1st Semester		Contact Hrs.			Marks			Credits
Code	**Course**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MELEE1-101	Power System Analysis	3	0	0	40	60	100	3
MELEE1-102	Power System Dynamics-I	3	0	0	40	60	100	3
MRMIP-101	Research Methodology and IPR	2	0	0	40	60	100	2
MELEE1-103	Power System (Power System Steady State Analysis) Lab-I.	0	0	4	60	40	100	2
MELEE1-104	Power System (Renewable Energy) Lab-II.	0	0	4	60	40	100	2
Departmental Elective-I		3	0	0	40	60	100	3
MELEE1-156	Renewable Energy System and Distributed Generation							
MELEE1-157	Smart Grids							
MELEE1-158	High Power Converters							
MELEE1-159	Wind and Solar Systems							
Departmental Elective-II		3	0	0	40	60	100	3
MELEE1-160	Electrical Power Distribution System							
MELEE1-161	Optimization Techniques for Power Engineering							
MELEE1-162	Pulse Width Modulation for PE Converters							
MELEE1-163	Electric and Hybrid Vehicles							
Audit Course (Choose any one)		2	0	0	100	0	100	0
MHUMA0-101	English For Research Paper Writing							
MCIVE0-101	Disaster Management							
MHUMA0-102	Sanskrit for Technical Knowledge							
MHUMA0-103	Value Education							
MHUMA0-104	Constitution of India							
MHUMA0-105	Pedagogy Studies							
MHUMA0-106	Stress Management by Yoga							
MHUMA0-107	Personality Development through Life Enlightenment Skills							
Total		**16**	**0**	**8**	**420**	**380**	**800**	**18**

2nd Semester		Contact Hrs.			Marks			Credits
Code	**Course**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MELEE1-205	Digital Protection of Power System	3	0	0	40	60	100	3
MELEE1-206	Power System Dynamics-II	3	0	0	40	60	100	3
MELEE1-207	Power System Lab.-III (Power System Protection Lab.)	0	0	4	60	40	100	2
Lab.-IV (Choose any one)		0	0	4	60	40	100	2
MELEE1-208	Artificial Intelligence Lab.							
MELEE1-209	Smart Grid Lab.							
MELEE1-210	Mini Project	0	0	4	60	40	100	2
Departmental Elective-III		3	0	0	40	60	100	3
MELEE1-264	Restructured Power Systems							
MELEE1-265	Advanced Digital Signal Processing							
MELEE1-266	Dynamics of Electrical Machines							
MELEE1-267	Electrical Machine Design							
Departmental Elective-IV		3	0	0	40	60	100	3
MELEE1-268	Advanced Micro-Controller Based Systems							
MELEE1-269	SCADA System and Applications							
MELEE1-270	Power Quality							
MELEE1-271	Artificial Intelligence Techniques							
Audit Course (Choose any one)		2	0	0	100	0	100	0
MHUMA0-101	English For Research Paper Writing							
MCIVE0-101	Disaster Management							
MHUMA0-102	Sanskrit for Technical Knowledge							
MHUMA0-103	Value Education							
MHUMA0-104	Constitution of India							
MHUMA0-105	Pedagogy Studies							
MHUMA0-106	Stress Management by Yoga							
MHUMA0-107	Personality Development through Life Enlightenment Skills							
Total		**14**	**0**	**12**	**440**	**360**	**800**	**18**

Note: Choose any one Audit Course in the table for 2nd semester except the one chosen in 1st semester.

3rd Semester		Contact Hrs.			Marks			Credits
Code	**Course**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MELEE1-311	Major Project (Phase-I) Dissertation	0	0	20	60	40	100	10
Departmental Elective-V		3	0	0	40	60	100	3
MELEE1-372	Power System Transients							
MELEE1-373	FACTS and Custom Power Devices							
MELEE1-374	Industrial Load Modeling and Control							
MELEE1-375	Dynamics Of Linear Systems							
Open Elective		3	0	0	40	60	100	3
MELEE1-391	Business Analytics							
MELEE1-392	Industrial Safety							
MELEE1-393	Operations Research							
MELEE1-394	Cost Management of Engineering Projects							
MELEE1-395	Composite Materials							
MELEE1-396	Waste to Energy							
Total		**6**	**0**	**20**	**80**	**160**	**300**	**16**

4th Semester		Contact Hrs.			Marks			Credits
Code	**Course**	**L**	**T**	**P**	**Int.**	**Ext.**	**Total**	
MELEE1-412	Major Project (Phase-II) Dissertation	0	0	32	60	40	100	16
Total		**0**	**0**	**32**	**60**	**40**	**100**	**16**

Programme Outcomes of Power Systems Stream:

PO1: Ability to apply the enhanced knowledge in advanced technologies for modeling, analyzing and solving contemporary issues in power sector with a global perspective.
PO2: Ability to critically analyze and carry out detailed investigation on multifaceted complex Problems in area of Power Systems and envisage advanced research in thrust areas.
PO3: Ability to identify, analyze and solve real-life engineering problems in the area of Power Systems and provide strategic solutions satisfying the safety, cultural, societal and environmental aspects/ needs.
PO4: Ability for continued pursuance of research and to design, develop and propose theoretical and practical methodologies towards research and development support for the Power System infrastructure.
PO5: Ability to develop and utilize modern tools for modeling, analyzing and solving various Engineering problems related to Power Systems.
PO6: Willingness and ability to work in a team of engineers/ researchers with mutual understandings to take unsophisticated challenges, in the field of Power Systems, lead and motivate the group to inculcate multi-disciplinary and collaborative approach.PO7 Willingness and ability to take up administrative challenges including the management of various projects of interdisciplinary nature and carry out the same in an efficient manner giving due consideration to societal, environmental, economic and financial factors.
PO8: Ability to express ideas clearly and communicate orally as well as in writing with others in an effective manner, adhering to various national and international standards and practices for the documentation and presentation of the contents.

POWER SYSTEM ANALYSIS

Subject Code: MELEE1-101 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:
1. Study various methods of load flow and their advantages and disadvantages.
2. Understand how to analyze various types of faults in power system.
3. Understand power system security concepts and study the methods to rank the contingencies.
4. Understand need of state estimation and study simple algorithms for state estimation.
5. Study voltage instability phenomenon.

UNIT-I (8 Hrs.)

Load Flow: Overview of Newton-Raphson, Gauss-Siedel, Fast decoupled methods, convergence properties, sparsity techniques, handling Q- max violations in constant matrix, inclusion of frequency effects. AVR in load flow, handling of discrete variables in load flow.

UNIT-II (8 Hrs.)

Fault Analysis: Simultaneous faults, open conductor faults. Generalized method of fault analysis.

UNIT-III (8 Hrs.)

Security Analysis: Security state diagram, contingency analysis, generator shift distribution factors, line outage distribution factor, multiple line outages, Overload index ranking.

UNIT-IV (8 Hrs.)

State Estimation: Sources of errors in measurement, Virtual and pseudo measurement, Observability, Tracking state estimation. WSL method, bad data correction.

UNIT-V (8 Hrs.)

Voltage Stability: Voltage collapse, P-V curve, optimal power flow solution, continuation power flow, voltage collapse proximity indices.

Recommended Books:

1. J.J. Grainger and W.D. Stevenson, 'Power System Analysis', McGraw Hill, **2003**.
2. R. Bergen and Vijay Vittal, 'Power System Analysis', Pearson, **2000**.
3. L.P. Singh, 'Advanced Power System Analysis and Dynamics', New Age International, **2006**.
4. G.L. Kusic, 'Computer aided Power System Analysis', Prentice Hall India, **1986**.
5. A.J. Wood, 'Power Generation, Operation and Control', John Wiley, **1994.**
6. P.M. Anderson, 'Faulted Power System Analysis', IEEE Press, **1995**.

Course Outcomes: Students will be able to:
1. Able to calculate voltage phasor at all buses, given the data using various methods of load flow.
2. Able to calculate fault currents in each phase.
3. Rank various contingencies according to their severity.
4. Estimate the bus voltage phasor given various quantities viz. power flow, voltages, taps, CB status etc.
5. Estimate closeness to voltage collapse and calculate PV curves using continuation power flow.

POWER SYSTEM DYNAMICS-I

Subject Code: MELEE1-102 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:
1. Study of system dynamics and its physical interpretation.
2. Development of mathematical models for synchronous machine.
3. Modelling of induction motor.

UNIT-I (10 Hrs.)

Synchronous Machines: Per unit systems, Park's Transformation (modified), Flux-linkage equations, power angle characteristics during steady state and transient state, Significance of SCR.

UNIT-II (8 Hrs.)

Voltage and current equations, torque equation, Formulation of State-space equations, Equivalent circuit.

UNIT-III (8 Hrs.)

Sub-transient and transient inductance and Time constants, Simplified models of synchronous machines, synchronous machine dynamics (Electromechanical transients).

UNIT-IV (8 Hrs.)

Small Signal Model: Introduction to frequency model, Excitation systems and Philips-Heffron model, Power System Stabilizer Load modeling.

UNIT-V (6 Hrs.)

Modeling of Induction Motors: Prime mover controllers, Induction motor dynamics during starting and breaking.

Recommended Books:

1. P.M. Anderson & A.A. Fouad, 'Power System Control and Stability', Galgotia, New Delhi, **1981.**
2. J. Machowski, J. Bialek and J.R.W. Bumby, 'Power System Dynamics and Stability', John Wiley & Sons, **1997.**
3. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc.,**1994**.
4. E.W. Kimbark, 'Power System Stability', Vol.-I & III, John Wiley & Sons, New York, **2002**.

Course Outcomes: Students will be able to:
1. Understand the modeling of synchronous machine in details.
2. Carry out simulation studies of power system dynamics using MATLAB-SIMULINK, MI POWER.
3. Carry out stability analysis with and without power system stabilizer (PSS).
4. Understand the load modelling in power system.

RESEARCH METHODOLOGY AND IPR

Subject Code: MRMIP0-101 **L T P C** **Duration: 28 Hrs.**
2 0 0 2

Course Objectives:
To learn the fundamentals of Operating Systems and gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols

Course Outcomes: At the end of this course, students will be able to:

CO1: Understand research problem formulation, analyze research related information, Follow research ethics

CO2: Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
CO3: Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
CO4: Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT-I (7 Hrs.)

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations.

UNIT-II (7 Hrs.)

Effective literature studies approaches, analysis Plagiarism, Research ethics, Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT-III (7 Hrs.)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. Introduction to international Scenario on Intellectual Property, Procedure for grants of patents, Patenting under PCT.

UNIT-IV (7 Hrs.)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases.
New Developments in IPR: Administration of Patent System. New developments in IPR: introduction to IPR of Biological Systems, Computer Software etc. Traditional Knowledge Case Studies, IPR or IITs.

Recommended Books:

1. Stuart Melville and Wayne Goddard, 'Research methodology: An Introduction for Science & Engineering Students'.
2. Wayne Goddard and Stuart Melville, 'Research Methodology: An Introduction'.
3. Ranjit Kumar, 2nd Edn., 'Research Methodology: A Step by Step Guide for Beginners'.
4. Halbert, 'Resisting Intellectual Property', Taylor & Francis Ltd., **2007**.
5. Mayall , 'Industrial Design', McGraw Hill, **1992**.
6. Niebel , 'Product Design', McGraw Hill, **1974**.
7. Asimov, 'Introduction to Design', Prentice Hall, **1962**.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, 'Intellectual Property in New Technological Age', **2016**.
9. T. Ramappa, 'Intellectual Property Rights Under WTO', S. Chand, **2008.**

POWER SYSTEM (POWER SYSTEM STEADY STATE ANALYSIS) LAB-I.

Subject Code: MELEE1-103 **L T P C**
0 0 4 2

LIST OF EXPERIMENTS

1. Simulation of IGBT Inverters.
2. Simulation of Thyristor Converters.
3. Transient Stability Studies.
4. Short Circuit Studies.

5. Load Flow and optimal load flow Studies.
6. Load Flow and optimal load flow Studies.
7. Simulation of automatic generation control.

POWER SYSTEM (RENEWABLE ENERGY) LAB-II.

Subject Code: MELEE1-104 **L T P C**
0 0 4 2

LIST OF EXPERIMENTS

1. Power Curves.
2. Build a Wind Farm.
3. Test the Capabilities of the Hydrogen Fuel Cells and Capacitors.
4. Effect of Temperature on Solar Panel Output.
5. Variables Affecting Solar Panel Output.
6. Effect of Load on Solar Panel Output.
7. Wind Turbine Output: The Effect of Load.
8. Test the Capabilities of Solar Panels and Wind Turbines.

RENEWABLE ENERGY SYSTEM & DISTRIBUTED GENERATION

Subject Code: MELEE1-156 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:
1. To learn various renewable energy sources.
2. To gain understanding of integrated operation of renewable energy sources.
3. To understand Power Electronics Interface with the Grid.
4. To understand about Distributed Generation.

UNIT-I (8 Hrs.)

Introduction to Renewable Energy Resources: Types, Advantages, Limitations & scope of renewable energy resources.
Solar Energy: Basic principles and energy conversion schemes.
Wind Energy: Introduction, Basic principles & energy conversion schemes, Major components, Electrical wind generators and their analysis.

UNIT-II (4 Hrs.)

Hydro Energy: Site selection, Types of power stations, Major components & their working.
Biomass Energy: Biogas generation, Types of biogas plants.

UNIT-III (8 Hrs.)

Tidal Energy: Basic principles of tidal energy, Tidal power generation systems.
Wave Energy: Wave energy conversion devices, Advantages and Disadvantages of wave energy.
Geothermal Energy: Origin and nature of geothermal energy; Classification of geothermal resources; Schematic of geothermal power plants.
Fuel Cells: Schematic of fuel cell, Characteristics, Working of different types of fuel cells.

UNIT-IV (10 Hrs.)

Distributed Generation: Introduction, Distributed v/s central station generation, Technologies of distributed generation as sources of energy such as Micro-turbines, Micro combined heat power, Rooftop solar PV, Solar and wind hybrid system, Impact of distributed generation on power grid reliability.

UNIT-V (10 Hrs.)

Distributed Generators: Introduction, Various types of distributed generators, such as, Permanent magnet generator, Self-excited Induction generators, Power Electronic Interface of distributed Generators with the Grid, Analysis of Effect of Distributed Generation on Transmission System Operation, Protection of Distributed Generators, Economics Issues of Distributed Generation, Case Studies on distributed generations for electric vehicle and energy storage integration.

Recommended Books:

1. D.P. Kothari, K.C. Singal and Ranjan Rakesh, 'Renewable Energy Sources and Emerging Technologies', 2nd Edn., Prentice Hall of India, **2011**.
2. Math H. Bollen, Fainan Hassan, 'Integration of Distributed Generation in the Power System', Wiley-IEEE Press, **2011**.
3. Loi Lei Lai, Tze Fun Chan, 'Distributed Generation: Induction and Permanent Magnet Generators', Wiley-IEEE Press, **2007**.
4. A. Roger, Messenger and Jerry Ventre, 'Photovoltaic System Engineering', 3rd Edn., **2010.**
5. James F. Manwell, Jon G. McGowan and Anthony L. Rogers, 'Wind Energy Explained: Theory Design and Application', 2nd Edn., John Wiley and Sons **2010**.

Course Outcomes: Students will be able to:

1. Know about various renewable energy sources.
2. Understand the working of distributed generation system in autonomous/grid connected modes.
3. Know the Impact of Distributed Generation on Power System.

SMART GRIDS

Subject Code: MELEE1-157 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:

1. Understand concept of Smart Grid and its Advantages over Conventional Grid.
2. Know Smart Metering Techniques.
3. Learn wide area measurement techniques.
4. Understanding the problems associated with integration of distributed generation & its solution through smart grid.

UNIT-I (7 Hrs.)

Introduction to Smart Grid: Evolution of Electric Grid, Concept of Smart Grid, Definitions and Necessity of Smart Grid, Concept of Robust & Self-Healing Grid, Present Development & International Policies in Smart Grid.

UNIT-II (7 Hrs.)

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, Smart Substations, Substation Automation, Feeder Automation.

UNIT-III (7 Hrs.)

Smart Grid Technologies: Geographic Information System(GIS), Intelligent Electronic Devices(IED) & their application for monitoring & protection, Smart storage like Battery, Superconducting Magnetic Energy Storage (SMES), Pumped Hydro, Compressed Air Energy Storage (CAES), Wide Area Measurement System(WAMS), Phase Measurement Unit (PMU).

UNIT-IV (7 Hrs.)

Micro-Grid: Concept, Necessity & Applications of Micro-Grid, Formation of Micro-Grid,

Issues of Interconnection, Operation, Control & Protection 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-V (6 Hrs.)

Power Quality: Electromagnetic Compatibility (EMC) of 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.

UNIT-VI (6 Hrs.)

Communications in Smart Grid: Advanced Metering Infrastructure (AMI), Home Area Network (HAN), Neighborhood Area Network, Communication through GPRS and Power Line Carrier Communication, Internet of Things (IoT) based Protocols.

Recommended Books:

1. Ali Keyhani, 'Design of Smart Power Grid Renewable Energy Systems', 2nd Edn., Wiley IEEE Press.
2. Clark W. Gellings, 'The Smart Grid: Enabling Energy Efficiency and Demand Response', CRC Press, **2009**.
3. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu and Nick Jenkins, 'Smart Grid: Technology and Applications', Wiley Online Library, **2012**.
4. Stuart Borlase, 'Smart Grid: Infrastructure, Technology and solutions', CRC Press.

Course Outcomes:

Students will be able to:

1. Appreciate the difference between Smart grid & Conventional grid.
2. Apply smart metering concepts to industrial and Commercial Installations.
3. Formulate solutions in the areas of smart substations, distributed generation and wide area measurements.
4. Come up with smart grid solutions using modern communication technologies.

HIGH POWER CONVERTERS

Subject Code: MELEE1-158 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:

1. Understand the requirements of high power rated converters.
2. Understand the different topologies involved for these converters.
3. Able to understand the design of protection circuits for these converters.

UNIT-I (8 Hrs.)

Power Electronic Systems: Power semiconductors devices and circuits, Characteristics and specification of switches, Phase shifting transformer.

Multi-Pulse Diode Rectifier: Multiphase star rectifier, three phase bridge rectifier, three phase bridge rectifier with RL load, three phase rectifier with a highly inductive load, Rectifier circuit design, output voltage with LC filter.

UNIT-II (6 Hrs.)

Multi-Pulse SCR Rectifier: Three-phase full converters with *RL* load, Twelve –pulse converters, Effect of load and source inductance.

UNIT-III (8 Hrs.)

Multilevel Inverters: Introduction, Multilevel concept, Types of multilevel inverters such as: diode clamped multilevel inverter, Flying-Capacitor multilevel inverter, Cascaded multilevel inverter, Applications, PWM current source inverters.

UNIT-IV (4 Hrs.)

DC-DC Converter: Introduction, performance parameter of DC-DC converters, Switching

mode regulators such as: Buck, Boost and Buck-Boost regulators.

UNIT-V (8 Hrs.)

AC Voltage Controllers: Introduction, performance parameters of AC voltage controllers, single phase full wave controller with resistive loads and inductive loads, three phase full wave controllers, three phase full wave delta connected controllers, Single phase and three phase Cyclo-converters, Matrix converter.

Un-interruptible Power Supply (UPS): Switched mode DC and AC power supplies.

UNIT-VI (6 Hrs.)

Protection of Devices and Circuits: Introduction, Cooling and heat sinks, Thermal modeling of power switching devices, Snubber circuit, Reverse recovery transients, supply and load side transients, Voltage protection by selenium diodes and metal oxide varistors, Current protections, fusing, fault current with AC & DC source.

Recommended Books:

1. N. Mohan, T.M. Undeland and W.P. Robbins, 'Power Electronics: Converter, Applications and Design', John Wiley and Sons, **1989.**
2. P.S. Bhimbra, 'Power Electronics', Khanna Publishers, **2012.**
3. M.H. Rashid, 'Power Electronics', Pearson/Prentice Hall, **2004.**
4. B.K. Bose, 'Power Electronics and A.C. Drives', Prentice Hall, **1986.**
5. Bin Wu, 'High Power Converters and Drives', IEEE Press, Wiley Interscience.

Course Outcomes: Students will be able to:

1. Learn the characteristics of PSDs such as SCRs, GTOs, IGBTs and use them in practical systems.
2. Knowledge of working of multi-level VSIs, DC-DC switched mode converters, Cyclo-converters and PWM techniques and the ability to use them properly.
3. Acquire knowledge of power conditioners and their applications.
4. Ability to design power circuit and protection circuit of PSDs and converters.

WIND AND SOLAR SYSTEMS

Subject Code: MELEE1-159 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:

1. To get exposure to wind and solar systems.
2. To understand the factors involved in installation and commissioning of a Solar or Wind plant.
3. Learning the dynamics involved when interconnected with power system grid.

UNIT-I (7 Hrs.)

Historical development and current status, characteristics of wind power generation, network integration issues.

UNIT-II (7 Hrs.)

Generators and power electronics for wind turbines, power quality standards for wind turbines, Technical regulations for interconnections of wind farm with power systems.

UNIT-III (7 Hrs.)

Isolated wind systems, reactive power and voltage control, Economic aspects.

UNIT-IV (7 Hrs.)

Impacts on power system dynamics, power system interconnection.

UNIT-V (6 Hrs.)

Introduction of solar systems, Merits and demerits, concentrators, various applications.

UNIT-VI (6 Hrs.)

Solar thermal power generation, PV power generation, Energy Storage device, Designing the

solar system for small installations.

Recommended Books:

1. Thomas Ackermann, Editor, 'Wind Power in Power Systems', John Willy and Sons Ltd, , **2005**.
2. Siegfried Heier, 'Grid Integration of Wind Energy Conversion Systems', John Willy and Sons Ltd., **2006**.
3. K. Sukhatme and S.P. Sukhatme, 'Solar Energy', Tata McGraw Hill, 2nd Edn., **1996.**

Course Outcomes: Students will be able to:

1. Appreciate the importance of energy growth of the power generation from the renewable energy sources and participate in solving these problems.
2. Demonstrate the knowledge of the physics of wind power and solar power generation and all associated issues so as to solve practical problems.
3. Demonstrate the knowledge of physics of solar power generation and the associated issues Identify, formulate and solve the problems of energy crises using wind and solar energy.

ELECTRIC POWER DISTRIBUTION SYSTEM

Subject Code: MELEE1-160 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:

1. Learning about power distribution system.
2. Learning of SCADA System.
3. Understanding Distribution Automation.

UNIT-I (8 Hrs.)

Distribution of Power, Management, Power Loads, Load Forecasting Short-term & Long-term, Power system loading, Technological forecasting.

UNIT-II (8 Hrs.)

Advantages of Distribution Management System (D.M.S.) Distribution Automation: Definition, Restoration/Reconfiguration of Distribution Network, Different Methods and Constraints, Power Factor Correction.

UNIT-III (8 Hrs.)

Interconnection of Distribution, Control & Communication Systems, Remote Metering, Smart meter and Automatic Meter Reading and its implementation.

UNIT-IV (8 Hrs.)

Calculation of Optimum Number of Switches, Capacitors, Optimum Switching Device Placement in Radial Distribution Systems, Sectionalizing Switches – Types, Benefits, Bellman's Optimality Principle, Remote Terminal Units, Energy efficiency in electrical distribution & Monitoring.

UNIT-V (8 Hrs.)

Maintenance of Automated Distribution Systems: Difficulties in Implementing Distribution, Automation in Actual Practice, Urban/Rural Distribution, Energy Management, introduction to AI techniques applied to Distribution Automation.

Recommended Books:

1. A.S. Pabla, 'Electric Power Distribution', 4th Edn., Tata McGraw Hill Publishing Co. Ltd.
2. M.K. Khedkar, G.M. Dhole, 'A Text Book of Electrical Power Distribution Automation', University Science Press, New Delhi.
3. Anthony J. Panseni, 'Electrical Distribution Engineering', CRC Press.
4. James Momoh, 'Electric Power Distribution, Automation, Protection & Control', CRC Press.

Course Outcomes: Students will be able to:
1. Understand of power distribution system.
2. Study of Distribution automation and its application in practice.
3. To learn SCADA system.

OPTIMIZATION TECHNIQUES FOR POWER ENGINEERING

Subject Code: MELEE1-161 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: -Students will be able to:
1. To understand the relevance of mathematical methods to solve engineering problems.
2. To understand how to apply these methods for a given engineering problem.

UNIT-I (4 Hrs.)

Introduction to Optimization: Statement of an optimization problem, Classification of optimization problems, Optimization techniques, Engineering applications of optimization, Single variable optimization, Multivariable optimization with no constraints.

UNIT-II (6 Hrs.)

Linear Programming: Standard form of linear programming, Simplex method, Computer implementation of the Simplex method, Duality theory.
Transportation Problem: North-West Corner rule, least cost method, Vogel approximation method, testing for optimality.

UNIT-III (7 Hrs.)

Non-Linear Programming: One–Dimensional Minimization Methods: Unimodal function, Dichotomous search, Fibonacci search, Golden Section, Cubic interpolation method, Direct root, Newton Raphson Method.

UNIT-IV (7 Hrs.)

Unconstrained Multivariable Optimization Techniques: Random search method, Steepest descent method, Conjugate gradient method, Newton Raphson Method, Evolutionary search, Hooke-Jeeves Method, Simplex search Method.

UNIT-V (8 Hrs.)

Constrained Optimization Techniques: Interior Penalty function method, Exterior penalty function method, Method of Multipliers, KKT Conditions.

UNIT-VI (8 Hrs.)

Further Topics in Optimization: Critical path method (CPM), Program evaluation and review technique (PERT). Multi-objective Optimization Techniques, Weighting method, ε-constraint method. Simulated annealing method, Genetic Algorithm, Particle swarm optimization.

Recommended Books:

1. S.S. Rao, 'Optimization: Theory and Application', Wiley Eastern Press, 2nd Edn., **1984**.
2. Deb Kalyanmoy, 'Optimisation for Engineering Design - Algorithms and Examples', Prentice Hall India, **1998.**
3. H.A. Taha, 'Operations Research - An Introduction', Prentice Hall of India, **2003**.
4. R.L. Fox, 'Optimization Methods for Engineering Design', Addition Welsey, **1971**.
5. A. Ravindran, K.M. Ragsdell and G.V. Reklaitis, 'Engineering Optimization: Methods and Applications', Wiley, **2008**.
6. Godfrey C. Onwubolu, B.V. Babu, 'New Optimization Techniques in Engineering', Springer, **2004**.
7. D.P. Kothari & J.S. Dhillon, 'Power System Optimization', Prentice-Hall of India, **2010**.

Course Outcomes: Students will be able to:
1. Knowledge about vector spaces, linear transformation, Eigen values and Eigen vectors of

linear operators.
2. To learn about linear programming problems and understanding the simple method for solving linear programming problems in various fields of science and technology.
3. Acquire knowledge about nonlinear programming and various techniques used for solving constrained and unconstrained nonlinear programming problems.
4. Understanding the concept of random variables, functions of random variable and their probability distribution.
5. Understand stochastic processes and their classification.

PULSE WIDTH MODULATION FOR POWER ELECTRONICS CONVERTERS

Subject Code: MELEE1-162 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Course Objectives: Students will be able to:
1. To understand Necessity and Importance of PWM techniques.
2. Implementation of PWM controllers.

UNIT-I (8 Hrs.)

Introduction to Power Electronics Converters:
Modulation of One Inverter Phase Leg: Fundamental concepts of PWM, Evaluation of PWM schemes, Naturally sampled PWM, PWM analysis by duty cycle variation, Regular sampled PWM, Direct modulation.
Modulation of Single-phase Voltage Source Inverter: Topology of a single phase inverter, Three level modulation of a single phase inverter, Harmonic losses.
Modulation of Three-phase Voltage Source Inverter: Topology of three phase inverter (VSI), Three phase modulation with sinusoidal references, harmonic losses, discontinues modulation.

UNIT-II (8 Hrs.)

Zero Space Vector Placement Modulation Strategies: Space vector modulation, Harmonic losses for SVM, Placement of the Zero space vector, Discontinuous modulation (120,60,30 degree), Harmonic losses for discontinuous PWM.
Modulation of Current Source Inverter: Three phase modulators as state machines, Naturally sampled CSI space vector modulator.

UNIT-III (8 Hrs.)

Over modulation of an Inverter: The over modulation region, naturally sampled and regularly sampled over modulation of one phase leg of an inverter, naturally sampled over modulation of single-phase and three-phase inverters.
Programmed Modulation Strategies: optimized space vector modulation, harmonic elimination PWM, Performance Index for optimality, Optimum PWM, Minimum loss PWM.

UNIT-IV (6 Hrs.)

Pulse Width Modulation for Multilevel Inverters: PWM of cascaded single phase H-bridges, over modulation of cascaded H bridges, PWM alternatives for diode-clamped multilevel inverters, three level naturally sampled PD PWM, over modulation of three level inverters, five level PWM for diode clamped inverters. PWM of higher level inverters.

UNIT-V (4 Hrs.)

Implementation of Modulation Controller: Overview of a power electronic conversion system, Elements of a PWM converter system, Hardware implementation of the PWM process, PWM software implementation.

UNIT-VI (6 Hrs.)

Continuing Developments in Modulation: Random PWM, PWM Rectifier with Voltage unbalance, Effect of minimum pulse width, PWM Dead-Time compensation.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Recommended Books:

1. D. Grahame Holmes, Thomas A. Lipo, 'Pulse width modulation of Power Converter: Principles and Practice', John Wiley & Sons, **2003.**
2. Bin Vew, 'High Power Converter', Wiley Publication.
3. Marian K. Kazimicrczuk, 'Pulse Width modulated dc-dc Power Converter', Wiley Publication.

Course Outcomes: Students will be able to:

1. Appreciate importance of PWM techniques.
2. Implement PWM using different strategies.
3. Control CSI and VSI using PWM.
4. Compare performance of converter for different PWM techniques.

ELECTRIC AND HYBRID VECHILES

Subject Code: MELEE1-163 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT-I (7 Hrs.)

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, Mathematical models to describe vehicle performance.

UNIT-II (7 Hrs.)

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT-III (7 Hrs.)

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives.

UNIT-IV (6 Hrs.)

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT-V (6 Hrs.)

Sizing the Drive System: Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology.

UNIT-VI (7 Hrs.)

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies.

Recommended Books:

1. Sira -Ramirez, R. Silva Ortigoza, 'Control Design Techniques in Power Electronics Devices', Springer.
2. Siew-Chong Tan, Yuk-Ming Lai, Chi Kong Tse, 'Sliding Mode Control of Switching Power Converters'.

Course Outcomes: Students will be able to:
1. Acquire knowledge about fundamental concepts, principles, analysis and design of hybrid and electric vehicles.
2. To learn electric drive in vehicles/traction.

ENGLISH FOR RESEARCH PAPER WRITING

Subject Code: MHUMA-101 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:
Students will be able to:
1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission.

UNIT-I

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

UNIT-II

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT-III

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Recommended Books:
1. R. Goldbort, 'Writing for Science', Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses, Vol.-I, **2006**.
2. R. Day, 'How to Write and Publish a Scientific Paper', Cambridge University Press, **2006**.
3. N. Highman, 'Handbook of Writing for the Mathematical Sciences', SIAM. Highman's Book, **1998**.
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg, London, **2011**.

DISASTER MANAGEMENT

Subject Code: MCIVE0-101 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:
Students will be able to:
1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

UNIT-I

Introduction Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT-II

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

UNIT-III

Disaster Preparedness and Management Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT-IV

Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

Recommended Books:

1. R. Nishith, A.K. Singh, 'Disaster Management in India: Perspectives, Issues and Strategies', New Royal Book Company, Model Curriculum of Engineering & Technology PG Courses, Vol.-I.
2. Sahni, Pardeep et. al.(Eds.), 'Disaster Mitigation Experiences and Reflections', Prentice Hall of India, New Delhi.
3. S.L. Goel, 'Disaster Administration and Management, Text and Case Studies', Deep & Deep Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE

Subject Code: MHUMA0-102 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4. Enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore the
6. Huge knowledge from ancient literature

Alphabets in Sanskrit, Past/Present/Future Tense
Simple Sentences
Order
Introduction of roots
Technical information about Sanskrit Literature
Technical concepts of Engineering-Electrical, Mechanical
Architecture, Mathematics

Recommended Books:

1. Vishwas, 'Abhyaspustakam', Samskrita-Bharti Publication, New Delhi.
2. 'Teach Yourself Sanskrit', Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi, Publication.
3. Suresh Soni, 'India's Glorious Scientific Tradition', Ocean Books Pvt. Ltd., New Delhi.

Course Outcomes:

Students will be able to
1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students.

VALUE EDUCATION

Subject Code: MHUMA0-103 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:

Students will be able to
1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

UNIT-I

Content Hours Values and self-development –Social values and individual attitudes.
Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

UNIT-II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism, Love for nature, Discipline.

UNIT-III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labor. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature.

UNIT-IV

Character and Competence –Holy books vs Blind faith, Self-management and Good health.
Science of reincarnation, Equality, Nonviolence, Humility, Role of Women.
All religions and same message, mind your Mind, Self-control, Honesty, Studying effectively.

Recommended Books:

1. S.K. Chakroborty, 'Values and Ethics for Organizations Theory and Practice', Oxford University Press, New Delhi.

Course Outcomes: Students will be able to
1. Knowledge of self-development.
2. Learn the importance of Human values.
3. Developing the overall personality.

CONSTITUTION OF INDIA

Subject Code: MHUMA0-104 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:
Students will be able to:
1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT-1

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working). Philosophy of the Indian Constitution: Preamble Salient Features

UNIT-II

Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III

Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT IV

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. **Pachayati Raj:** Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), **Village Level:** Role of Elected and Appointed officials, importance of grass root democracy
Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Recommended Books:
1. 'The Constitution of India', (Bare Act), Government Publication, **1950**.
2. S.N. Busi, B.R. Ambedkar, 'Framing of Indian Constitution', 1st Edn., **2015**.
3. M.P. Jain, 'Indian Constitution Law', 7th Edn., Lexis Nexis, **2014**.
4. D.D. Basu, 'Introduction to the Constitution of India', Lexis Nexis, **2015**.

Course Outcomes:
Students will be able to:
1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India. Discuss the

circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution. 4. Discuss the passage of the Hindu Code Bill of 1956.

PEDAGOGY STUDIES

Subject Code: MHUMA0-105 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:
Students will be able to:
1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

UNIT-I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.
Thematic overview: Pedagogical practices are being used by teachers in formal and informal, classrooms in developing countries. Curriculum, Teacher education.

UNIT-II

Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT-III

Professional Development: alignment with classroom practices and follow- up, support Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

UNIT IV

Research Gaps and Future Directions: Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.

Recommended Books:

1. J. Ackers, F. Hardman, 'Classroom Interaction in Kenyan Primary Schools, Compare', 31 (2): 245-261, **2001**.
2. M. Agrawal, 'Curricular Reform in Schools: The Importance of Evaluation, Journal of Curriculum Studies', 36 (3): 361-379, **2004**.
3. K. Akyeampong, 'Teacher Training in Ghana - Does it Count?', Multi-site Teacher Education Research Project (MUSTER) Country Report 1. London: DFID, **2003**.
4. K. Akyeampong, K. Lussier, J. Pryor, J. Westbrook, 'Improving Teaching and Learning of basic Maths and Reading in Africa: Does Teacher Preparation Count?', International Journal Educational Development, 33 (3): 272–282, **2013**.
5. R.J. Alexander, 'Culture and Pedagogy: International Comparisons in Primary Education, Oxford and Boston', Blackwell, **2001**.
6. M. Chavan, 'Read India: A Mass Scale, Rapid, 'Learning to Read' Campaign, **2003**.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Course Outcomes: Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

STRESS MANAGEMENT BY YOGA

Subject Code: MHUMA0-106 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

UNIT-I

Definitions of Eight parts of Yog. (Ashtanga)

UNIT-II

Yam and Niyam. Do`s and Don'ts in life:

a) Ahinsa, satya, astheya, bramhacharya and aparigraha
b) Shaucha, santosh, tapa, swadhyay, ishwar pranidhan

UNIT-III

Asan and Pranayam:

a) Various yog poses and their benefits for mind & body
b) Regularization of breathing techniques and its Effects-Types of pranayam

Recommended Books:

1. 'Yogic Asanas for Group Tarining', Part-I, Janardan Swami Yogabhyasi Mandal, Nagpur.
2. 'Rajayoga or Conquering the Internal Nature', Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata.

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency.

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Subject Code: MHUMA0-107 **L T P C** **Duration: 30 Hrs.**
2 0 0 0

Course Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

UNIT-I

Neetisatakam-Holistic development of personality Verses- 19, 20, 21, 22 (wisdom), Verses- 29, 31, 32 (pride & heroism) Verses- 26,28,63,65 (virtue), Verses- 52, 53, 59 (dont's), Verses- 71, 73, 75, 78 (do's)

UNIT-II

Approach to day to day work and duties.2 Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47, 48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5, 13, 17, 23, 35, Chapter 18-Verses 45, 46, 48

UNIT-III

Statements of basic knowledge.3 Shrimad Bhagwad Geeta: Chapter 2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18, Personality of Role model. Shrimad Bhagwad Geeta: Chapter 2-Verses 17, Chapter 3-Verses 36, 37, 42, Chapter 4-Verses 18, 38, 39, Chapter18 – Verses 37, 38, 63

Recommended Books:

1. 'Srimad Bhagavad Gita', Swami Swarupananda Advaita Ashram (Publication Department), Kolkata.
2. 'Bhartrihari's Three Satakam (Niti-sringar-vairagya)', P. Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

DIGITAL PROTECTION OF POWER SYSTEM

Subject Code: MELEE1-205 **L T P C** **Duration: 40 Hrs.**

3 0 0 3

UNIT-1 (6 Hrs.)

Evolution of digital relays from electromechanical relays**,** Performance and operational characteristics of digital protection**,** Recent Advances in Digital Protection of Power Systems.

UNIT-II (10 Hrs.)

Mathematical background to protection algorithms, Interpolation formulae, Forward, backward and central difference interpolation, Curve fitting and smoothing, Finite difference techniques, Numerical differentiation, Differential equation based algorithms, Sample and first derivative (Mann and Morrison) algorithm, least squares method and its algorithms.

UNIT-III (10 Hrs.)

Fourier analysis, Fourier series and Fourier transform, Fourier Algorithm: Full cycle window algorithm, fractional cycle window algorithm, Walsh function analysis and its algorithm, Sinusoidal wave based algorithms**,** Traveling Wave based Techniques.

UNIT-IV (14 Hrs.)

Basic elements of digital protection**,** Signal conditioning, transducers, surge protection, analog filtering, analog multiplexers**,**

Conversion subsystem: the sampling theorem, signal aliasing**,** Error, sample and hold circuits, multiplexers, analog to digital conversion**,** Digital filtering concepts

Digital relay as a unit consisting of hardware and software, Digital differential protection of Transformers, Digital Differential Protection of Lines.

Recommended Books:

1. A.G. Phadke and J.S. Thorp, 'Computer Relaying for Power Systems', Wiley/Research Studies Press, **2009.**
2. A.T. Johns and S.K. Salman, 'Digital Protection of Power Systems', IEEE Press, **1999.**
3. Gerhard Zeigler, 'Numerical Distance Protection', Siemens Publicis Corporate Publishing, **2006.**
4. S.R. Bhide, 'Digital Power System Protection', PHI Learning Pvt. Ltd., **2014.**

5. T.S. Madhava Rao, 'Power System Protection: Static Relays: with Microprocessor Applications', **2017.**

Course Objectives: To make the students familiar to:

1. Study of numerical relays
2. Developing mathematical approach towards protection
3. Study of algorithms for numerical protection

Course Outcomes: Students will be able to:

1. Learn the importance of Digital Relays.
2. Apply Mathematical approach towards protection.
3. Learn to develop various Protection algorithms.

POWER SYSTEM DYNAMICS-II

Subject Code: MELEE1-206 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit - I (8 Hrs.)

Basic Concepts of Dynamic Systems and Stability Definition, Small Signal Stability (Low Frequency Oscillations) of Unregulated and Regulated System

Unit-II (12 Hrs.)

Large Signal Rotor Angle Stability, Dynamic Equivalents and Coherency, Direct Method of Stability Assessment, Stability Enhancing Techniques, Asynchronous Operation and Resynchronization, Multi-Machine Stability.

Unit-III (10 Hrs.)

Effect of Damper winding, Flux Linkage Variation and Automatic Voltage Regulator, Dynamic Analysis of Voltage Stability, Voltage Collapse.

Unit-IV (10 Hrs.)

Frequency Stability, Automatic Generation Control, Primary and Secondary Control, Sub-Synchronous Resonance and Counter Measures

Recommended Books:

1. P. Kundur, 'Power System Stability and Control', McGraw Hill Inc, **1994.**
2. J. Machowski, Bialek, Bumby, 'Power System Dynamics and Stability', John Wiley & Sons, **1997.**
3. L. Leonard Grigsby (Ed.), 'Power System Stability and Control', 2nd Edn., CRC Press, **2007.**
4. V. Ajjarapu, 'Computational Techniques for voltage stability assessment & control', Springer, **2006.**

Course Objectives: To introduce the students to:

1. Study of power system dynamics
2. Interpretation of power system dynamic phenomena
3. Study of various forms of stability

Course Outcomes: Students will be able to:

1. Gain valuable insights into the phenomena of power system including obscure ones.
2. Understand the power system stability problem.
3. Analyse the stability problems and implement modern control strategies.
4. Simulate small signal and large signal stability problems.

POWER SYSTEM LAB. - III (POWER SYSTEM PROTECTION LAB.)

Subject Code: MELEE1-207 **L T P C**
0 0 4 2

List of Experiments

1. Introduction to Power System Protection.
2. Impact of Induction Motor Starting on Power System.
3. Modelling of Differential Relay using MATLAB.
4. Radial Feeder Protection.
5. Parallel Feeder Protection.
6. Principle of Reverse Power Protection.
7. Differential Protection of Transformer.
8. To study time vs. voltage characteristics of over voltage induction relay.
9. To study the characteristics of CT saturation.

POWER SYSTEM LAB. - IV (ARTIFICIAL INTELLIGENCE LAB)

Subject Code: MELEE1-208 **L T P C**
0 0 4 2

List of Experiments

1. Write A Program for Best Fit Search.
2. Write A Program to Generate the output for A* Algorithm.
3. Write a Program To Show the Tic Tac Toe Game for 0 and X.
4. Write A Program For Expert System By Using Forward Chaining.
5. Comparing the Search Methods.
6. Implement the Greedy Search Algorithm.
7. Implement the min-max Algorithm.
8. Adding a Heuristic.

POWER SYSTEM LAB. - IV (SMART GRID LAB.)

Subject Code: MELEE1-209 **L T P C**
0 0 4 2

List of Experiments

1. To study the components of smart grid.
2. To analyse the geographic information system for smart grid.
3. Formation of micro grid, protection and control of grid.
4. Understand power quality issues in grid connected renewable energy sources.
5. Performance analysis of smart meters.

MINI PROJECT

Subject Code: MELEE1-210 **L T P C**
0 0 4 2

The object of Mini Project is to enable the student to take up investigative study in the broad field of Electrical Engineering, either fully theoretical/practical or involving both theoretical and practical work to be assigned by the Department on an individual basis under the guidance of a supervisor from the department alone or jointly with a supervisor drawn from R&D laboratory/Industry. This is expected to provide a good initiation for the student in R&D work. The assignment to normally include:

1. Survey and study of published literature on the assigned topic.
2. Define the objective, formulate the problem and prepare an action plan for conducting the investigation.
3. Then perform the required Experiment/Develop a Simulation Model/Solve the Problem/Develop a Design/Explore the feasibility/Conduct a survey etc. depending upon the action plan.
4. Analyse the results and prepare a written report on the study conducted for presentation to the Department.
5. Final seminar, as oral presentation before a departmental committee.

RESTRUCTURED POWER SYSTEMS

Subject Code: MELEE1-264 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Units-I (8 Hrs.)

Fundamentals of restructured system, Market architecture, Load elasticity**,** Social welfare maximization.

Unit-II (12 Hrs.)

Mathematical Modeling of optimal power flow problem and its solution in restructured electricity markets, Locational marginal price (LMP) Energy, loss and congestion components of LMP.

Unit-III (8 Hrs.)

Congestion management and its methods, Strategic bidding, Risk assessment, Hedging, Transmission pricing and its methods, Tracing of power.

Unit-IV (12 Hrs.)

Ancillary services, Standard market design, distributed generation in restructured markets, Working of restructured power systems, IT applications in restructured markets, Recent developments of restructuring in India, International scenario of restructured power systems.

Recommended Books:

1. Lorrin Philipson, H. Lee Willis, 'Understanding Electric Utilities and De-regulation', Marcel Dekker, **1998**.
2. Steven Stoft, 'Power System Economics: Designing Markets for Electricity', John Wiley and Sons, **2002**.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, 'Operation of Restructured Power Systems', Kluwer Academic Pub., **2001**.
4. Mohammad Shahidehpour, Muwaffaq Alomoush, 'Restructured Electrical Power Systems: Operation, Trading and Volatility', Marcel Dekker.
5. Loi Lee Lei, 'Power system Restructuring and Deregulation', John Wiley & Sons, Ltd., **2002**.

Course Objectives: To make the students to:

1. Understand about the restructuring of the electricity market
2. Understand about the need for deregulation of the electricitymarket
3. Understand about the money, power & information flow in a deregulated power system

Course Outcomes:

Students will be able to:

1. Describe various types of regulations in power systems.
2. Identify the need of regulation and deregulation.
3. Define and describe the Technical and Non-technical issues in Deregulated Power Industry.
4. Identify and give examples of existing electricity markets.

5. Classify different market mechanisms and summarize the role of various entities in the market.

ADVANCED DIGITAL SIGNAL PROCESSING

Subject Code: MELEE1-265 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (10 Hrs.)

Discrete time signals, Linear shift invariant systems-, Stability and causality, Sampling of continuous time signals, Reconstruction, Zero and First order hold circuit, Discrete time Fourier transform- Discrete Fourier series- Discrete Fourier transform, Z Transform- Properties, Inverse Z transform and its applications.

Unit-II (8 Hrs.)

Linear convolution using Discrete Fourier Transform (DFT), Computation of DFT Design of IIR (Infinite Impulse Response) digital filters from analog filters, Impulse invariance method, Bilinear transformation method.

Unit-III (12 Hrs.)

Finite Impulse Response (FIR) filter design using window functions, Comparison of FIR and IIR digital filters, Basic IIR and FIR filter realization structures, Signal flow graph representations Quantization process and errors, Coefficient quantization effects in IIR and FIR filters.

Optimum linear filters, Optimum signal estimation, Mean square error estimation, Optimum FIR and IIR Filters.

Unit-IV (10 Hrs.)

A/D conversion noise- Arithmetic round-off errors, Dynamic range scaling, Overflow oscillations and zero Input limit cycles in IIR filters, Linear signal models, All pole, all zero and Pole-zero models, Power spectrum estimation- Spectral analysis of deterministic signals, Estimation of power spectrum of stationary random signals.

Recommended Books:

1. Sanjit K. Mitra, 'Digital Signal Processing: A Computer-based Approach ', Tata McGraw Hill Edn.,**1998.**
2. Dimitris G. Manolakis, Vinay K. Ingle and Stephen M. Kogon, 'Statistical and Adaptive Signal Processing', McGraw Hill International Edn., **2000.**
3. John G. Proakis, Dimitris G. Manolakis, 'Digital Signal Processing: Principles, Algorithms, and Applications', 4th Edn., Prentice Hall, **2006.**
4. M.H. Hayes, 'Statistical Signal Processing and Modelling', John Wiley and Sons, **1996**.

Course Objectives: To acquaint the Students with:

1. The difference between discrete-time and continuous-time signals
2. The application of DFT to IIR filter design and window functions to FIR design
3. The optimal design of FIR and IIR filters
4. The linear signal models and power spectrum of stationary random signals.

Course Outcomes: Students will be able to:

1. Knowledge about the time domain and frequency domain representations as well analysis of discrete time signals and systems.
2. Study the design techniques for IIR and FIR filters and their realization structures. Design of optimum FIR and IIR filters.
3. Acquire knowledge about the finite word length effects in implementation of digital filters.
4. Knowledge about the various linear signal models and estimation of power spectrum of stationary random signals.

DYNAMICS OF ELECTRICAL MACHINES

Subject Code: MELEE1-266 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (6 Hrs.)

Stability, Primitive four winding commutator machine and its complete voltage equation

Unit-II (12 Hrs.)

Torque Equation, Analysis of simple DC machines using the primitive machine equations, three phase Induction Motor transformed Equations, Different reference frames for Induction Motor Analysis, Transfer function formulation.

Unit-III (8 Hrs.)

Three Phase Salient Pole Synchronous Machine, Parks' transformation, Steady state analysis.

Unit-IV (14 Hrs.)

Large signal transients**,** Small oscillation equations in state variable form, Dynamical analysis of interconnected machines.

Large signal transient analysis using transformed equations, DC generator/DC motor System, Alternator /Synchronous Motor System.

Recommended Books:

1. D.P. Sengupta & J.B. Lynn, 'Electrical Machine Dynamics', The Macmillan Press Ltd., **1980.**
2. R. Krishnan, 'Electric Motor Drives, Modelling, Analysis, and Control', Pearson Education, **2001.**
3. P.C. Kraus, 'Analysis of Electrical Machines', McGraw Hill Book Company, **1987.**
4. I. Boldia & S.A. Nasar, 'Electrical Machine Dynamics', The Macmillan Press Ltd., **1992.**
5. C.V. Jones, 'The Unified Theory of Electrical Machines', Butterworth, London, **1967.**
6. P.S. Bimbhra, 'Generalized Theory of Electrical Machines', Khanna Publishers, **2002.**

Course Objectives: To make the Students to:

1. Learn about the performance characteristics of machines.
2. To understand the dynamics of the machines.
3. To understand how to determine stability of machine.

Course Outcomes: Students will be able to:

1. Formulate the electrodynamics equations of all electric machines and analyze the performance characteristics.
2. Knowledge of transformations for the dynamic analysis of machines.
3. Knowledge of determination of stability of the machines under small signal and transient conditions.
4. Study about synchronous machines.

ELECTRICAL MACHINE DESIGN

Subject Code: MELEE1-267 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (10 Hrs.)

Principles of Design of Machines: Specific loadings, choice of magnetic and electric loadings and materials, Real and apparent flux densities, temperature rise calculation, Separation of main dimension for induction machines and synchronous machines, Heating and cooling of machines, Types of ventilation, Continuous and intermittent rating

Unit-II (12 Hrs.)

Design of Transformers: General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size,

design of tank and cooling,
General considerations, output equation, emf per turn, choice of flux density and current density, main dimensions, leakage reactance and conductor size, design of tank and cooling tubes, Calculation of losses, efficiency and regulation, Forces winding during short circuit

Unit-III (10 Hrs.)

Design of Three Phase Induction Motors: Design of stator and rotor winding, Number of slots in stator and rotor, Slot leakage flux, Leakage reactance, Equivalent resistance of squirrel cage rotor, Magnetizing current, Efficiency from design data.

Unit-IV (8 Hrs.)

Design of Alternators: Types of alternators, comparison, specific loadings, output co-efficient, design of main dimensions, Introduction to computer aided electrical machine design of energy efficient machines.

Recommended Books:

1. A.E. Clayton, 'The Performance and Design of D.C. Machines', Sir I. Pitman & Sons, Ltd.
2. M.G. Say, 'The Performance and Design of A.C. Machines', Pitman.
3. A.K. Sawhney, 'A Course in Electrical Machine Design', Dhanpat Rai & Sons, 5th Edn.,
4. R.K. Aggarwal, 'Principles of Electrical Machine Design', S.K. Kataria & Sons, **2009.**

Course Objectives: To apprise the students with:

1. The modeling and analysis of AC machines.
2. The electromagnetic energy conversion process.
3. The design and rating of machines.

Course Outcomes:

Students will be able to:

1. To give a systematic approach for modeling and analysis of all rotating machines under both transient and steady state conditions with the dimensions and material used.
2. Ability to model and design transformers, three-phase induction motors and alternator.

ADVANCED MICRO-CONTROLLER BASED SYSTEMS

Subject Code: MELEE1-268 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (8 Hrs.)

Basic Computer Organization, Accumulator based Processes-Architecture, Memory Organization-I/O Organization.

Unit-II (12 Hrs.)

Micro-Controllers-Intel 8051 & Intel 8052, Registers, Memories, I/O Ports, Serial Communication, Timers, Interrupts, Programming
Intel 8051 – Assembly language programming, Addressing-Operations, Stack & Subroutines, Interrupts-DMA.

Unit-III (10 Hrs.)

ARDUINO UNO ATMEGA 328 Microcontroller, Architecture, Programming, Interfacing Memory/ I/O Devices, Serial I/O and data communication.

Unit-IV (10 Hrs.)

Microcontroller development for motor control applications, Stepper motor control using micro controllers.
Introduction to Digital Signal Processor (DSP) and its Architecture, Introduction to field Programmable gate arrays and implementation.

Recommended Books:

1. John. F. Wakerly, 'Microcomputer Architecture and Programming', John Wiley and Sons,

1981.
2. Ramesh S. Gaonker, 'Microprocessor Architecture, Programming and Applications with the 8051', Penram International Publishing (India), **1994.**
3. Raj Kamal, 'The Concepts and Features of Microcontrollers', Wheeler Publishing, **2005.**
4. Creig Steiner, 'The 8051/8052 Microcontrollers, Architecture, Assembly language and Hardware Interfacing', Universal Publishers, Boca Raton, Florida, **2005**.
5. Kenneth J. Ayala, 'The 8051 microcontroller', Cengage Learning, **2004.**
6. Kilts Steve, 'Advanced FPGA Design: Architecture, Implementation, and Optimization', A John Wiley & Sons Inc., 1st Edn., **2007**.

Course Objectives: To familiarize the students with:
1. The architecture and programming of advance microcontrollers.
2. The applications of these controllers.
3. The introductory concepts of field programmable gate arrays (FPGA).

Course Outcomes: Students will be able to:
1. To learn how to program a processor in assembly language and develop an advanced processor based system.
2. To learn configuring and using different peripherals in a digital system.
3. To compile and debug a Program.
4. To generate an executable file and use it.

SCADA SYSTEM AND APPLICATIONS

Subject Code: MELEE1-269 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (10 Hrs.)

Introduction to SCADA, Data acquisition systems, Evolution of SCADA, Communication technologies, Monitoring and supervisory functions, SCADA applications in Utility Automation.

Unit-II (10 Hrs.)

Industries SCADA System Components, Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

Unit-III (12 Hrs.)

SCADA Architecture, Various SCADA architectures, advantages and disadvantages of each system, Single unified standard architecture -IEC 61850.

SCADA Communication, various industrial communication technologies, wired and wireless methods and fiber optics, Open standard communication protocols.

Unit-IV (8 Hrs.)

SCADA Applications: Utility applications, Transmission and distribution sector operations, monitoring, analysis and improvement, Industries - oil, gas and water, Case studies, Implementation, Simulation exercises.

Recommended Books:

1. Stuart A. Boyer, 'SCADA-Supervisory Control and Data Acquisition', Instrument Society of America Publications, USA, **2004.**
2. Gordon Clarke, Deon Reynders, 'Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems', Newnes Publications, Oxford, UK, **2004.**
3. William T. Shaw, 'Cyber-security for SCADA Systems', Penn Well Books, **2006.**
4. David Bailey, Edwin Wright, 'Practical SCADA for Industry', Newnes, **2003.**
5. Michael Wiebe, 'A Guide to Utility Automation: AMR, SCADA, and IT Systems for Electric Power', Penn Well Books, **1999**.

6. Bela G. Liptak, Halit Eren, 'Instrument Engineers Process Software and Digital Networks', 4th Edn., Vol.-3, **2016**.

Course Objectives: To make the students to get insight into the:

1. Basic architecture and components of SCADA.
2. Functions and communication in SCADA.
3. Applications of SCADA.

Course Outcomes: Students will be able to:

1. Describe the basic tasks of supervisory control and data acquisition systems (SCADA) as well as their typical applications.
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system.
3. Knowledge about single unified standard architecture IEC 61850.
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server.
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc.

POWER QUALITY

Subject Code: MELEE1-270 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (8 Hrs.)

Introduction to power quality, voltage quality, overview of power quality phenomena, classification of power quality issues, power quality measures and standards, Total harmonic distortion (THD), Total demand distortion (TDD), Telephone influence factor (TIF), Distortion index (DIN), occurrence of power quality problems, various solutions of these problems.

Unit-II (8 Hrs.)

Harmonics, individual and total harmonic distortion, RMS value of a harmonic waveform, harmonic resonance, Triplex harmonics, important harmonic introducing devices, SMPS, three phase power converters, arcing devices, saturable devices, harmonic distortion of fluorescent lamps, effect of power system harmonics on power system equipment and loads.

Unit-III (8 Hrs.)

Modeling of networks and components under non-sinusoidal conditions transmission and distribution systems, Shunt capacitors, transformers, electric machines, grounding systems, loads that cause power quality problems, Power quality problems created by drives and its impact on drive.

Unit-IV (8 Hrs.)

Power factor improvement, passive and active compensation, Passive and active filtering, Control methods for single phase APFC (active power factor correction) and three phase APFC, Power factor correction (PFC) based on bilateral single phase and three phase converter.

Unit-V (8 Hrs.)

Hybrid Filtering techniques and various types, NEC grounding requirements, reasons for grounding, typical grounding and wiring problems, solutions to grounding and wiring problems

Recommended Books:

1. Angelo Baggini, 'Handbook of Power Quality', Wiley, **2008**.
2. G.T. Heydt, 'Electric Power Quality', McGraw Hill Professional, **2007.**
3. Math H. Bollen, 'Understanding Power Quality Problems', IEEE Press, **2000.**

4. J. Arrillaga, 'Power System Quality Assessment', John Wiley, **2000.**

Course Objectives: To make the students aware about:

1. The different power quality issues to be addressed.
2. The recommended practices by various standard bodies like IEEE, IEC, etc. on voltage, frequency and harmonics.

Course Outcomes: Students will:

1. Acquire knowledge about the harmonics, harmonic introducing devices and effect of harmonics on system equipment and loads.
2. Develop analytical skills needed for modeling and analysis of harmonics in networks and components.
3. To introduce the students to active power factor correction based on static VAR compensators and their control techniques.
4. To introduce the students to series and shunt active power filtering techniques for harmonics.

ARTIFICIAL INTELLIGENCE TECHNIQUES

Subject Code: MELEE1-271 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (10 Hrs.)

Biological foundations to intelligent systems, Artificial neural networks (ANN), Single layer and multilayer feed forward NN, Least-mean-square (LMS) and back propagation algorithm, Feedback networks and Radial basis function networks.

Unit-III (8 Hrs.)

Genetic algorithm (GA) and its operators; reproduction, cross over, mutation, Introduction to evolutionary programming.

Unit-II (12 Hrs.)

Fuzzy logic, Knowledge representation and inference mechanism, De-fuzzification methods, Introduction to type 2 fuzzy systems.

Fuzzy neural networks, System identification using fuzzy and neural network, some algorithms to learn the parameters of the network like GA.

Unit-IV (10 hrs)

Applications of above mentioned techniques i.e. Artificial neural networks, Fuzzy Neural networks, Genetic algorithms to practical problems.

Recommended Books:

1. J.M. Zurada, 'An Introduction to ANN', Jaico Publishing House, West, **1992**.
2. Simon Haykins, 'Neural Networks', Pearson Prentice Hall, **2005.**
3. Timothy J. Ross, 'Fuzzy Logic with Engineering Applications', McGraw Hill.
4. Driankov, Dimitra, 'An Introduction to Fuzzy Control', Narosa Publication.
5. Davis E. Goldberg, 'Genetic Algorithms in Search, Optimization, and Machine Learning', Adison Willey Publishing Company, **1989**.
6. Siva Nandam, 'Introduction to Fuzzy Logic using MATLAB', Springer Science & Business Media, **2006**.
7. N.P. Padhy, 'Artificial Intelligence and Intelligent Systems', Oxford University Press, **2005.**

Course Objectives: To make the students to:

1. Understand ANN, fuzzy logic and fuzzy neural networks.
2. Understand Genetic Algorithm and Evolutionary programming.
3. Learn to apply these techniques to practical problems.

Course Outcomes: Students will be able to:
1. Learn the concepts of biological foundations of artificial neural networks.
2. Learn Feedback networks and radial basis function networks and fuzzy logics.
3. Identifications of fuzzy and neural networks.
4. Acquire the knowledge of GA and EP.

MAJOR PROJECT (PHASE – I) DISSERTATION

Subject Code: MELEE1-311 **L T P C**
0 0 20 10

Course Objectives: To learn, practice, and critique effective scientific writing and to formulate the research objectives clearly.

Course Outcomes:
1. Design 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. Synopsis and its Presentation.

POWER SYSTEM TRANSIENTS

Subject Code: MELEE1-372 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit - I (8 Hrs.)

Fundamental circuit analysis of electrical transients, Laplace Transform method of solving simple Switching transients, Damping circuits, Abnormal switching transients, Three-phase circuits and transients, Computation of power system transients.

Unit - II (8 Hrs.)

Principle of digital computation, Matrix method of solution, Modal analysis, Z transform-Computation using EMTP (electromagnetic transients program), Lightning, switching and temporary over voltages, Lightning, Physical phenomena of lightning.

Unit - III (10 Hrs.)

Effect of lightning on power transmission system, Influence of tower footing resistance and earth resistance, switching: Short line or kilometric fault, energizing transients - closing and re-closing of lines, line dropping, load rejection, over voltages induced by faults.
Protective devices, Protection of system against over voltages, Lightning arresters, Substation earthing.

Unit - IV (8 Hrs.)

Switching of HVDC line, travelling waves on transmission line, Circuits with distributed parameters wave equation, Reflection, Refraction, Behaviour of Travelling waves at the line terminations, Lattice Diagrams – attenuation and distortion, Multi-conductor system and Velocity wave.

Unit - V (6 Hrs.)

Insulation Co-ordination: Principle of insulation co-ordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS), Coordination between insulation and protection level, Statistical approach.

Recommended Books:
1. Allan Greenwood, 'Electrical Transients in Power System', Wiley & Sons Inc. New York, **1991**.
2. J. Arrillaga and C.P. Arnold, 'Computer Aided Power System', John Wiley and Sons,

1994.
3. Sunil S. Rao, 'Switch Gear Protection and Power System', Khanna Publishers, **2008.**

Course Objectives: To make the students aware about:
1. The occurrence of transients in a power system.
2. The change in parameters like voltage and frequency during transients.
3. The lightning phenomenon and its effect on power system.

Course Outcomes: Students will be able to:
1. Knowledge of various transients that could occur in power system and their mathematical formulation.
2. Ability to design various protective devices in power system for protecting equipment and personnel.
3. Coordinating the insulation of various equipment in power system.
4. Modelling the power system for transient analysis.

FACTS AND CUSTOM POWER DEVICES

Subject Code: MELEE1-373 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT-I (10 Hrs.)

Reactive power flow control in Power Systems, Control of dynamic power unbalances in Power System, Power flow control, Constraints of maximum transmission line loading, Benefits of FACTS Transmission line compensation, Uncompensated line shunt compensation, Series compensation, Phase angle control, Reactive power compensation, Shunt and Series compensation principles, Reactive compensation at transmission and distribution level.

UNIT-II (8 Hrs.)

Static versus passive VAR compensator, Static shunt compensators: Static Var compensator (SVC) and Static compensator (STATCOM), Operation and control of Thyristor switched capacitor (TSC), Thyristor controlled reactor (TCR) and STATCOM, Compensator control, Comparison between SVC and STATCOM, Multilevel inverter based DSTATCOM (Distributed Static Compensator) and its applications.

UNIT-III (8 Hrs.)

Static Series Compensation: Thyristor switched series capacitor (TSSC), Static synchronous series compensator (SSSC), Static voltage and phase angle regulators, Thyristor-controlled voltage regulators (TCVR) and phase angle regulators (TCPAR): Operation and Control, Applications.

UNIT-IV (8 Hrs.)

Unified power flow controller (UPFC), Circuit arrangement, Operation and control of UPFC, Basic Principle of active power (P) and reactive power (Q) control, Independent real and reactive power flow control- Applications, Comparison of UPFC and UPQC (unified power quality conditioner).

UNIT-V (6 Hrs.)

Introduction to interline power flow controller, Modeling and analysis of FACTS controllers, Simulation of FACTS controllers, Power quality problems in distribution systems, Comparison of various Custom power devices and their applications.

Recommended Books:

1. K.R. Padiyar, 'FACTS Controllers in Power Transmission and Distribution', New Age International Publishers, **2007.**
2. X.P. Zhang, C. Rehtanz, B. Pal, 'Flexible AC Transmission Systems- Modelling and Control', Springer Verlag, Berlin, **2006.**

3. N.G. Hingorani, L. Gyugyi, 'Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems', IEEE Press Book, Standard Publishers and Distributors, Delhi, **2001**.
4. K.S. Sureshkumar, S. Ashok, 'FACTS Controllers & Applications', e-book Edn., Nalanda Digital Library, NIT Calicut, **2003.**
5. Angelo Baggini, 'Handbook of Power Quality', Wiley, **2008**.

Course Objectives: To make the students:

1. To learn the active and reactive power flow control in power system.
2. To understand the need for static compensators.
3. To develop the different control strategies used for compensation.

Course Outcomes: Students will be able to:

1. Acquire knowledge about the fundamental principles of passive and active and reactive power compensation schemes at transmission and distribution level in power systems.
2. Learn various Static VAR Compensation Schemes like Thyristor/GTO controlled reactive power systems; PWM inverter based reactive power systems and their controls.
3. To develop analytical modelling skills needed for modelling and analysis of such Static VAR Systems.

INDUSTRIAL LOAD MODELING AND CONTROL

Subject Code: MELEE1-374 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit -I (8 Hrs.)

Electric Energy Scenario, Demand side management, Industrial load management**,** Load curves, Load Shaping Objectives, Methodologies, Barriers, Classification of industrial loads, Continuous and Batch processes, Load modeling.

Unit - II (8 Hrs.)

Electricity pricing, Dynamic and spot pricing Models, Direct load control, Interruptible load control, Bottom up approach, Scheduling, Formulation of load Models, Optimization and control algorithms, Case studies.

Unit - III (6 Hrs.)

Reactive power management in industries, Controls, Power quality impacts, Application of filters, Energy saving in industries.

Unit - IV (8 Hrs.)

Cooling and heating loads, load profiling, Modeling cool storage, Types, Control strategies, Optimal operation, Problem formulation, Case studies.

Unit -V (10 Hrs.)

Captive power units, Operating and control strategies, Power Pooling, Operation models, Energy banking, Industrial cogeneration.

Selection of Schemes, Optimal operating strategies, Peak load saving, Constraints problem formulation, Case study, Integrated load management for industries.

Recommended Books:

1. C.O. Bjork, 'Industrial Load Management - Theory, Practice and Simulations', Elsevier, the Netherlands, **1989.**
2. C.W. Gellings and S.N. Talukdar, 'Load Management Concepts', IEEE Press, New York, **1986**.
3. Y. Manichaikul and F.C. Schweppe, 'Physically based Industrial load', IEEE Trans. on PAS, April, **1981.**
4. H.G. Stoll, 'Least Cost Electricity Utility Planning', Wiley Interscience Publication, USA, 1989.

5. I.J. Nagarath and D.P. Kothari, Modern Power System Engineering., Tata McGraw Hill publishers, NewDelhi, 1995
6. IEEE Bronze Book- 'Recommended Practice for Energy Conservation and Cost Effective planning in Industrial Facilities', IEEE Inc., USA.

Course Objectives: To acquaint the students with:

1. The energy demand scenario.
2. The modelling of load and to study load demand industrially.
3. To know electricity pricing models.
4. Study reactive power management in industries.

Course Outcomes: Students will be able to:

1. Knowledge about load control techniques in industries and its application.
2. Learn different types of industrial processes and optimize the process using tools like LINDO and LINGO.
3. Apply load management to reduce demand of electricity during peak time.
4. Apply different energy saving opportunities in industries.

DYNAMICS OF LINEAR SYSTEMS

Subject Code: MELEE1-375 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit - I (12 Hrs.)

State variable representations of systems, transfer function and transfer function matrix, solutions of state equations.
Observability and controllability, minimal realization of MIMO systems, analysis of linear time varying systems, the concepts of stability.

Unit II (10 Hrs.)

Lyapunov stability analysis, Lyapunov function and its properties, controllability by state variable feedback, Kassvoki method for stability.
Ackerman's Formula, Stabilization by output feedback, Asymptotic observers for state measurement, Observer design.

Unit III (8 Hrs.)

State space representation of discrete systems, Solution of state equations, controllability and Observability stability analysis using Lyapunov method.

Unit IV (10 Hrs.)

State feedback of linear discrete time systems, MATLAB Exercises for above mentioned topics.

Recommended Books:

1. Thomas Kailath, 'Linear Systems', Prentice Hall Inc., Englewood Cliffs, N.J., **1980**.
2. K. Ogata, 'State Space Analysis of Control Systems', Prentice Hall Inc., Englewood Cliffs, N.J., **1965**.
3. K. Ogata, 'Modern Control Engineering', 2nd Edn., Prentice Hall Inc., Englewood Cliffs, N.J., **1990.**
4. M. Gopal, 'Digital Control and State Variable Methods', Tata McGraw Hill Publishing Company Ltd., New Delhi, **1997.**
5. C.T. Chen, 'Linear System Theory and Design', Holt Rinehart and Winston, New York, **1984.**
6. R.C. Dorf and R.T. Bishop, 'Modern Control Systems', Addison Wesley Longman Inc., **1999**.

Course Objectives: To make the students:

1. To understand the linear and discrete systems and their functions.

2. To understand the stability analysis of linear systems and implement the same in MATLAB.

Course Outcomes: Students will be able to:

1. To learn linear system modelling, analysis and design so as to obtain the ability to apply the same to engineering problems in a global perspective.
2. Knowledge on carrying out detailed stability analysis of both linear and nonlinear systems.
3. Design observers and controllers for linear systems.
4. Acquire knowledge of discrete time linear systems modelling, analysis and design.
5. Develop and utilize modern software tools for analysis and design of linear continuous and discrete time systems.

BUSINESS ANALYTICS

Subject Code: MELEE1-391 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-1 (8 Hrs.)

Business analytics, its Overview, Scope, Process, Relationship of Business Analytics Process and organization, Competitive advantages of Business Analytics.
Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods an overview.

Unit-2 (8 Hrs.)

Trendiness and Regression Analysis: Modeling relationships and trends in data, Simple linear regression.
Important resources, Business analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and exploring Data, Business analytics technology.

Unit-3 (8 Hrs.)

Organization Structures of Business analytics, Team management, Management Issues, Designing Information policy, Outsourcing, ensuring data Quality, measuring contribution of business analytics, Managing changes.
Descriptive Analytics, predictive analytics and its modeling, Predictive analytics analysis, Data Mining and its methodologies, Prescriptive analytics and its step in the business analytics process, Prescriptive modeling, Nonlinear optimization.

Unit-4 (8 Hrs.)

Forecasting Techniques: Qualitative and judgmental forecasting, Statistical forecasting models: for stationary time series, for time series with a linear trend, time series with seasonality.
Regression forecasting with casual variables, selecting appropriate forecasting models, Monte Carlo simulation and risk analysis: Monte Carle simulation using analytic solver platform, New-product development model, Newsvendor model, Overbooking model, Cash budget model.

Unit-5 (8 Hrs.)

Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Recent Trends in: Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Recommended Books:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, 'Business Analytics Principles, Concepts and Applications', Pearson F.T. Press.

2. James Evans, 'Business Analytics', Persons Education.

Course Objectives:

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes:

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.

Students will demonstrate the ability to translate data into clear, actionable insights.

INDUSTRIAL SAFETY

Subject Code: MELEE1-392 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

Unit-I (8 Hrs.)

Industrial Safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II (6 Hrs.)

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III (8 Hrs.)

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i) Screw down grease cup, ii) Pressure grease gun, iii) Splash lubrication, iv) Gravity lubrication, v) Wick feed lubrication vi) Side feed lubrication, vii) Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV (8 Hrs.)

Fault Tracing: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i) Any one machine tool, ii) Pump iii) Air compressor, iv) Internal combustion engine, v) Boiler, vi) Electrical motors, Types of faults in machine tools and their general causes.

Unit-V (10 Hrs.)

Periodic and Preventive Maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets,

Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Recommended Books:

1. Higgins & Morrow, 'Maintenance Engineering Handbook', Da Information Services.
2. H.P. Garg, 'Maintenance Engineering', S. Chand and Company.
3. Audels, 'Pump-hydraulic Compressors', McGraw Hill Publication.
4. Winterkorn, Hans, 'Foundation Engineering Handbook', Chapman & Hall London.

OPERATIONS RESEARCH

Subject Code: MELEE1-393 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT – I (8 Hrs.)

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNIT – II (8 Hrs.)

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT – III (8 Hrs.)

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT – IV (8 Hrs.)

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

UNIT – V (8 Hrs.)

Competitive Models, Single and Multi-Channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

Recommended Books:

1. H.A. Taha, 'Operations Research, An Introduction', PHI, **2008.**
2. H.M. Wagner, 'Principles of Operations Research', PHI, Delhi, **1982**.
3. J.C. Pant, 'Introduction to Optimisation: Operations Research', Jain Brothers, Delhi, **2008.**
4. Hitler Libermann, 'Operations Research: McGraw Hill Pub.', **2009.**
5. Pannerselvam, 'Operations Research', Prentice Hall of India, **2010.**
6. Harvey M. Wagner, 'Principles of Operations Research', Prentice Hall of India, **2010.**

Course Outcomes: At the end of the course, the students should be able to:

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming.
3. Students should able to carry out sensitivity analysis.

NOTE: Student should able to model the real world problem and simulate it.

COST MANAGEMENT & ENGINEERING PROJECTS

Subject Code: MELEE1-394 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT-I (8 Hrs.)

Introduction and Overview of the Strategic cost management process, Cost Concepts in Decision-Making; Relevant Cost, Differential Cost, Incremental Cost and Opportunity Cost. Objectives of a Cost Management, Inventory Management, Creation of a Database for operational control; Provision of data for Decision-Making.

UNIT-II (12 Hrs.)

Project: Meaning, Different types, why to manage, cost over runs centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed engineering activities. Pre project execution, main clearances and documents.

Project Team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution, Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT-III (10 Hrs.)

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Standard Costing and Variance Analysis, Pricing Strategies: Target Costing, Life Cycle Costing.

Budgetary Control: Flexible Budgets, Performance Budgets, Zero-Based Budgets, Pricing Decisions: Transfer Pricing.

UNIT IV (10 Hrs.)

Costing of service sector, Just-in-Time Approach, Material requirement planning, Enterprise Resource Planning, Total Quality Management Principles, Theory of Constraints, Activity-Based Cost Management, Benchmarking, Balanced Score Card and Value-Chain Analysis.

Quantitative Techniques for Cost Management: Linear Programming formulation and graphical, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

Recommended Books:

1. Charles T. Horngren, 'Cost Accounting: A Managerial Emphasis', Prentice Hall of India, New Delhi, **2012.**
2. Charles T. Horngren and George Foster, 'Advanced Management Accounting'.
3. Robert S. Kaplan, Anthony A. Alkinson, 'Management & Cost Accounting'.
4. Ashish K. Bhattacharya, 'Principles & Practices of Cost Accounting', A.H. Wheeler Publisher.
5. N.D. Vohra, 'Quantitative Techniques in Management', Tata McGraw Hill Book Co. Ltd.

COMPOSITE MATERIALS

Subject Code: MELEE1-395 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT–I (8 Hrs.)

Introduction: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II (8 Hrs.)

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III (10 Hrs.)

Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV (6 Hrs.)

Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V (8 Hrs.)

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

Recommended Books:

1. R.W. Cahn, 'Material Science and Technology – Composites', Vol-13, VCH, West Germany.
2. W.D. Callister, Jr., Adapted by R. Balasubramaniam, 'Materials Science and Engineering, An introduction', John Wiley & Sons, NY, Indian Edn., **2007**.
3. Lubin ed, 'Hand Book of Composite Materials'.
4. K.K. Chawla, 'Composite Materials'.
5. Deborah D.L. Chung, 'Composite Materials Science and Applications'.
6. Danial Gay, Suong V. Hoa, and Stephen W. Tasi., 'Composite Materials Design and Applications'.

WASTE TO ENERGY

Subject Code: MELEE1-396 **L T P C** **Duration: 40 Hrs.**
3 0 0 3

UNIT – I (6 Hrs.)

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT – II (8 Hrs.)

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – III (8 Hrs.)

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT - IV (8 Hrs.)

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT - V (10 Hrs.)

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification.

Biomass Conversion Processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

Recommended Books:

1. Desai, Ashok V., 'Non-Conventional Energy', Wiley Eastern Ltd., **1990**.
2. K.C. Khandelwal and S.S. Mahdi, 'Biogas Technology - A Practical Hand Book', Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., **1983**.
3. D.S. Challal, 'Food, Feed and Fuel from Biomass', IBH Publishing Co. Pvt. Ltd., **1991**.
4. C.Y. WereKo-Brobby and E.B. Hagan, John, 'Biomass Conversion and Technology'.

MAJOR PROJECT (PHASE – II) DISSERTATION

Subject Code: MELEE1-412 **L T P C**
0 0 32 16

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. Execute a meaningful research project that demonstrates spatial thinking and uses the knowledge and skills.
2. Able to learn effectively record data and experiments so that others can understand them.
3. 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**