Annexure-1

M.TECH.

IN

POWER AND ENERGY SYSTEM

UNDER
DEPARTMENT OF ELECTRICAL ENGINEERING

TRIPURAUNIVERSITY

(A CENTRAL UNIVERSITY)

TRIPURA, INDIA

SYLLABUS

(13TH BPGS, FEB 2022)

11/2/2022 11.02.2022 11/02/22

Sd/-

Sd/- Arabinda Das

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Detailed Curriculum for M. Tech. in "Power & Energy System"

Course Structure

1st Semester: 700 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective	MOOCs
MEE 0901 C	Modern Power System Operation and Control	100 *(70+30)	4	0	0	4	C	
MEE0908C	Renewable and Distributed Energy Systems	100 *(70+30)	4	0	0	4	C	
MEE0909C	Advanced Power System Analysis	100 *(70+30)	4	0	0	4	C	
MEE00XXE	Elective Paper I	100 *(70+30)	4	0	0	4	E	
CSK III	Computer Skill III (JAVA Software/ Python/C/C++)	100 *(70+30)	4	0	0	4	CFC(Compulsory Foundation) (Offered by CSE or IT)(As per TU Norms	
MEE0904P	Mini Project	100 *(70+30)	0	0	4	2	C	
MEE0910P	Power & Energy Laboratory	100 *(70+30)	0	0	4	2	C	
	Total	700	20	0	8	24		

2nd Semester: 600 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective	MOOCs
MEE 1002 C	Advance Power System Protection	100 *(70+30)	4	0	0	4	C	
MEE1005C	Direct energy conversion System	100 *(70+30)	4	0	0	4	C	
MEE00XXE	Elective Paper II	100 *(70+30)	4	0	0	4	E	
MEE00XXE	Elective Paper III	100 *(70+30)	4	0	0	4	E	
MEE1007C	Simulation and Advanced Electrical Engineering Laboratory.	100 *(70+30)	0	0	4	2	C	

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MEE1004C	Design Project & Term Paper leading to Thesis	100 *(70+30)	0	0	4	2	C	
	Total	600	16	0	8	20		

3rd Semester: 700 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective	MOOCs
MEE 1101C	Thesis Report Interim	200	0	8	8	8	C	
MEE 1102C	Thesis Seminar Interim (Presentation & Viva	200	0	4	4	4	C	
MEE 1103C	Technical Communication	100	0	2	2	2	C	
MEE 1104C	Workshop and Seminars	100 *(70+30)	0	2	2	2	C	
MEE00XXE	Elective Paper IV	100 *(70+30)	4	0	0	4	E	
	Total	700	4	16	16	20		

4th Semester: 600 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective	MOOCs
MEE 1201C	Thesis Report Final	200	0	8	8	8	C	
MEE 1202C	Thesis Seminar Final (Presentation & Viva Voce)	200	0	8	8	8	C	
MEE 1203C	Workshop and Seminars	100 *(70+30)	0	2	2	2	C	
MEE 00XXE	Elective Paper V	100 *(70+30)	4	0	0	4	E	
	Total	600	4	16	18	20		

List of Elective subject for "Power & Energy Systems"

Course Code	Course	L	T	P	C	Elective	MOOCs
MEE 0010E	Smart Grid	4	0	0	4		
MEE 0030E	Advanced Power Electronics	4	0	0	4		
MEE 0031E	Advanced Control Systems	4	0	0	4		

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MEE 0032E	Modeling and Analysis of Electrical Machines	4	0	0	4		
MEE 0033E	Energy policy and Planning	4	0	0	4		
MEE 0034E	Energy Conservation and Management	4	0	0	4		
MEE 0035E	Modeling and control of sustainable Energy system	4	0	0	4		
MEE 0036E	HVDC and FACTS Devices	4	0	0	4		
MEE 0037E	Power Quality Analysis	4	0	0	4		
MEE 0038E	Lightning design and Calculations	4	0	0	4		
MEE 0039E	High Voltage Measurements	4	0	0	4		
MEE 0040E	Power System Transients	4	0	0	4		
MEE 0041E	Condition Monitoring of High Voltage equipments	4	0	0	4		
MEE 0042E	Power System Optimization	4	0	0	4		
MEE0043E	Electric and Hybrid Vehicle	4	0	0	4		

Elective Subjects offered by other Departments

Course	Course name	L	T	P	C	Elective	Department /MOOCs
MVE-402O	Cyber security and data encryption	4	0	0	4	E	Offered by ECE Deptt.
MTE-401O	Principle of Refrigeration and Cryogenics	4	0	0	4		Offered by ME Deptt.
MDS-402O	Data Ware House	4	0	0	4		Offered by CSE Deptt.

NOTE: C – Core, E – Elective, P- Practical, L-Lectures and T- Tutorials;

Total Credit = 88

[Departmental Total credit: 84 & other Departmental Credit: 4]

Compulsory Foundation [Skill III] = 4; Core=60(Theory: 20, Practical: 40), Elective=24 (Departmental: 20, other Departmental open Elective: 4*)
Open Elective (Non-Departmental) (4 credits)

*As offered by other departments in respective Semester under CBCS.

Students, those who are willing to attend the MOOCs course(s) instead of courses of Open Elective; they should register themselves through the local centre of Tripura University for successful completion of MOOCs course.

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Semester-I

1st Semester: 700 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective	MOOCs
MEE 0901 C	Modern Power System Operation and Control	100 *(70+30)	4	0	0	4	C	
MEE0906C	Advanced Power System Analysis	100 *(70+30)	4	0	0	4	C	
MEE0907C	Renewable and Distributed Energy Systems	100 *(70+30)	4	0	0	4	C	
MEE00XXE	Elective Paper I	100 *(70+30)	4	0	0	4	E	
CSK III	Computer Skill III (JAVA Software/ Python/C/C^{++})	100 *(70+30)	4	0	0	4	CFC(Compulsory Foundation) (Offered by CSE or IT)(As per TU Norms	
MEE0904P	Mini Project	100 *(70+30)	0	0	4	2	C	
MEE0909P	Power & Energy Laboratory	100 *(70+30)	0	0	4	2	C	
	Total	700	20	0	8	24		

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Semester-1

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0901 C	Modern Power System Operation and Control	100	4	0	0	4	C

Course Outcomes:

At the end of the course students will be able to	
CO-1	Analyze Key Issues in Power System Stability problem and Stability Problems faced by modern Power Systems
CO-2	Understand Load frequency Control and Automatic Generation Control
CO-3	Describe the stability issues of a Single Machine and Multi-machine Systems
CO-4	Understand the concept of Reactive Power control and Voltage Stability.

Syllabus Contents:

Operation and control of modern power systems, Power system deregulation; Load flow and stability studies; optimal pow flow, distributed generation, magneto hydrodynamic generation, power system reliability, voltage stability

Books:

1. J.Duncan Glover,M.S.Sharma, T.J.Overbye, " Power System Analysis & Design", Cengage Learning
2. D.P.Kothari, I.J. Nagrath, " Modern Power System Analysis" , Mc Graw Hill, 2016
3. T.K. Nagsarkar, M.S. Sukhija," Power System Analysis", Oxford 2013

Semester-1

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0908C	Renewable and Distributed Energy Systems	100	4	0	0	4	C

Course Outcomes: -

At the end of the course students will be able to	
CO1:	Learn various renewable energy sources. (k1)
CO2:	Understand the integrated operation of renewable energy sources. (k2)
CO3:	Apply their knowledge on Distributed Generation on Power System and learn the planning and operational issues related to Distributed Generation. (k3)
CO4:	Apply their knowledge on the working of off-grid and grid-connected renewable energy generation schemes based on Micro-Grids. (k3)

Syllabus Contents:

World energy scenario & Sources-Classifications, Distributed & Central Station Generation, Impact of Distributed Generation on the Power System, Power Disturbances, Sources of Electromechanical Energies. Solar Energy, Wind Energy, Combined Heat & Power, Hydro Energy, Tidal Energy, Wave

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Energy, Geothermal Energy, Biomass and Fuel Cells, MHD generations, Power Electronic Interface with the Grid. Economic and control aspects of Distributed Generation Market facts- Issues, challenges & Limitations, Harmonics- Power quality issues, Reliability of Distributed Generation based systems. Micro-grids, Types of micro-grids: autonomous and non-autonomous grids, Sizing of micro-grids. Modelling & analysis of Micro-grids with multiple DGs. Micro-grids with power electronic interfacing units, Protection of micro-grids, Case studies.

Suggested Reading

1. Ranjan Rakesh, Kothari D.P, Singal K.C, "Renewable Energy Sources and Emerging Technologies", 2nd Ed. Prentice Hall of India ,2011.
2. Math H.Bollen, Fainan Hassan, "Integration of Distributed Generation in the Power System", July 2011, Wiley –IEEE Press.
3. Loi Lei Lai, Tze Fun Chan, "Distributed Generation: Induction and Permanent Magnet Generators", October 2007, Wiley-IEEE Press.
4. Roger A.Messenger, Jerry Ventre, "Photovoltaic System Engineering", 3rd Ed, 2010 5.James F.Manwell, Jon G.Mc Gowan, Anthony L Rogers, "Wind energy explained: Theory Design and Application", John Wiley and Sons 2nd Ed, 2010.
5. H. Lee Willis, Walter G. Scott, "Distributed Power Generation – Planning and Evaluation", Marcel Decker Press.
6. M.Godoy Simoes, Felix A.Farret, "Renewable Energy Systems – Design and Analysis with Induction Generators", CRC press. 3. Stuart Borlase. "Smart Grid: Infrastructure Technology Solutions" CRC Press

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0909C	Advanced Power System Analysis	100	4	0	0	4	C

Course Outcomes:

At the end of the course students will be able to	
CO-1	Analyze Series and shunt Faults on digital computers
CO-2	Demonstrate the computing procedure to solve the PSA problem
CO-3	Evaluate contingency ranking of transmission network
CO-4	Analyze the reliability of electrical systems.

Syllabus Contents:

US building algorithm: modification due to network changes, generalized fault analysis using Z-bus building algorithm: Sequence network modeling using Z-BUS matrix, Analysis of Series and shunt Faults on digital computers using Z-BUS matrix. DC load flow, solution of ill conditioned systems, Continuation Power Flow: mathematical formulation, predictor step and corrector step. Contingency Evaluation: Necessity of contingency evaluation in power systems, Contingency Ranking, methods of distribution factors for line and generator outages, calculation of PTDF & LODF. Reliability Analysis: Representation of power system

components for reliability analysis, Loss of Load Expectation (LOLE), Frequency and duration approach, State Estimation: Static as well as dynamic

References:

1. G.W. Stagg, El-Abaid "Computer Methods in Power System Analysis", Tata McGraw Hill.
2. John J. Grainger, William D Stevenson, "Power System Analysis", Tata McGraw Hill.
3. M.A.Pai, "Computer Techniques in Power System Analysis", Tata McGraw Hill.

Semester –I

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0030E	Advanced Power Electronics	100	4	0	0	4	E

Course outcomes:

At the end of the completion of the course students will be able to	
CO-1	Understand about analysis & design about the AFC Management and Control
CO-2	Understand about analysis and design of Load Commutated CSI and PWM CSI
CO-3	Learn analysis and design of series Inverters.
CO-4	Acquire knowledge about analysis and design of Switched Mode Rectifiers, DC-DC converters & Circuits of induction motor-based drives.

Syllabus Contents:

Boost type APFC (Active Power factor Correction) Management & Control, three phase utilit y inter phases and control-Buck, Boost, Buck-Boost SMPS Topologies. Modes of operation –Push-Pull and Forward Converter Topologies - Voltage Mode Control. Half and Full Bridge Converters. Flyback Converter. Introduction to Resonant Converters. Load Resonant Converter. Zero Voltage Switching Clamped Voltage Topologies. Resonant DC Link Inverters with Zero Voltage Switching. High Frequency Link Integral Half Cycle Converter. Modelling and design of DC-DC Converters for various renewable energy conversion. Few power electronic circuits used in practice for controlling electric drives, V/F Control and Vector Control of Induction motor.

Books & References:

1. Rashid "Power Electronics" Prentice Hall India 2007.
2. G.K.Dubey et.al "Thyristorised Power Controllers" Wiley Eastern Ltd., 2005, 06.
3. Dewan&Straughen "Power Semiconductor Circuits" John Wiley &Sons., 1975.
4. G.K. Dubey& C.R. Kasaravada "Power Electronics & Drives" Tata McGraw Hill., 1993
5. Cyril W Lander "Power Electronics" McGraw Hill., 2005.
6. B. K Bose "Modern Power Electronics and AC Drives" Pearson Education (Asia)., 2007 7. Abraham I Pressman "Switching Power Supply Design" McGraw Hill Publishing Company., 2001

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Semester –I

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0031E	Advanced Control Systems	100	4	0	0	4	E

Course Outcomes:

At the end of the completion of the course students will be able to	
CO-1	Understand to analysis the characteristics of Digital Control Systems.
CO-2	Understand for the analysis of stability and design using state variable method of a digital control system.
CO-3	Understand for the formulation of Optimal control problems.
CO-4	Understand for the optimization of a control problem using constrained minimization.

Syllabus Contents:

Discrete data System: Introduction to Discrete data systems, Pulse transfer functions-sampled data systems and analysis. Stability analysis of Discrete data systems, State variable analysis-Controllability &Observability, State feedback analysis, State Observer design. Introduction to Optimal control: Formulation of Optimal Control Problems, calculus of Variations, minimization of functional of single functions. Functional optimal control problems involving independent functions, constrained minimization. Hamiltonian method for optimal control problems.

Books / References:

1. Benjamin C. Kuo, "Digital Control Systems", Ed. 2, Oxford Uiversity Press, 1999
2. K. Ogata, "Discrete-time Control Systems', Ed. 2, Prentice-Hall, 1995.
3. Donald E. Kirk, "Optimal Control Theory, An introduction", Prentice Hall Inc., 2004
4. A.P. Sage, "Optimum Systems Control", Prentice Hall, 1977
5. HSU and Meyer , "Modern Control, Principles and Applications", McGraw Hill, 1968
6. M. Gopal, " Digital Control and State variable Methods", Tata McGraw Hill Publishing Company limited, second edition, 2004.

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Semester –I

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0032E	**Modeling and Analysis of Electrical Machines**	100	4	0	0	4	E

Course Outcomes:

At the end of the completion of the course students will be able to	
CO-1	Understand the principles of energy conversion and construct machine models based on different reference frames
CO-2	Analyze basic concepts of rotating machines
CO-3	Synthesize equivalent circuit parameters for synchronous and asynchronous machines.
CO-4	Understand and analyze special machines

Syllabus Contents:

Different methods of Transformation. Reference Frame Theory (Different Reference Frames and Transformation between Reference Frames). Basic Performance Equations and Analysis of different Rotating Machines- DC Machines, Synchronous and Induction Machines. Three phase symmetrical induction machine and salient pole synchronous machines in phase variable form. Application of reference frame theory to three phase symmetrical induction and synchronous machines, Dynamic direct and quadrature axis model in arbitrarily rotating reference frames. Analysis and dynamic modeling of two-phase asymmetrical induction machine and single- phase induction machine. Transients in electrical machines - Switching Transients and surges. Transient and short circuit studies on alternators. Modelling of Special Machines-Permanent magnet synchronous machine, Surface permanent magnet (square and sinusoidal back emf t ype) and interior permanent magnet machines – Construction and operating principle-Dynamic modeling and self-controlled operation. Analysis of Switch Reluctance Motors. Brushless D.C. Motors.

Reference Books:

1. Electric Machinery, Charles Kingsle, Jr., A.E.Fitzgerald, Stephen D.Umans, Tata Mcgraw Hill.
2. Electric Motor & Drives: Modeling, Analysis and Control, R.Krishnan, Prentice Hall of India.
3. Brushless Permanent Magnet and Reluctance Motor Drives, T.J.E.Miller, Clarendon Press.
4. Analysis of Electric Machine,P.C.Krause,WileyIEEEPress3rd Edition

Computer Skill III

Course Code	Name of the course	Remarks
CSK III	Computer Skill III (JAVA Software / Python/C/C++)	**Compulsory Foundation Course (To be decided by TU)**

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Mini Project

Course Code	Course name	Marks	L	T	P	Credit	Core
MEE-0904P	Mini Project	100	0	0	4	2	C

Course Outcomes

	At the end of the course, students will demonstrate the ability to-
CO-1	Outline the points to formulate problem corresponding to the project topic
CO-3	Develop & know how to organize, scope, plan, do and act within a project thesis.
CO-4	Define problem specific tools (i.e. hardware equipment and software) and its functionality.

Syllabus Contents:

The mini project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Problem formulation.
2) Knowledge of how to organize, scope, plan, do and act within a project thesis.
3) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.

Power & Energy Laboratory

Course Code	Course name	Marks	L	T	P	Credit	Core
MEE-0909P	Power & Energy Laboratory	100	0	0	4	2	C

Course Outcome:

At the end of the completion of the course students will be able to	
CO-1	Understand the working of solar PV and wind energy technology to
CO-2	Measure solar radiation, sunshine hours, and do technical analysis of photo
CO-3	Conduct experiments related to wind standalone as well as hybrid wind Solar system, do technical analysis to study their characteristics.
CO-4	Apply the concept to end use applications.

Experiments:

1. Experimentation to determine I-V&P-V characteristics of series and parallel combination of PV modules and also to observe the effect of variation of tilt angle on PV module power.
2. Experiment to demonstrate the effect of shading on module output power and also to determine the working of diode as bypass diode and blocking diode.
3. Experimentation on work out power flow calculations of stand-alone PV system of DC load with battery, work out power flow calculations of stand-alone PV system of AC load with battery and workout power flow calculations of stand-alone PV system of AC load with battery.
4. Experiment to measure the solar radiation using thermoelectric pyranometer in different global sunshine conditions, Synchronization of grid tied inverter, observation of current wave form and calculations for distortion and power factor of grid tied inverter.
5. Analysis and characterization of wind standalone system, Evaluation of cut-in speed and cut-off speed and I-V characteristics of wind turbine at different wind speed and experimentation of other applications..
6. Experiment P,V and measurement of output of wind generator and impact of load and wind speed on power output and its quality.
   a. Economic Load Dispatch of Electrical Power plants.
   b. Load Flow Analysis using various solution approaches.
   c. Studies on short circuit analysis.
7. Study of power transmission line behavior using SCADA based Power TL
8. Study of numerical relays (over current &distance) using relay hardware setup & power TLS model.
9. Assessment of power quality issues in LT systems.

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Semester-II

M.TECH SEMESTER –II

2nd Semester: 600 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective	MOOCs
MEE 1002C	Advance Power System Protection	100 *(70+30)	4	0	0	4	C	
MEE 1006C	Direct energy conversion System	100 *(70+30)	4	0	0	4	C	
MEE 00XXE	Elective Paper II	100 *(70+30)	4	0	0	4	E	
MEE 00XXE	Elective Paper III	100 *(70+30)	4	0	0	4	E	
MEE 1007C	Simulation and Advanced Electrical Engineering Laboratory.	100 *(70+30)	0	0	4	2	C	
MEE 1004C	Design Project & Term Paper leading to Thesis	100 *(70+30)	0	0	4	2	C	
	Total	600	16	0	8	20		

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Semester-2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 1002C	Advance Power System Protection	100	4	0	0	4	C

Course Outcomes:

At the end of the course students will be able to	
CO-1	Describe the protection schemes used for protection of generator, motor and transformer.
CO-2	Implement the applications of distance Relaying, Wire pilot and Carrier Pilot Relaying in Power System.
CO-3	Implement the microprocessor based numerical relaying for power system protections.
CO-4	Implement the advance technique techniques for protections for power system

Syllabus Contents:

Protection of generators: under frequency, loss of excitation, loss of prime mover, rotor earth fault, pole slipping, over speed, unbalanced loading; Protection of Transformer: generalized differential protection, protection due to switching surge, Earth fault, over current, over fluxing protection; over current, directional, differential and distance protection, current transformer & potential transformer, Power swing conditions, Static Relays: current, voltage and impedance relays, Motor protection relay, Computer and microprocessor applications in protection schemes, Numerical relays, Transmission line protection, Power Electronics based Protections for power system, Recent Advances in Digital/Computer based Protection of Power Systems.

Books and References:

1. Power System Protection and Switchgear, B.Ram – Tata Mc-Graw Hill Pub.
2. Switchgear and Protection, M.V. Deshpande - Tata Mc-Graw Hill Pub.
3. Power System Protection & Switchgear, Ravindra Nath, M.Chander, Willy P
4. Power System Protection- Static Relays By T.S.M. Rao Tata McGraw Hill
5. Digital Protection- Protective Relaying from Electromechanical to Microprocessor By L. P. Singh, New Age International
6. Protective relaying Application Guide, General Electric Company, GEC measurements.
7. Bhavesh Bhalja, R.P. Maheshwari, Nilesh G. Chothani "Protection and Switchgear", Oxford University press, 2013.
8. Badri Ram, D.N. Vishwakarma "Power System Protection and Switchgear", McGraw Hill Education (India) Private Limited, 2014.

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Semester-2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-1006C	Direct Energy Conversion Systems	100	4	0	0	4	C

Course outcome:

At the end of the course students will be able to	
CO-1	After the completion of the course students will be able to know about the basics of energy conversion, Thermoelectric Power Generation.
CO-2	After the completion of the course students will be able to understand the future energy technology like hydrogen energy, thermionic emission, MHD etc
CO-3	After the completion of the course students will be able to apply the knowledge of solar photovoltaic cells, Design concept of PV cell systems, Solar cells connected in series and parallel.
CO-4	After the completion of the course students will be able to understand about Fusion Technique.

Syllabus Contents:

Basic science of energy conversion: Energy conversion chart, Direct Energy Conversion (DEC) devices, General representation of DEC devices, Thermoelectric Vs Photoelectric phenomena, Thermoelectric Power Generation. Future energy technologies: Hydrogen energy, Nuclear fusion, Thermionic emission, Richardso's equation; Analysis of high vacuum thermionic converter, Gaseous converters; Introduction to MHD generators, Seeding and ionization in MHD generators, Analysis of MHD engines and MHD equations - Conversion efficiency and electrical losses in MHD power generation systems. Fundamentals of solar photovoltaic cells, Production of solar cells, thin film solar cell technologies, Design concept of PV cell systems, PV System design and applications; Concentrator PV cells and systems; Fusion Power& Fission Power, Wind energy conversion technologies.

References:

1. S.S.L. Chang, Energy Conversion, Prentice Hall, 1963
2. G.W. Sutton, Direct Energy Conversion, McGraw Hill, 1966
3. S.L. Soo, Direct Energy Conversion, Prentice Hall, 1968
4. S.W. Angrist, Direct Endergy Conversion, 4e, Allwyn&Bycon, 1982
5. D. Merick and R. Marshall, Energy, Present and Future Options, Vol1 & II, John Wiley, 1981
6. B. Sorenson: Renewable Energy, Academic Press, 1989
8. B. Viswanathan and M. A.Scibioh, Fuel Cells – Principles and Applications, Universities Press, 2006
9. G. Boyle, Renewable Energy- Power for Sustainable Future, 2e, Oxford University Press, 2004
10. "Direct Energy Conversion" by M.AllKettani, Addison-Wesley, 1970.
11. "Direct Energy Conversion" by S.W.Angrist, Allyn & Bacon, Boston, 4th Edn., 1982.
12. "Direct energy Conversion" by S.L.Soo, Prentice Hall, 1968.

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Semester –2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-00XXE	Energy policy and planning	100	4	0	0	4	E

Course outcome:

At the end of the course students will be able to	
CO-1	After the completion of the course students will be able to know about the Sector wise consumption of energy resources
CO-2	After the completion of the course students will be able to understand the Renewable Energy Policy, Role of MNES, IREDA
CO-3	After the completion of the course students will be able to understand about Climate Change Policies like Global Warming, International Environmental Policy Practices
CO-4	After the completion of the course students will be able to understand Energy demand analysis, Energy Pricing

Syllabus Contents:

Sector wise consumption of energy resources: Electricity, Fuel, Transportation, Energy Scenario. Global market outlook, import and export position, Resources, Reserves, Energy Conservation Act 2001 and amendments, Energy Security -Concept, Issues and Economics, Trade-Off between Energy Security and Climate Change Renewable Energy Policy, Incentives and subsidies, Foreign Investment, Role of MNES, IREDA, Bio Energy Policy, Solar Policy, National Solar Mission, Waste Management Practices and policies, Renewable purchase obligations, Feed in Tariffs, Renewable Energy Certificates, Hydro Power Policy, Small/Large Scale Hydro Power Plants, PSH, National policy on Hydropower in India, India EV Policy, Other schemes. Global Warming, International Environmental Policy and Practices, Emissions Trading System (ETS). Trend analysis and Econometric models, Energy investment planning; Energy environment interaction, Energy Pricing.

Reference Books:

1. SC Bhattacharyya. Energy Economics, Concepts, Issues, Markets and Readings Governance,Springer Science & Business Media, (2011) ISBN 978-0-85729-268-1.
2. RS Axelrod & SD VanDeveer (Eds.). The Global Environment: Institutions, Law, and Policy. CQPress; Fifth edition (2019). ISBN 1544330146
3. TF Braun & MG Lisa. Understanding Energy and Energy Policy. Zed Books,(2014) ISBN 1780329342
4. Kandpal, Tara Chandra, and Hari Prakash Garg. Financial evaluation of renewable energy technologies. MacMillam India Limited, 2003.

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Semester –2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-0034E	**Energy Conservation and Management**	100	4	0	0	4	E

Course Outcomes:

At the end of the course students will be able to-	
CO-1	Understand the concept of energy scenario, tariff and thermal management in electrical system.
CO-2	Understand the basic concepts of energy audit & management.
CO-3	Understand the methods of improving energy efficiency in different electrical and industrial systems.
CO-4	Analyze energy saving opportunities using different energy efficient devices.

Syllabus Contents:

Energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, energy strategy for the future. Electricity tariff, load management and maximum demand control, selection & location of capacitors, Thermal Basics-fuels, thermal energy contents of fuel, temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation, steam, moist air and humidity & heat transfer, units and conversion. Energy audit. Energy management. Electrical system: Electricit y billing, electrical load management and maximum demand control, Reactive power management. Energy saving opportunities with energy efficient motors. Pumps and Pumping System, Cooling Tower and their performances and control strategies. Energy efficient technologies in electrical systems: Maximum demand controllers, automatic power factor controller etc. electronic ballast, occupancy sensors, energy efficient lighting controls, energy saving potential of each technology.

Book and References:

1. "Optimizing Energy Efficiencies in Industry", G. G. Rajan, Tata McGraw Hill.
2. Energy Auditing and Conservation; Methods, Measurements, Management and Case Study"", Hemisphere Publishers.
3. "Industrial Energy Conservation", Charles M. Gottschalk, John Wiley and Sons.
4. "Utilization of Electrical Energy and Conservation", S. C. Tripathy, McGraw Hill, 1991.
5. "Success stories of Energy Conservation by BEE", New Delhi (www.bee-india.org).
6. "Guide books for National Certification Examination for Energy Manager / Energy Auditors Book1", General Aspects (available online)
7. "Guide books for National Certification Examination for Energy Manager / Energy Auditors Book3", Electrical Utilities (available online).

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Semester –2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-0035E	Modeling and Control of Sustainable Energy System	100	4	0	0	4	E

Course Outcome:

After the successful completion of the course Students will be	
CO-1	Able to define and explain the basic concept of distributed generation and microgrids.
CO-2	Able to demonstrate the control of voltage and frequency of Microgrid.
CO-3	Able to explain energy generation by wind power and solar power.
CO-4	Able to get competency in the development of dynamic model of sustainable energy system.

Syllabus Contents:

General introduction to the concept of distributed generation, Standalone System. Integration of distributed renewable generation into the electricity system (Current status, challenges and prospects) and its impacts on the electrical system. Sources of Energy - Wind Power, Solar Power, Combined Heat- and-Power, Hydropower, Tidal Power, Geothermal Power. Control of standalone system and Grid connected system (Voltage and frequency control). Primary frequency control in large systems, Fault ride through. Analysis of Wind and PV systems: Stand-alone operation of fixed and variable speed wind energy conversion systems and solar system. Grid connection Issues -Grid integrated PMSG and SCIG Based WECS Grid. Integrated solar system. Dynamic modeling and performance analysis of a DFIG wind energy conversion system and Photovoltaic plant.

TEXT BOOKS:

1. Bollen M.H.J., Hassan F., Integration of distributed generation in the power system. IEEE Press Series on Power Engineering. Wiley. Hoboken 2011.
2. Leon Freris, David Infield, "Renewable energy in power systems", John Wiley & Sons, 2008.
3. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, John Wiley & Sons,

2011.

4. Wind Electric Systems: S.N. Bhadra, D.Kastha, OXFORD university press, 2005.

Semester –2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-00J6C	HVDC and FACTS Devices	100	4	0	0	4	E

Course Outcomes:

At the end of the course students will be able to	
CO1	Describe various methods for the control of HVDC systems and to perform power flow analysis in AC/DC systems.
CO2	Choose proper FACTS controller for the specific application based on system requirements.
CO3	Analyze the control circuits of Shunt Controllers, Series controllers.
CO4	Analyze combined controllers for various functions viz. Transient stability Enhancement, voltage instability prevention and power oscillation damping.

Syllabus Contents:

HVDC Transmission system. HVDC Converters. Inverter operation, equivalent circuit representation of rectifier and inverter configurations. LCC bridge characteristics and boundary for rectifier and inverter operations. Analysis of 12- pulse bridge converter configuration. Harmonics introduction, generation, ac filters and dc filters. Introduction to multi terminal DC systems and applicat ions, comparison of series and parallel MTDC systems, Voltage Source Converter based HVDC systems. Reactive power control in electrical power transmission, principles of conventional reactive power compensators. Introduction to FACTS, flow of power in AC parallel paths, meshed systems, basic types of FACTS controllers, definitions of FACTS controllers, AC transmission line and reactive power compensation. Analysis of uncompensated line, performance of line connected to unity PF load. Shunt compensation – objectives of shunt compensation, methods of controllable VAR generation, static VAR compensators – SVC, STATCOM, SVC and STATCOM. Improvement of transient stability using SPS, Applications of SPST. Unified power flow controller (UPFC) – Analysis of operation of a UPFC connected at the sending end/ at the receiving end/ at the midpoint. Schematic concept of IPFC, BTB HVDC link and Convertible Static Compensator (CSC).

Books and References:

1. K.R. Padiyar, HVDC Power Transmission Systems, New Age International.
2. K.R. Padiyar, FACTS Controllers in Power Transmission and Distribution, New Age International.
3. Narain G. Hingorani and Laszlo GyuGui, Understanding FACTS Concepts and Technology of Flexible AC Transmission Systems, IEEE Press.

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4. Vijay K. Sood, HVDC and FACTS Controllers Applications of Static Converters in Power Systems, Springer.
5. Arindam Ghosh and Gerald Ledwich, Power Quality Enhancement using Custom Power Devices, Kluwer Academic Publishers Boston/Dordrecht/London.

Semester –2

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-0037E	Power Quality Analysis	100	4	0	0	4	E

Course Outcome:

After the successful completion of the course Students will be	
CO-1	Able to understand and handle power quality related problems.
CO-2	Familiar with power quality terminologies, and ready to tackle power quality related challenges.
CO-3	Able to identifying the cause or source of the problem and assessing the severity of each problem with respect to the vulnerability of the affected devices.
CO-4	Able to know how to identify the adverse effects of non-linear loading at the distribution end and different ways of eliminating system harmonics.

Syllabus Contents:

Power quality-voltage quality-overview of power quality phenomena-classification of power quality issues-power quality measures and standards-THD-TIF-DIN-message weights-flicker factor-transient phenomena-occurrence of power quality problems-power acceptability curves-IEEE guides, EMC standards and recommended practices. Terms used in PQ: Voltage, Sag, Swell, Surges, Harmonics, over voltages, spikes, Voltage fluctuations, Transients and Interruption – Characteristics, causes, effects and methods of mitigation. Voltage sag performance evaluations for transmission and distribution systems. Role of energy storage devices in mitigating poor voltage quality. Reliability indices and their importance. High voltage transients in power system- their causes, effects and methods of reduction. Ferro-resonance, its effects, mitigation and ways of detection of its occurrence. Devices for over voltage protection and electrical noise. Power Qualit y Monitoring. Evaluation of power system harmonic distortion.

TEXT BOOKS:

1. "Understanding Power Quality Problems" by Math H J Bollen. IEEE Press.
2. Power Quality in Electrical Systems" by Alexander Kusko, The McGraw-Hill

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Companies, 2007.

REFERENCE BOOKS:

1. Power Quality in Power System" by Mohammad A.S. Masoum, EwaldF.Fuchs, Elsevier, Academic Press, 2015.
2. Electrical Power Systems Quality

Semester –2

Course	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0010E	Smart Grid	100	4	0	0	4	E

Course Outcome:

After the successful completion of the course Students will be	
CO-1	Explain the smart grid components and architecture.
CO-2	Interpret about different smart grid technologies.
CO-3	Demonstrate the basic concept of Demand side management and its strategies.
CO-4	Analyze on Microgrid protection and different security issues in smart grid.

Syllabus Contents:

The Smart Grid, Smart Grid Communication and Measurement Technology-Monitoring, PMU, Smart Meters, GIS and Google Mapping Tools, Multiagent Systems (MAS) Technology, Components of Smart Grid, Smart Grid Benefits and Challenges, Performance Analysis Tools for Smart Grid Design, Stability Analysis Tools for Smart Grid, Information Security for the Smart Grid.

Book and References:

(i) Smart Grid: Fundamentals of Design and Analysis; James Momoh; Edition: 2015; Publisher: Wiley India Pvt Ltd
(ii) The Advanced Smart Grid:Edge Power Driving Sustainability ; John Cooper; Edition: 2011; Publisher: Artech House Publishers
(iii) The Smart Grid; Clark W Gellings; Edition: 2009; Publisher: T&F
(iv) Smart Grid Technology and Applications; Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins; Edition: 2015; Publisher: Wiley India Pvt Ltd
(v) Smart Grids- Engineering and Management; Jean-Claude Sabonnadiere; Edition: 2011; Publisher: Wiley

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Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE-1007C	Simulation and Advanced Electrical Engineering Laboratory	100	0	0	4	2	C

Course Outcome:

At the end of the completion of the course students will be able to	
CO-1	Able to verify the theoretical concepts of power system studies.
CO-2	Able to solve various power systems problems using modern power systems tools.
CO-3	Able to assess the computational complexities involved in the solution process.

Experiments:

1. Hands on practices on the following software for system analysis.
   i. MATLAB
   ii. ETAP
   iii. CASPOC
   iv. LABView Software for real time data analysis.
2. Experiment on static Kramer drive.
3. Experiment on Closed loop speed control using DC shunts motor-based drive system.
4. Experiment on V/F control of Induction Motor based drives.
5. Hand on Practices of PLC based experimentation for bidirectional movement of conveyer belt using PLC based Programming.
6. Experiment for the determination of Characteristics of different types of sensors for analog and Digital measurement of electrical and physical quantities.
7. Experimentation on the effects of system characteristics and performances due to the successive loop closure for the pole placement of Electromechanical plant.
8. Observation on the feedback flow rate controlled designing the PID controller at different methods.

Course Code	Course name	Marks	L	T	P	Credit	Core /El
MEE-1004C	Design Project & Term Paper Leading to Thesis	100	0	0	4	2	C

Course Outcomes:

At the end of the course, students will demonstrate the ability to-	
CO-1	Identify the project of their expertise domain and interest.
CO-2	Explain the recent trend of research and its recent developments through literature survey
CO-3	Make an in-depth study of a specific topic within suitable engineering design and specifications.

Syllabus Contents:

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Identification of domain for research.
2) Literature review.
3) In-depth study for suitable engineering design and specifications.

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Semester-III

3rd Semester:700 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective	MooCs
MEE 1101C	Thesis Report Interim	200	0	8	8	8	C	
MEE 1102C	Thesis Seminar Interim (Presentation & Viva	200	0	4	4	4	C	
MEE 1103C	Technical Communication	100	0	2	2	2	C	
MEE 1104C	Workshop and Seminars	100 *(70+30)	0	2	2	2	C	
MEE00XXE	Elective Paper IV	100 *(70+30)	4	0	0	4	E	
	Total	700	4	16	16	20		

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 1101C	Thesis Report Interim	200	0	8	8	8	C

Course outcomes:

At the end of the course, students will demonstrate the ability to	
CO-1	Understand that how to write thesis with good readability
CO-2	Learn to write section wise.
CO-3	Understand the skills needed while writing a thesis
CO-4	Ensure the quality of thesis report

Syllabus Contents:

Planning and Preparation, clarifying contributions of other authors, summarizing your findings, paraphrasing and plagiarism, sections of your thesis. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a thesis, 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 about the methods and results, skills are needed when writing the discussion, skills are needed when writing the conclusions. Useful phrases, how to ensure thesis is as good as it could possibly be the first-time thesis writing.

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 1102C	Thesis Seminar Interim (Presentation & Viva Voce)	200	0	4	4	4	C

Course Outcome:

At the end of the course, students will demonstrate the ability to-	
CO-1	Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
CO-2	Identify from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO-3	Demonstrate the findings of their technical solution in a written report.
CO-4	Present the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thusreduce the gap between the world of work and the world of study.

A. The dissertation should have the following-

i) Relevance to social needs of society
ii) Relevance to value addition to existing facilities in the institute
iii) Relevance to industry need
iv) Problems of national importance
v) Research and development in various domain

B. The student should complete the following:

i) Literature survey Problem Definition
ii) Motivation for study and Objectives
iii) Preliminary design / feasibility / modular approaches
iv) Implementation and Verification
v) Report and presentation

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 1103C	**Technical Communication**	100	0	2	2	2	C

Course outcomes:

At the end of the course, students will demonstrate the ability to:	
CO-1	Understand that how to improve your writing skills and level of readability
CO-2	Learn about what to write in each section
CO-3	Understand the skills needed when writing a Title
CO-4	Ensure the good quality of paper at very first-time submission

Syllabus Contents:

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and

Sentences, B e i n g Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction. 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. Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission

BOOKS AND REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wall work, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 1104C	Workshop and Seminars	100	0	2	2	2	C

Course outcomes:

At the end of the course, students will demonstrate the ability to	
CO-1	Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments
CO-2	Prepare appropriately to participate effectively and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience
CO-3	Speak and debate with an appreciation for complex social and technical sensibilities
CO-4	Offer compelling, articulate oral arguments, showing an understanding of the unique demands of oral presentation as opposed to writing

Syllabus Contents:

1. Participate effectively in discussion of workshops and seminars [at least 02(two)].
2. Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments and submit a comprehensive report to the department.
3. Demonstration of the ability to speak and defend (to be presented in the presentation seminar organized by the department).
4. Understanding of the unique demands of oral presentation as opposed to writing.(presentation skills will be evaluated)

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Semester –3
Elective-IV

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0038E	Lightning design and Calculations	100	4	0	0	4	E

Course outcomes:

At the end of the course, students will demonstrate the ability to:	
CO-1	Understand the basic concepts related to Illumination Engineering
CO-2	Understand the Illuminance calculations
CO-3	Understand the optical and exterior lighting design

Syllabus Contents:

Review of fundamentals of Illumination Engineering. Lighting field of luminaries Practical coordinate systems, Transformation of coordinate system from point, line area source, Illuminance calculation- Derivation of luminous flux from luminous intensity, flux transfer and inter-reflection luminance calculations, Discomfort glare. Optical design reflector system, refractor system. Principal of lighting design- Indoor lighting design by lumen method, by point method, Designing problem and solution and designing documentation. Exterior lighting system- Road lighting system and highway lighting system

Suggested Books:

1. Prafulla C. Sorcar , Rapid lighting design and cost estimating, McGraw-HillPublication,1979.
2. Mark Karlen, James R. Benya, "Lighting Design Basics", John Wiley & Sons publication
3. R. H. H. Simons, A.R. R. Bean, Lighting Engineering: Applied Calculations, Architectural Press, 2001
4. Advanced Lighting Guidelines by California Energy Commission Staff, 1993
5. John Hauck, Electrical Design of Commercial and Industrial Buildings, Jones and Bartlett Publishers, Canada

Semester –3

Elective-IV

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0039E	High Voltage Measurements	100	4	0	0	4	E

Course outcomes:

At the end of the course, students will demonstrate the ability to:	
CO-1	Understand different high voltage dc and ac measurement techniques.
CO-2	Know effect of different types of connections to measuring instruments
CO-3	Apply different optical methods in high voltage measurements.

Syllabus Contents:

Measurement of high direct and alternating voltages, Sphere gaps and uniform field gaps and the influence of external parameters on measurement, Generating voltmeters, Voltmeter and voltage dividers, milli-ammeter and series impedance. Impulse voltage measurement, Sphere gaps, impulse peak voltmeters, oscillographic measurements, Potential dividers for high voltage measurements, voltage dividers for ac and dc voltage measurements. Dividers for impulse voltage measurements a) Resistance dividers. b) Capacitance dividers. c) Resistance/capacitance dividers. Effects of connections to test object, Effect of delay cables and terminations, Effect of connections to measuring instruments. Impulse current measurements, measuring technique and design of different type of shunt. High-speed oscillographic technique 1) Recurrent surge oscillographs. 2) Sealed off and continuously evacuated oscillographs. Partial discharge measurements and measuring techniques. Application of optical methods in high voltage measurement.

References:

1. High Voltage Engineering-D.H. Razavig
2. High Voltage Measurement Techniques-A.J. Schwab
3. Naidu M. S. and Kamaraju V., "High Voltage Engineering", fourth Edition, Tata McGraw- Hill Publishing Company Limited, New Delhi, 2009.
4.Kuffel, E., Zaengl W.S., Kuffel J., "High Voltage Engineering: Fundamentals" Butterworth Heinmann (A division of Reed Educational & Profession Publishing Limited), 2nd Edition, 2000.
5.Wadhwa C.L., "High Voltage Engineering", third edition, New Age publishers, New Delhi, 2010.

Semester –3

Elective-IV

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0040E	Power System Transients	100	4	0	0	4	E

Course outcomes:

At the end of the course, students will demonstrate the ability to:	
CO-1	Understand and analyze switching and lightning transients.
CO-2	Acquire knowledge on generation of switching transients and their control.
CO-3	Understand the importance of propagation, reflection and refraction of travelling waves.
CO-4	Find the voltage transients caused by faults

Syllabus Contents:

Fundamental of Transient in Electrical Networks-role of damping, abnormal switching transients, transients in three phase circuits. Computations of Power System transients, principle of digital computations-solutions, Modal analysis of Power system networks, over voltages due to lighting, & Switching- physical phenomena of lightning, interaction between lightning & power system, switching – shortline or kilometric fault, energizing transients – closing and reclosing of lines. Line droping, load rejection, over voltage induced by faults. Switching HVDC line, travelling waves on transmission line circuits with distributed parameters. Wave equations. Behaviour of Travelling waves at the line terminations. Lattice diagram- Attenuation and Distortion. Multi conductor system and velocity wave. Insulation co-ordination: Principle of insulation coordination in Air Insulated substation (AIS) and Gas Insulated Substation (GIS)

Suggested Books:

1. Allan Greenwood, 'Electrical Transients in Power Systems', Wiley Inter Science, New York, 2nd Edition, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", John Wiley and Sons Inc., Second Edition, 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', PHI Learning Private Limited, Second Edition, 2010

Semester-IV

4th Semester: 600 Marks

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective	MooCs
MEE 1201C	Thesis Report Final	200	0	8	8	8	C	
MEE 1202C	Thesis Seminar Final (Presentation & Viva Voce)	200	0	8	8	8	C	
MEE 1203C	Workshop and Seminars	100 *(70+30)	0	2	2	2	C	
MEE 00XXE	Elective Paper V	100 *(70+30)	4	0	0	4	E	
	Total	600	4	16	18	20		

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 1201C	Thesis Report Final	200	0	8	8	8	C

Course outcomes:

At the end of the course, students will demonstrate the ability to	
CO-1	Understand that how to write thesis with good readability
CO-2	Learn to write section wise.
CO-3	Understand the skills needed while writing a thesis
CO-4	Ensure the quality of thesis report

Syllabus Contents:

Planning and Preparation, Clarifying contributions of other authors, summarizing your findings, paraphrasing and plagiarism, sections of your thesis. Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. Key skills are needed when writing a thesis, 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 about the methods and results, skills are needed when writing the discussion, skills are needed when writing the conclusions. Useful phrases, how to ensure thesis is as good as it could possibly be the first-time thesis writing.

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Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 1202C	Thesis Seminar Final (Presentation and Viva Voce)	200	0	8	8	8	C

Course Outcome:

At the end of the course, students will demonstrate the ability to	
CO-1	Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
CO-2	Identify from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
CO-3	Demonstrate the findings of their technical solution in a written report.
CO-4	Present the work in International/ National conference or reputed journals.

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

A. The dissertation should have the following-

vi) Relevance to social needs of society
vii) Relevance to value addition to existing facilities in the institute
viii) Relevance to industry need
ix) Problems of national importance
x) Research and development in various domain

B. The student should complete the following:

vi) Literature survey Problem Definition
vii) Motivation for study and Objectives
viii) Preliminary design / feasibility / modular approaches
ix) Implementation and Verification
x) Report and presentation

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 1203C	Workshop and Seminars	100	0	2	2	2	C

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Semester – 4

Elective-V

Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 0041E	**Condition Monitoring of High Voltage equipments**	100	4	0	0	4	E

Course Outcomes:

At the end of the course students will be able to	
CO-1	Apply for preventive maintenance of high voltage equipments.
CO-2	Apply for the dielectric response measurement.
CO-3	Understand Measurements of paper conductivity.
CO-4	Able to analyze Condition monitoring of dielectric response.

Contents of Syllabus:

Preventive Maintenance: How Preventive Maintenance Helps, Purpose of Diagnostic Testing, Why Condition Monitoring, Causes of Insulation Degradation, Oil-Paper composite Insulation System. Traditional Condition Assessment Techniques for Oil-Paper Composite Insulation: Dissolved Gas Analysis, Furan Analysis, Degree of Polymerization. Moisture in Oil-Paper Composite Insulation: Moisture Distribution, Moisture Dynamics, Effects of Moisture, Moisture Detection – Crackle Test, Karl Fischer Titration, Equilibrium Curves, Comparison of Equilibrium Curves, ABB and Serena's Equations, Moisture Content in Paper, Moisture Management, Oil Reclamation. Dielectric Response Measurement: Polarization Mechanisms in Dielectrics, Dielectric Response in Time-Domain. Polarisation and Depolarisation Current (PDC) Measurement, PDC Measurement – Test Set Up and Typical Results. Recovery Voltage Measurement (RVM), RVM Fundamentals, Polarization Spectrum, Typical RVM Results. Frequency Domain Spectroscopy (FDS), FDS equipment and analysis. Dielectric Response Function and Insulation Model: Mathematical Model of Dielectric Response, Oil Conductivity, Paper Conductivity, Relating Oil and Paper Conductivities with Insulation Condition, Modeling of Recovery Voltage, Modeling Dielectric Response in Frequency Domain, Dissipation Factor, Circuit Model, Identification of Equivalent Model Parameters, Calculating RV from Equivalent Model, Calculating Dissipation Factor From Equivalent Model, Calculating Complex Capacitance from Equivalent Model.

Books and References:

1.T.S.Ramu,H.N.Nagmani," Partial Discharge Based Condition Monitoring of High Voltage Equipment, New Age International Publishers

2. R.E.James and Q.Su," Condition Assessment of High Voltage Insulation in Power System Equipment ,IET Power and Energy Series.

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Course Code	Course name	Marks	L	T	P	Credit	Core/Elective
MEE 0042E	Power System Optimization	100	4	0	0	4	E

Course Outcomes:

At the end of the course students will be able to	
CO-1	Understand the different types of Optimisation techniques.
CO-2	Apply the different Algorithms for fault section Optimisation
CO-3	Apply for the optimization of Generation & Transmission lines
CO-4	Apply for the optimization of economic load dispatch using Algorithms.

Syllabus Contents:

Optimization techniques in Engineering fields as well as in power system- Current framework; economic dispatch, unit commitments, operational of power system in competitive environment, Genetic Algorithm, Neural network, Fuzzy programming, Interior point method, hybrid techniques, Integrating fuzzy logic & genetic algorithm, simulating annealing approach-Digital simulation of annealing process, Algorithm of simulating annealing. Applications of algorithm to distributed system optimization. Application of algorithm in fault section optimization, state identification of unobserved protective relays in power system. Applications of Genetic Algorithm for scheduling generation & maintenance in power system. Transmission network planning using GA, Optimization using artificial neural network for scheduling. Application of algorithm for the optimization in deregulated power environment. Lagrange relaxation application for Electric Power optimization & planning problem-Problem formulation, solution approach, medium/long term hydrothermal scheduling techniques-the treatment of uncertainty decomposition procedure. Applications of GA for economic load dispatch system.

Books and References:

1. Power Generation, Operation and Control, Allen J. Wood and Bruce F. Wollengerg, Wiley.
2. Economic Operation of Power Systems, L. K. Kirchamayer, John Wiley & Sons.
3. Power System Optimization, D.Kothari, J. S. Dhillon, PHI Publication.
4. Engineering optimization Theory and Practice, Singiresu S. Rao, John Wiley & Sons.

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Semester – 4

Elective-V

Course Code	Course name	Marks	L	T	P	Credit	Core /Elective
MEE 0043E	Electric and Hybrid Vehicle	100	4	0	0	4	E

Course Outcomes:

At the end of the course students will be able to	
CO-1	Acquire knowledge about fundamental concepts and principles about Electric and Hybrid vehicle.
CO-2	Acquire knowledge about the basic concept of Power-flow in hybrid drive systems,
CO-3	Analysis the electric motor-based drives for traction purposes.
CO-4	Acquire knowledge about energy storage technology & Management for hybrid and electric vehicles.

Contents of Syllabus:

History of hybrid and electric vehicles, Social and environmental importance of hybrid and electric vehicles, Impact of modern drive-trains on energy supplies, Basics of vehicle performance, vehicle power source, characterization Transmission, characteristics, Mathematical models to describe vehicle performance, Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis. Basic concept of hybrid traction, Introduction to various hybrid drive-train topologies, Power flow control in hybrid drive-train topologies, Fuel efficiency analysis, Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Introduction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency, Matching the electric machine and the internal combustion engine(ICE),Sizing the propulsion motor, sizing the power electronics Selecting the energy storage technology, Communications, supporting subsystems, Introduction to energy management and their strategies used in hybrid and electric vehicle.

Books and References:

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.

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