1

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

EHVAC TRANSMISSION SYSTEM

Subject Code: MELE3-156 **L T P C** **Duration: 40 Hrs.**
4 0 0 4

UNIT-1

1. INTRODUCTION (10 Hrs.)

Introduction to EHV AC Transmission, Tower Configurations, types of self-supporting Lattice towers, Flexible and Semi Flexible towers, Thermal Rating of Lines, Temperature rise of conductors and current carrying capacity of lines and cables, properties of bundled conductor, Average value of line parameters, power handling capacity and line loss, selection of cable for EHV AC transmission, Electrical characteristics and cable insulating materials. Types of circuit breakers for EHV AC system.

UNIT-2

2. VOLTAGE GRADIENT OF CONDUCTORS (10 Hrs.)

Field of line charges and their properties, surface voltage gradient on conductors, maximum surface voltage gradient. Corona e effects, Corona formulas based on voltages and voltage gradients, Corona currents, Power loss, Audible Noise and Radio interference, Limits of audible noise, AN measurement, day night equivalent noise level.

UNIT-3

3. ELECTROSTATIC FIELD OF EHV LINES (10 Hrs.)

Capacitance of long objects under transmission lines, electrostatic field of 3 phase single circuit and double circuit AC lines, Biological effects of electrostatic fields.

UNIT-4

4. LIGHTNING AND LIGHTNING PROTECTION (10 Hrs.)

Over voltage factors, type of surge arresters, rating and classification of surge arresters based on applications, insulation withstand characteristics of long air gaps. Design of EHV Lines based on Stability limits.

RECOMMENDED BOOKS:

1. R.D. Begamudre, 'EHV AC Transmission', 2nd Edn., Wiley Eastern Ltd.
2. 'Transmission Line Reference Book: 345 KV and above EPRI', Palo Alto USA.

3. ‘Electrical Transmission and Distribution Reference Book’, Oxford Book Company, Calcutta.
4. S. Rao, ‘EHV –AC and HV DC Transmission Engineering Practice’, Khanna Publishers.
5. Related IEEE/IEE Publications.

FAST TRANSIENTS IN POWER SYSTEM

Subject Code: MELE3-157 **L T P C** **Duration: 42 Hrs.**
4 0 0 4

UNIT-1

1. ORIGIN AND NATURE OF TRANSIENTS AND SURGES (10 hrs.)

Surge parameters of plant. Equivalent circuit representations. Lumped and distributed circuit transients.

UNIT-2

2. LINE ENERGIZATION AND DE-ENERGIZATION TRANSIENTS (10 Hrs.)

Earth and earth wire effects. Current chopping in circuit breakers. Short line fault condition and its relation to circuit breaker duty. Trapped charge effects. Effect of source and source representation in short line fault studies. Control of transients.

UNIT-3

3. LIGHTNING PHENOMENON (10 Hrs.)

Influence of tower footing resistance and earth resistance. Traveling waves in distributed parameter multi-conductor lines, parameters as a function of frequency. Simulation of surge diverters in transient analysis. Influence of pole opening and pole re-closing.

UNIT-4

4. INSULATION CO-ORDINATION (6 Hrs.)

Over voltage limiting devices, dielectric properties, breakdown of gaseous insulation, tracking and erosion of insulation, high current arcs, and metallic contacts.

5. COMMUNICATION LINKS (6 Hrs.)

PLCC, Microwave, Telephone line, Satellite, Fibre optic. Requirements of' various communication equipment used in power systems. Computer networking in power systems.

RECOMMENDED BOOKS:

1. V.A. Vanikov, ‘Transients in Power System’, Mir Publications, Moscow.
2. L.V. Bewley, ‘Traveling Waves on Transmission Lines’, Dover Publications Inc., New York.
3. Ravindera Arora and Mosch Wolfgang, ‘High Voltage Insulation Engineering’, New Age International Publishers Limited.
4. A. Greenwood, ‘Electrical Transients in Power Systems’, John Wiley & Sons.
5. Stallings William, ‘Data and Computer Communication’, PHI, **1994**.
6. Gowar John, ‘Optical Communications Systems’, PHI, **1993**.
7. R.E. Collin, ‘Foundations of Microwave Engineering’.
8. Theodore S. Rappaport, ‘Wireless Communication, Principles and Practice’, IEEE Press; PTR, **1996.**

NON-CONVENTIONAL ENERGY RESOURCES

Subject Code: MELE3-158 **L T P C** **Duration: 45 Hrs.**
4 0 0 4

UNIT-1

1. Introduction to Energy Sources (10 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 (10 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 (10 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 (5 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.
6. Related IEEE/IEE Publications.

APPLIED INSTRUMENTATION & MEASUREMENTS

Subject Code: MELE3-159	**L T P C** **4 0 0 4**	**Duration: 45 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 (10 Hrs.)

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

UNIT-3

3. Display Device (10 Marks)

Digital Voltmeters, Dual Slope DVMS, Digital encoders, Analog and Digital encoders, Analog and Digital Data Acquisition System, A/D Converter. Fibre 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 (10 Marks)

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.

BOOKS RECOMMENDED:

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. 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 Mc-Graw Hills, **2005**.
9. Robert H. Bishop, 'Course with Lab VIEW 7 Express', Pearson Education, **2005**.
10. Related IEEE/IEE Publications.

HVDC TRANSMISSION SYSTEM

Subject Code: MELE3-159 **L T P C 4 0 0 4** **Duration: 45 Hrs.**

UNIT-1

1. Introduction (10 Hrs.)

Merits & Demerits of H.V.D.C. transmission over E.H.V. A.C. transmission, types of HVDC links.

UNIT-2

2. Converter Configurations (10 Hrs.)

Connection, rectifier & inverter waveforms, complete analysis of 3-phase (6 pulses) bridge converter, equations of voltage & current on AC& DC side. Equivalent Circuit of HVDC link, Basic means of control of HVDC link, CIA, CEA & CC, control characteristics, combined characteristics of a converter.

UNIT-3

3. Reactive Power compensation: (10 Hrs.)

Fundamentals of Harmonics and Harmonic filters, Stability aspect of synchronous & asynchronous link.

UNIT-4

4. Hybrid HVDC System (10 Hrs.)

Introduction to multi-terminal HVDC systems, Protective system in HVDC substations.

BOOKS RECOMMENDED:

1. K.R. Padiyar, 'HDVC Power Transmission System', Wiley Eastern Ltd., **1990.**
2. E.W. Kimbark, 'Direct Current Transmission', Vol 1, Wiley Interscience, **1971**.
3. J. Arrillage, 'H.V.D.C. Transmission', Peter Peregrines, **1983**.
4. J. Arrillage, 'HVDC et.al Computer Modelling of Electrical Power System', John Wiley, **1993**.
5. S. Rao, 'EHV-AC and Transmission Engineering Practice', Khanna Publishers, **1990**.

6. Related IEEE/IEE Publications.

POWER SYSTEM COMMUNICATION

Subject Code: MELE3-161 **L T P C** **Duration: 40 Hrs.**
4 0 0 4

UNIT I

1. Introduction (10 Hrs.)
Communication links required in telemetry, tele-control and tele protection.

UNIT 2

2. Analog and digital communication (10 Hrs.)
SPEd and banding requirements, Noise in power systems.

UNIT 3

3. Communication Links (10 Hrs.)
PLCC, Microwave, Telephone line, Satellite, Fiber optic, Requirements of' various communication equipment used in power systems

UNIT 4

4. Computer Networking (10 Hrs.)
Computer networking in power systems

RECOMMENDED BOOKS:

1. William Stallings, 'Data and Computer Communication', PHI, **1994**.
2. John Gowar, 'Optical Communications Systems', PHI, **1993**.
3. R.E. Collin, 'Foundations of Microwave Engineering'.
4. Theodore S. Rappaport, 'Wireless Communication, Principles and Practice', IEEE Press, PTR, **1996.**
5. K. Feher, 'Wireless Digital Communications', PHI, **1995**.
6. Related IEEE /IEE Publications.
7. Tanenbaum, 'Computer Network'.

SMART GRID TECHNOLOGIES

Subject Code: MELE3-162 **L T P C** **Duration: 40 Hrs.**
4 0 0 4

UNIT I

1. Introduction to Smart Grid (10 Hrs.)
Evolution of Electric Grid, Concept of Smart Grid, Definitions, Need of Smart Grid, Functions of Smart Grid, Opportunities & Barriers of Smart Grid, Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid, Present development & International policies in Smart Grid. Case study of Smart Grid. CDM opportunities in Smart Grid

UNIT 2

2. Smart Grid Technologies (10 Hrs.)
Part 1: Introduction to Smart Meters, Real Time Pricing, Smart Appliances, Automatic Meter Reading (AMR), Outage Management System (OMS), Plug in Hybrid Electric Vehicles (PHEV), Vehicle to Grid, Smart Sensors, Home & Building Automation, Phase Shifting Transformers.
Part 2: Smart Substations, Substation Automation, Feeder Automation. Geographic Information System(GIS), Intelligent Electronic Devices (IED) & their application for monitoring & protection, Smart storage like Battery, SMES, Pumped Hydro, Compressed Air Energy Storage, Wide Area Measurement System (WAMS), Phase Measurement Unit (PMU).

UNIT 3

3. Micro grids and Distributed Energy Resources (10 Hrs.)

Concept of micro grid, need & applications of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid. Plastic & Organic solar cells, Thin film solar cells, Variable speed wind generators, fuel cells, micro turbines, Captive power plants, Integration of renewable energy sources

UNIT 4

4. Power Quality Management in Smart Grid (10 Hrs.)

Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.

5. Information and Communication Technology for Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network (NAN), Wide Area Network (WAN). Bluetooth, Zig-Bee, GPS, Wi-Fi, Wi-Max based communication, Wireless Mesh Network, Basics of CLOUD Computing & Cyber Security for Smart Grid. Broadband over Power line (BPL). IP based protocols.

RECOMMENDED BOOKS:

1. Ali Keyhani, Mohammad N. Marwali, Min Dai, 'Integration of Green and Renewable Energy in Electric Power Systems', Wiley.
2. Clark W. Gellings, 'The Smart Grid: Enabling Energy Efficiency and Demand Response', CRC Press Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu.
3. Akihiko Yokoyama, 'Smart Grid: Technology and Applications', Wiley.
4. Jean Claude Sabonnadière, Nouredine Hadjsaïd, 'Smart Grids', Wiley Blackwell.

DISCRETE TIME CONTROL SYSTEMS

Subject Code: MELE3-163 | **L T P C 4 0 0 4** | **Duration: 40 Hrs.**

UNIT I

1. Introduction (10 Hrs.)

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

2. Stability Methods (10 Hrs.)

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

UNIT III

3. Models of Digital Control Systems (10 Hrs.)

Digital temperature control System, Digital position control system, stepping motors and their control. Design of Digital compensator using frequency response plots.

UNIT IV

4. State Variable Analysis (10 Hrs.)

Digital Control Systems, 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 & M. Gopal, 'Control System Engg.', John Wiley & Sons.
5. K.K. Aggarwal, 'Control System Analysis and Design', Khanna Publishers.

POWER SYSTEM PLANNING

Subject Code: MELE3-205 | **L T P C 4 0 0 4** | **Duration: 48 Hrs.**

Course Objectives:

1. To acquire skills in planning and building reliable power system.

Course Outcomes:

1. The scope of employability in power utilities will increase.
2. The management skills required in the field of power system engineering is enhanced.

Unit-1

Introduction: power system planning, objective, stages in planning and design, the electric utility industry, growth characteristics generation, transmission and distribution systems.

Demand/energy forecasting: electricity consumption pattern, peak demand and energy forecasting by trend and economic projection methods. Review of load forecasting.

Unit-2

Power System Planning: Investment planning: traditional generation expansion planning models, integrated resource planning models, production cost simulation models.

Generating System Capability Planning: probabilistic models of generating units, growth rate, rate of generation capacity, outage performance and system evaluation of loss of load and loss of energy indices, power supply availability assessment. Expansion planning, unit maintenance schedule, unit effective load carrying capability.

Transmission System Planning: automatic transmission system expansion planning, automatic transmission planning using interactive graphics.

Unit-3

Distribution System Planning and Automation: load characteristics, design of sub transmission lines and distribution, substations, design considerations of' primary and secondary distribution systems, voltage drop and power loss calculations.

Interconnected Systems: multi-area reliability analysis, power pool operation and power exchange energy contracts, quantification of economic and reliability benefits of pool operation.

Unit-4

Power system Expansion Planning: formulation of least cost optimization problem involving capital, operation and maintenance costs of candidate units of different types.

RECOMMENDED BOOKS

1. Y. Wallach, 'Power System Planning', McGraw Hill International.
2. P. Sullivan, 'Power System Planning', McGraw Hill International.
3. S. Dasari, 'Electric Power System Planning', IBT Publishers, New Delhi.
4. R. Billinton, 'Power System Reliability Calculation', MIT Press, USA.
5. Endreyni, 'Reliability Modeling in Electric Power System', John Wiley, New York.
6. J.R. McDonald, 'Modern Power System Planning', McGraw Hill International.
7. A.S. Pabla, 'Electrical Power System Planning', Macmillan, **1998**.

ADVANCED POWER SYSTEM PROTECTION

Subject Code: MELE3-206 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Course Objectives:

1. To facilitate the students, understand the basic concepts and recent trends in power system protection.
2. To enable the students design and work with the concepts of digital and numerical relaying.

Course Outcomes:

On completion of the course the students would be skilled enough to work with various type of schemes used for different apparatus protection.

Unit-1

Fundamentals: Types of relays, their classifications and theory Phase and amplitude comparators. Static Comparators Computer Applications to protective relaying.

Circuit Breakers: Physical stress in circuit breakers, Vacuum circuit breakers, SF6 Circuit Breakers Direct current C.B.'s, Short circuit testing of circuit breakers. Comparison of different types of circuit breakers.

Unit-2

Transmission Line Protection: Carrier Current Protection. Applications of microwave Channels for protective relaying, Selection of suitable static relaying scheme for transmission line protection. Performance specifications of distance relays, effect of fault resistance and effects of power swings on operation of relays and Distance relay settings.

Unit-3

Generators and Transformers Protection: CT's and PTs burden and accuracy and their connections. Protection of rotor winding. Miscellaneous protection schemes for generators and transformers, Over fluxing protection of transformers.

Unit-4

Differential Relays: Operating Characteristics, Restraining Characteristics, Analysis of Electromagnetic and differential Static relays schemes.

Bus Zone Protection: Types of bus bar faults, Protection requirements, protection schemes and modern trend in bus-bar protection.

RECOMMENDED BOOKS:

1. T.S. Madhava Rao, 'Power System Protection (Static Relays)', Tata McGraw-Hill, **1989**.
2. A.R. Van C. Warrington, 'Protective Relays', Chapman and Hall London, **1968**.
3. S.K. Basu and S. Chaudhary, 'Power System Protection', Raju Primlan Oxford and IBH Press, **1983**.
4. Ravindra Nalh M. Chander, 'Power System Protection and Switch Gear', John Wiley Eastern, **1989**.
5. Sunil S. Rao, 'Power System Protection and Switch Gear', Khanna Publishers, **1989**.
6. Related IEEE/IEE Publications.

POWER SYSTEM DYNAMICS & STABILITY

Subject: MELE3-207 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

Course Objectives:

1. To know the elementary mathematical model and system response to small disturbances.
2. To impart the concepts of transient stability.
3. To impart knowledge on voltage stability.

Course Outcomes:

After Completion of this course students will be able to

1. Solve mathematical calculations and swing equation and obtain classical model of an infinite bus system.
2. Analyse the effect of small speed changes in multi machine synchronous machines and voltage regulator governor system.
3. Understand the transient stability analysis under common disturbances including the short circuits and find clearing time to solution for swing equation by step by step method.

Unit-1

OVERVIEW: Angular Stability, Transient stability, steady state stability, dynamic stability, Small Signal, Voltage Stability.

TRANSIENT STABILITY ANALYSIS: Single Machine - Infinite Bus System, Equal Area Criterion, Multi-machine Stability, Network Reduction and Numerical Integration Methods, Methods of Improvement.

Unit-2

SMALL SIGNAL STABILITY ANALYSIS: Eigen Value and Participation Factor Analysis; Single machine -Infinite Bus and Multi-Machine Simulation; Effect of Excitation System and AVR, improvement of Damping, Power System Stabilizer and Static VAR System (SVS) supplementary controls.

Unit-3

SUB SYNCHRONOUS OSCILLATIONS: Sub Synchronous Resonance (SSR) Phenomenon, Counter measures to SSR problems.

Unit-4

VOLTAGE STABILITY: PV and QV curves, Impact of Load and Tap changer Dynamics; Static Analysis, Sensitivity and Continuation Methods; Dynamic Simulation, Introduction to Bifurcation Analysis; Proximity Indices, Methods to enhance Stability Margin.

RECOMMENDED BOOKS:

1. P. Kundur, 'Power System Stability and Control', McGraw Hill.
2. C.W. Taylor, 'Power System Voltage Stability', McGraw Hill.
3. P.M. Anderson and A.A. Foud, 'Power System Control and Stability', IEEE Press.
4. E. Kimbark, 'Power System Stability', Vol. I, II & III, IEEE Press.

SIMULATION LAB.

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

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 RELIABILITY

Subject Code: MELE3-264/MELE1-374 L T P C Duration: 48 Hrs.
4 0 0 4

Course Objectives:
To develop an understanding of power system reliability evaluation by using deterministic and probabilistic techniques.

Course Outcomes
Upon successful completion of this course, a student will be able to:
1. Understand the application of basic probability theory and distribution to power system
2. Identify the main subsystems of a power system and their constituent components
3. To produce mathematical models for generator, transmission line and load
4. Apply techniques for reliability evaluation of individual systems
5. Apply techniques for reliability evaluation of composite systems

Unit-1

BASIC RELIABILITY CONCEPTS: The General reliability function, Hazard rate, MTTF, Markov processes.
STATIC GENERATING CAPACITY RELIABILITY EVALUATION: Capacity outage probability tables, loss of load probability method, Frequency and duration approach.

Unit-2

SPINNING GENERATION CAPACITY RELIABILITY EVALUATION: Spinning reserve, spinning reserve capacity evaluation, Load forecasting methods, Load forecast uncertainty, maximum capacity levels, Derated capacity levels.

Unit-3

TRANSMISSION SYSTEM RELIABILITY EVALUATION: Average interruption rate method, Frequency and duration method, Stormy and normal weather effects, The Markov process approach.

Unit-4

COMPOSITE SYSTEM RELIABILITY EVALUATION: Conditional probability approach, two–plant single load system, multi plant multi load system

RECOMMENDED BOOKS:
1. R. Billinton, ‘Power System Reliability Calculation’, MIT Press, USA.
2. Endreyni, ‘Reliability Modelling in Electric Power System’, John Wiley, New York.

CUSTOMIZED POWER DEVICES

Subject Code: MELE3-265/MELE1-265 L T P C Duration: 48 Hrs.
4 0 0 4

Course Objectives:
1. To study advances in rapid development of Power systems.

Course Outcomes
1. Upon successful completion of this course, students will be able to select suitable advanced power system for the enhancement of power transfer capability and to control the power flow in an efficient manner.

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 Unity Displacement Factor Frequency Charger (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 multi-pulse 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**.

ARTIFICIAL INTELLIGENT TECHNIQUES

MELE3-267/MELE1-267 | **L T P C 4 0 0 4** | **Duration: 48 Hrs.**

Course Objectives:

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

Course Outcomes:

1. The students acquire the skills required to innovate and build, smart and intelligent applications in electrical and electronics engineering.
2. 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.
3. They will be able to take up fuzzy systems approach to solve applications in engineering.

UNIT I

NEURAL NETWORKS (9 hours)

Neural Networks – biological neurons – Artificial neurons – activation function – Course rules – feed forward networks – supervised & Unsupervised Course –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**.

DISTRIBUTION SYSTEM OPERATION AND ANALYSIS

Subject Code: MELE3-369/ MELE1-375 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

UNIT-I

1. System Planning: Introduction, Distribution system planning, Factors affecting system planning, present planning techniques, planning models, Introduction to optimum line network. future trends in planning, systems approach, distribution automation. Load Characteristic: Basic definitions, relation between load and loss factors, maximum diversified demand, load forecasting, Load management.

UNIT-II

2. System Design and Operation: Criteria, system developers, dispersed generation, distribution systems, economics and finance, mapping, Design of substation and feeder, Operation criteria, voltage measurements, harmonics, load variations, system losses, Introduction to energy management.

UNIT-III

3. Voltage Regulation and Automation: Quality of Service and Voltage Standards, Voltage Control, Line Drop Compensation, Distribution capacitor automation, Voltage fluctuations, SCADA and Communication with Load Dispatch Centres.

UNIT-IV

4. Distribution System Protection: Objective of distribution system protection, high impedance faults coordination of protective devices: fuse to fuse co-ordination, re-closer to re-closer coordination, re-closer to fuse coordination, re-closer to substation transformer high side fuse coordination, fuse to circuit breaker coordination, re-closer to circuit breaker coordination, lightning protection.

RECOMMENDED BOOKS:

1. Gonen, Turan, 'Electric Power Distribution System Engineering', CRC PRESS, Third Indian Reprint, **2012**.
2. A.S. Pabla, 'Electric Power Distribution', 6^{th} Edn., TMH, **2011**.
3. 'Electric Power Distribution Handbook' Thomas Allen Short.

DIGITAL SIGNAL PROCESSING AND APPLICATIONS

Subject Code: MELE3-370/ MELE1-161 L T P C Duration: 48 Hrs.
4 0 0 4

UNIT-I

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-II

2. Z Transform: (6 Hrs.) Introduction, Z-Transform, Region of convergence; Inverse Z Transform methods, properties of Z transform.

UNIT-III

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-IV

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, John R. Back, 'Discrete-Time Signal Processing', 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', Johny R. Johnson 1^{st} Edn., Prentice Hall, **2006**.

ENGINEERING OPTIMIZATION

Subject Code: MELE3-371/ MELE0-F94 MELE1-371 **L T P C 4 0 0 4** **Duration: 48 Hrs.**

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

Course Outcomes:
1. After Course the techniques, they can apply to engineering and other problems.
2. They can get skills to optimize the variety of programming.

UNIT I

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

UNIT II

Linear Programming (LP) and Non Linear Programming (NLP): Simplex method of solving LP, revised simplex method, duality, Constrained Optimization, Theorems and procedure, linear programming, mathematical model, solution technique, duality. Steepest descent method, Conjugate gradient method, Newton 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 (GA): Introduction to Genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between GA and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded GA, Advanced GA, global optimization using GA, Applications to power system.

RECOMMENDED BOOKS:

1. D.A. Pierre, 'Optimization Theory with applications', Wiley Publications.
2. H.A. Taha, 'Operations Research: An Introduction', 7th Edn., Pearson Education Edition, Asia, Delhi.
3. S.S. Rao, 'Optimization –Theory and Applications', Wiley-Eastern Limited.
4. D.P. Kothari & J.S. Dhillon, 'Power System Optimization', PHI Publishers.
5. Donald E. Kirk, 'Optimal Control Theory', Dover Publications, New York.
6. 'Optimization for Engineering Design: Algorithms and Examples', Kalyanmoy Deb, PHI Publishers.

POWER SYSTEM HARMONICS

Subject Code: MELE3-372 **L T P C 4 0 0 4** **Duration: 48 Hrs.**

UNIT-I

Harmonic Analysis: Representation of harmonics, Fourier series and Coefficients, odd-even and half wave symmetry, phase sequence, voltage and current harmonic distortion, active and reactive power, apparent power, distortion power, power factor, current and voltage crest factors, Power in passive elements: power in a pure resistance, power in a pure inductance and power in a pure capacitance, Series and parallel resonance.

UNIT-II

Harmonic Sources: Types of harmonic sources, Harmonics in transformers, normal excitation characteristics, determination of current wave shape in transformers, inrush current in transformers. Harmonic in rotating machines: m.m.f. distribution of ac windings, slot harmonics, voltage harmonics produced by synchronous machines, rotor saliency effects, voltage harmonics produced by induction motors, Distortion caused by arcing devices: Electric arc furnaces and discharge type lighting. Distortion caused by dc power supplies.

UNIT-III

Effects of Harmonic Distortion in Power Systems: Thermal losses in harmonic environment: Copper losses, iron losses, dielectric losses, Harmonic amplification in capacitor banks, Effects of harmonics in transformers. Effects of harmonics in rotating machines: induced e.m.f, chorded windings, distributed winding, winding factor. Harmonic interference with power system protection: harmonic problems during fault conditions, Effects of harmonics on consumer equipment, Interference with Communications.

UNIT-IV

Limits of Harmonic Distortion: Voltage harmonic distortion limits: IEEE limits, IEC limits EN limits and NORSOK limit. Current harmonic distortion limits: IEEE limits IEC limits and NORSOK limits, Tuned filters and damped filters Active filters: Series and parallel connection of active filters Role of power converters, transformers, rotating machines and capacitor banks in reduction of harmonics. Harmonic filter design: Series tuned filters and second order damped filters.

RECOMMENDED BOOKS:

1. J. Arrillaga and N. R. Watson, 'Power System Harmonics', Wiley.
2. George J. Wakileh, 'Power Systems Harmonics', Springer.

ELECTIVE-V: SYSTEM MODELING AND OPTIMIZATION

Subject Code: MELE3- 373 | **L T P C 4 0 0 4** | **Duration: 48 Hrs.**

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, Sparsity and Optimal ordering.

UNIT-II

Power Flow Analysis: Review of power flow problem, power flow analysis methods, power flow using Newton Raphson method, power flow for unbalanced system.

Optimal Power Flow: Significance of optimal power flow (OPF), formulation of OPF problems, solution using Gradient based methods.

UNIT-III

Short Circuit Studies: Review of symmetrical components, sequence impedances and networks for power system components, Fault analysis of balanced and unbalanced faults in small and large system, Estimation of short circuit capacity of breakers.

UNIT-IV

Power System Security: Introduction to power system contingencies, Factors affecting security, Contingency analysis, Network sensitivity using DC and AC load flow methods, correcting the generation dispatch.

RECOMMENDED BOOKS:

1. J.D. Grainger, 'Power System Analysis', Tata McGraw Hill Publishing Company.
2. C.L. Kusic, 'Computer Aided Power System Analysis', Tata McGraw Hill Publishing Company.

3. 3 M.A. Pai, 'Computer Techniques in Power System Analysis', TMH Publishing Company.
4. G.W. Stagg and A.H. Elabiad, 'Computer Methods in Power System Analysis', McGraw Hill.
5. P.M. Anderson, 'Analysis of Faulted Power System', IOWA State University Press, New York.
6. D.P. Kothari & J.S. Dhillon, 'Power System Optimization', PHI Publishers.

EMBEDDED SYSTEMS

Subject Code: MELE3-374 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

UNIT-I

Digital Electronics: Microprocessors & Microcontrollers, Computer Architecture. MSP 430 Microcontroller – Functional block diagram – memory – Interrupts and Resets – Input/ Output units – Instruction set – Addressing modes – Constant generator and Emulated Instructions. MSP 430 Timers – on-chip data conversion systems – ADC and DAC – on-chip communication peripherals – SPI, I2C, UART – Programming concepts.

UNIT-II

ARM7TDMI – architecture overview - processor modes – data types – Registers – program status registers – Simple programs.

UNIT-III

Introduction to Design of Systems on a chip – Core architectures for Digital media and compilation techniques – Microsystems technology and applications – Hardware/ software co-design concepts.

UNIT-IV

Multi-core System-on-Chip (McSoC) design – Application specific McSoC design – QueueCore Architecture – Synthesis and evaluation results – Reconfigurable multi-core architectures.

RECOMMENDED BOOKS:

1. John H. Davies, 'MSP 430 Microcontroller Basics', Elsevier Ltd., **2008**.
2. William Hohl, 'ARM Assembly Language, Fundamentals and Techniques', CRC Press, **2009**.
3. Abderazek Ben Abdallah, 'Multi-core systems on-Chip: Practical Software and Hardware Design', Atlantis Press, **2010**.
4. Ricardo Reis, Marcelo Lubaszewski, Jochen A.G. Jess, 'Design of Systems on a Chip: Design and Test', Springer, **2006**.

WIND ENERGY AND SMALL HYDRO POWER STATION

Subject Code: MELE3-375/MELE1-159 **L T P C** **Duration: 48 Hrs.**
4 0 0 4

UNIT-I

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-II

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-III

3. Tariffs (8 Hrs.)
Study of load management and tariff scheme, distribution and marketing issues related to power generation.

UNIT-IV

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. Martin O.L. Hansen, ‘Aerodynamics of Wind Turbines’, Earthscan, **2008**.
3. ‘Wind Turbine Control Systems- Principles, Modelling and Gain Scheduling Design’, Fernando D. Bianchi, Hernan De Battista and Ricardo J. Mantz, 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**.

PROJECT

Subject Code: MELE3-309/ MELE1-309/ MELE2-309 **L T P C**

Course Objective:

1. To propose engineering based project in a clear and concise manner.
2. Allow students to develop problem solving, analysis, synthesis and evaluation skills.

Course Outcomes:

1. Synthesis of knowledge.
2. To demonstrate the aptitude of applying the own knowledge to solve a specific problem.
3. To mature the knowledge.
4. Able to organize, compile and record all work details in an efficient manner

Each student will be required to complete a Project and submit a Project Report on a topic on any of the areas of modern technology related to Electrical Engineering including interdisciplinary fields. The project will carry 10 credits. Its evaluation will be done as under:

Internal Marks		External Marks	
1. Formulation of Problem	10	Implementation	10
2. Design	10	Result & Analysis	10
3. Implementation	20	Report	10
4. Testing & Analysis	10	Viva-Voce	10
5. Report	10	----	---
Total Marks	60	**Total Marks**	40

SEMINAR

Subject Code: MELE3-310/ MELE1-310/ MELE2-310 **L T P C**
0 0 4 2

Course Objectives:

1. To identify, understand and discuss current advanced research topic.
2. To gain experience in the critical assessment of the available scientific literature

3. To practice the use of various resources to locate and extract information using offline & online tools, journals

Course Outcomes:

1. An ability to utilize technical resources
2. An ability to write technical documents and give oral presentations related to the work completed.
3. To learn preparation and presentation of scientific papers in an exhaustive manner

Each student will be required to prepare a Seminar Report and present a Seminar on a topic in any of the areas of modern technology related to Electrical Engineering including interdisciplinary fields.

Seminar will carry 4 credits. It will be done on any topic within/outside the curriculum. Its evaluation will be done as under:

Sr. No.	Parameters for Evaluation	Internal Marks	External Marks
1	Depth & Coverage of Topic	40	-
2	PPT Presentation & Report	20	-
3	Presentation	20	-
4	Questions & Answers	20	-
Total		**100**	**-**

RESEARCH LAB.

Subject Code: MELE3-311/ MELE1-311/ MELE2-311 **L T P C**
0 0 4 2

Students will be made familiar with one or more available softwares like MATLAB, ETAP, GAMS, Power System Toolbox, Power world Simulator, Network Simulator, LABVIEW, etc. so that students can use any one or more of them for their dissertation. Students will be advised to go through maximum research papers and conclude a particular domain to work further.

DISSERTATION

Subject Code: MELE3-412/ MELE1-412/ MELE2-412 **L T P C**

Course Objectives: To learn, practice, and critique effective scientific writing and to formulate the research objectives clearly, state claims and evidence clearly, assess validity of claims, evidence, outcomes, and results.

Course Outcomes:

1. Design and execute a meaningful research project that demonstrates spatial thinking and uses the knowledge and skills.
2. Define and analyse a problem in latest research areas.
3. Formulate and write a research proposal.
4. Able to learn effectively record data and experiments so that others can understand them.
5. Communicate the findings by means of a thesis, written in the format specified by the department/institute.

Each student will be required to complete a Dissertation and submit a written Report on the topic on any of the areas of modern technology related to Electrical Engineering including interdisciplinary fields in the Final semester of M.Tech. Course.

The Dissertation will carry 24 credits and will be evaluated as under:

Dissertation will be evaluated as under:

Sr. No.	Parameters for Evaluation	Internal Marks	External Marks
1	Originality	12	08
2	Presentation	12	08
3	Contents & Volume of work	18	12
4	Discussion (Contribution of candidate)	18	12
Total		**60**	**40**