REVISED CURRICULUM STRUCTURE

(TO BE EFFECTIVE FROM 2025 ADMISSION BATCH)

JIS COLLEGE OF ENGINEERING

EDPS CURRICULUM-R25

DEPARTMENT OF ELECTRICAL ENGINEERING

Course: M.Tech Specialization in Electrical Devices & Power System

Semester I

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Core 1	EDPM 101	Soft Computing Techniques	3	0	0	3
2	Core 2	EDPM 102	Energy-Efficient Motor	3	0	0	3
3	PE 1	EDPM 103	(a) Smart Grid (b) Power System Operation & Control (c) Grid Integrated RES through Net Metering (d) Mathematical Methods for Power Engineering	3	0	0	3
4	PE 2	EDPM 104	(a) Advanced Power Electronics for Renewable and Non-Renewable Generation (b) Wireless Power Transfer (c) Control of Electric Drives (d) High Power Converters	3	0	0	3
5	MLC	MLC 101	Research Methodology and IPR	2	0	0	2
6	Lab 1	EDPM 191	Soft Computing Techniques Lab	0	0	4	2
7	Lab 2	EDPM 192	Energy-Efficient Motor Lab	0	0	4	2
8	Audit-I	EDPM 182	Thesis Component I	2	0	0	0

Total: L=16, T=0, P=8, Credit=18

Semester II

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Core 3	EDPM 201	Digital Protection of Power Systems	3	0	0	3
2	Core 4	EDPM 202	FACTS and Custom Power Devices	3	0	0	3
3	PE 3	EDPM 203	a) Power System Transient b) Power Quality Improvement Techniques c) Electric Vehicles d) Battery Management Systems (BMS)	3	0	0	3
4	PE 4	EDPM 204	(a) Electrical Power Distribution Systems (b) SCADA System and Applications (c) Advanced Embedded and Micro-Controller Based Systems (d) EHV AC Power Transmission	3	0	0	3
5	Minor Project	EDPM 281	Literature Review & Research Dissemination of Minor Project with Seminar	0	0	4	2
6	Lab 3	EDPM 291	Power System Digital Protection Lab	0	0	4	2
7	Lab 4	EDPM 292	(a) Electrical Power Distribution System Lab (b) PLC & SCADA Lab (c) Microcontroller Lab (d) Power Systems Computation Lab	0	0	4	2
8	Audit-II	EDPM 282	Thesis Component II	2	0	0	0

Total: L=14, T=0, P=12, Credit=18

Semester III

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	PE 5	EDPM 301	(a) Restructured Power Systems (b) Advanced Embedded and Micro-Controller Based Systems (c) Power System Planning & Reliability (d) Engineering Optimization	3	0	0	3
2	OE	EDPM 302	(a) Data Analytics in Power Systems & Devices (b) Safety and Risk Management in Power Systems and Electrical Devices (c) Energy Management and Auditing (d) Green Technology and Waste Management	2	0	0	3
3	Major Project	EDPM 381	Phase – I Dissertation	0	0	20	10

Total: L=6, T=0, P=20, Credit=16

Semester IV

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Major Project	EDPM 481	Phase – II Dissertation	0	0	32	16

Total: L=0, T=0, P=32, Credit=16

GRAND TOTAL CREDITS = 68

REVISED CURRICULUM STRUCTURE

(TO BE EFFECTIVE FROM 2025 ADMISSION BATCH)

JIS COLLEGE OF ENGINEERING

EDPS CURRICULUM-R25

DEPARTMENT OF ELECTRICAL ENGINEERING
Course: M.Tech Specialization in Electrical Devices & Power System
Semester I

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Core 1	EDPM 101	Soft Computing Techniques	3	0	0	3
2	Core 2	EDPM 102	Energy-Efficient Motor	3	0	0	3
3	PE 1	EDPM 103	(a) Smart Grid (b) Power System Operation & Control (c) Grid Integrated RES through Net Metering (d) Mathematical Methods for Power Engineering	3	0	0	3
4	PE 2	EDPM 104	(a) Advanced Power Electronics for Renewable and Non-Renewable Generation (b) Wireless Power Transfer (c) Control of Electric Drives (d) High Power Converters	3	0	0	3
5	MLC	MLC 101	Research Methodology and IPR	2	0	0	2
6	Lab 1	EDPM 191	Soft Computing Techniques Lab	0	0	4	2
7	Lab 2	EDPM 192	Energy-Efficient Motor Lab	0	0	4	2
8	Audit-I	EDPM 182	Thesis Component I	2	0	0	0

Total: L=16, T=0, P=8, Credit=18

Semester II

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit	Faculty

1	Core 3	EDPM 201	Digital Protection of Power Systems	3	0	0	3	BD
2	Core 4	EDPM 202	FACTS and Custom Power Devices	3	0	0	3	BD
3	PE 3	EDPM 203	a) Power System Transient b) Power Quality Improvement Techniques c) Electric Vehicles d) Battery Management Systems (BMS)	3	0	0	3	DU
4	PE 4	EDPM 204	(a) Electrical Power Distribution Systems (b) SCADA System and Applications (c) Advanced Embedded and Micro-Controller Based Systems (d) EHV AC Power Transmission	3	0	0	3	MS
5	Minor Project	EDPM 281	Literature Review & Research Dissemination of Minor Project with Seminar	0	0	4	2	AKS
6	Lab 3	EDPM 291	Power System Digital Protection Lab	0	0	4	2	BD
7	Lab 4	EDPM 292	(a) Electrical Power Distribution System Lab (b) PLC & SCADA Lab (c) Microcontroller Lab (d) Power Systems Computation Lab	0	0	4	2	MS
8	Audit-II	EDPM 282	Thesis Component II	2	0	0	0	SP

Total: L=14, T=0, P=12, Credit=18

Semester III

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit	Faculty
1	PE 5	EDPM 301	(a) Restructured Power Systems (b) Advanced Embedded and Micro-Controller Based Systems (c) Power System Planning & Reliability (d) Engineering Optimization	3	0	0	3	GR
2	OE	EDPM 302	(a) Data Analytics in Power Systems & Devices (b) Safety and Risk Management in Power Systems and Electrical Devices (c) Energy Management and Auditing (d) Green Technology and Waste Management	2	0	0	3	SP
3	Major Project	EDPM 381	Phase – I Dissertation	0	0	20	10	

Total: L=6, T=0, P=20, Credit=16

Semester IV

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Major Project	EDPM 481	Phase – II Dissertation	0	0	32	16

Total: L=0, T=0, P=32, Credit=16

GRAND TOTAL CREDITS = 68

Semester I

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Core 1	EDPM 101	Soft Computing Techniques	3	0	0	3
2	Core 2	EDPM 102	Energy-Efficient Motor	3	0	0	3
3	PE 1	EDPM 103	(a) Smart Grid (b) Power System Operation & Control (c) Grid Integrated RES through Net Metering (d) Mathematical Methods for Power Engineering	3	0	0	3
4	PE 2	EDPM 104	(a) Advanced Power Electronics for Renewable and Non-Renewable Generation (b) Wireless Power Transfer (c) Control of Electric Drives (d) High Power Converters	3	0	0	3
5	MLC	MLC 101	Research Methodology and IPR	2	0	0	2
6	Lab 1	EDPM 191	Soft Computing Techniques Lab	0	0	4	2
7	Lab 2	EDPM 192	Energy-Efficient Motor Lab	0	0	4	2
8	Audit-I	EDPM 182	Thesis Component I	2	0	0	0

Total: L=16, T=0, P=8, Credit=18

SYLLABUS OF R25 CURRICULLAM
COURSE: - M. TECH SPECILIZATION ON EDPS (ELECTRIC DEVICES & POWER SYSTEM)
DEPARTMENT: -ELECTRICAL ENGINEERING

Course Name: Soft Computing Techniques

Course Code: EDPM 101
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Basics of Artificial Intelligence, Optimization, and Power Systems Analysis

Course Objectives

Obj.1: Introduce the concept and need of soft computing methods for solving complex and nonlinear engineering problems.
Obj.2: Develop understanding of neural networks, fuzzy logic systems, and evolutionary algorithms.
Obj.3: Illustrate hybrid intelligent systems combining multiple soft computing techniques.
Obj.4: Apply soft computing approaches to power system optimization, control, and prediction tasks.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Describe the fundamentals and motivation behind soft computing techniques.
CO2: Apply neural networks, fuzzy logic, and genetic algorithms to solve engineering problems.
CO3: Analyze hybrid soft computing approaches for complex optimization and decision-making.
CO4: Implement soft computing techniques in power system operation, control, and forecasting.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Introduction to Soft Computing (8L)

Overview of soft computing and its importance. Difference between hard and soft computing. Components of soft computing – fuzzy logic, neural networks, and genetic algorithms. Applications in engineering systems.

Module 2: Artificial Neural Networks (ANN) (9L)

Biological neuron and artificial neuron models. Activation functions. Multilayer perceptron (MLP), backpropagation algorithm, Hopfield network, radial basis function (RBF) networks, and self-organizing maps (SOM). Training and testing of neural networks.

Module 3: Fuzzy Logic and Fuzzy Systems (8L)

Fuzzy sets and membership functions. Fuzzy operations and rules. Fuzzy inference systems (Mamdani and Sugeno models). Defuzzification techniques. Fuzzy controllers and their applications in control systems.

Module 4: Evolutionary Computation and Genetic Algorithms (8L)

Concept of natural evolution and genetic algorithms. Representation, selection, crossover, mutation, and fitness functions. Convergence of GA. Applications in optimization and power system scheduling.

Module 5: Hybrid Soft Computing and Applications (9L)

Neuro-fuzzy systems, fuzzy-GA hybrid models, and other hybrid intelligent systems. Case studies on soft computing applications in power system load forecasting, fault diagnosis, optimal power flow, and voltage stability enhancement.

Text Books

1. S. N. Sivanandam and S. N. Deepa, *Principles of Soft Computing*, Wiley.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, Pearson.
3. D. E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison Wesley.

Reference Books

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, PHI.
2. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, Wiley.
3. Simon Haykin, *Neural Networks and Learning Machines*, Pearson.
4. Kalyanmoy Deb, *Optimization for Engineering Design: Algorithms and Examples*, PHI.

Course Name: Energy-Efficient Motors

Course Code: EDPM102

Contact: 4L:0T:2P

Total Contact Hours: 36

Credit: 3

Standard: PG M. Tech

Prerequisite: Fundamentals of Electrical Machines, Power Electronics, Control Systems, and Energy Systems.

Course Objectives

The objectives of this course are to:

Obj.1: Develop an in-depth understanding of electrical motor losses, efficiency, and their performance characteristics.

Obj.2: Introduce international and Indian standards on energy-efficient motor design and testing.

Obj.3: Explore design, material, and control strategies to enhance energy performance.

Obj.4: Provide exposure to drive integration, system-level optimization, and energy auditing.

Obj.5: Familiarize students with industrial practices, Indian case studies, and recent technological trends in smart and efficient motor systems.

Course Outcomes

After completing the course, students will be able to:

CO1: Analyze different loss components and efficiency characteristics of electric motors under various operating conditions.

CO2: Interpret and apply BIS, BEE, and IEC motor efficiency standards for performance classification and selection.

CO3: Design and propose material and structural modifications to improve motor energy efficiency.

CO4: Evaluate motor control and drive integration methods for enhanced energy savings and operational reliability.

CO5: Conduct energy audits and propose optimization strategies for industrial motor systems in line with Indian standards.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	-	2	3	-	-	-	2
CO2	2	3	3	-	3	-	-	-	-	-
CO3	3	3	2	3	-	-	-	-	-	2
CO4	3	2	3	-	3	-	-	-	-	-
CO5	3	3	2	-	3	2	-	-	-	2

Course Content

Module 1 – Fundamentals of Motor Efficiency (7L)

Overview of motor types: Induction, Synchronous, DC, Reluctance, PM motors, Classification of motor losses: copper, iron, mechanical, stray load losses, Efficiency determination and testing: direct and indirect methods, Effect of voltage, frequency, and load on efficiency, Performance indices and energy flow in motor systems.

Module 2 – Efficiency Standards and Indian Regulations (6L)

International efficiency classes (IE1 to IE5) – IEC 60034 series, Indian Standards: IS 12615:2018, IS 4029, IS 4889, BEE star labelling, certification process, and MNRE initiatives, Economic evaluation: life-cycle cost, payback analysis, motor replacement vs rewinding, Policy framework for energy-efficient motors in India.

Module 3 – Design and Material Optimization (8L)

Design parameters affecting efficiency: magnetic circuit, winding design, air-gap length, Use of high-grade silicon steel, amorphous core materials, and advanced insulation, Reduction of stray load losses through optimized geometry, Cooling and thermal management in efficient motors, IE4 and IE5 motor technologies and emerging materials.

Module 4 – Control Techniques and Drive Integration (8L)

Energy-efficient operation using variable frequency drives (VFDs), Speed control techniques: scalar (V/f), vector control, DTC, Soft starters, regenerative braking, and energy recovery, Retrofitting for existing motor systems, Power factor correction, harmonics mitigation, and monitoring systems.

Module 5 – Energy Auditing and Case Studies (7L)

Motor system energy audit: methodology, instrumentation, and measurement, Benchmarking of motor performance and efficiency improvement assessment, Applications in pumps, fans, compressors — system-level optimization, Industrial case studies (Indian industries / BEE pilot projects), Emerging technologies: smart sensors, IoT-based monitoring, and predictive maintenance.

Text Books

1. Nagrath, I.J. & Kothari, D.P., Electric Machines, Tata McGraw-Hill.
2. Andreas, J.C., Energy-Efficient Electric Motors: Selection and Application, CRC Press.
3. Vedam Subrahmanyam, Electric Drives: Concepts and Applications, Tata McGraw-Hill.

4. BEE Study Material, Energy Efficiency in Electrical Utilities – Book 3, Bureau of Energy Efficiency, Govt. of India.
5. A.K. Sawhney, A Course in Electrical Machine Design, Dhanpat Rai Publications.

Reference Books

1. Bhattacharya, S.K., *Electrical Machines*, Tata McGraw-Hill.
2. S.C. Tripathy, *Energy Management: Principles, Applications and Case Studies*, McGraw-Hill Education (India).
3. IS 12615:2018, *High-Efficiency Induction Motors – Specification*, Bureau of Indian Standards (BIS).
4. Singh, M.D. & Khanchandani, K.B., *Power Electronics*, Tata McGraw-Hill.
5. TERI (The Energy and Resources Institute), *Energy Efficiency in Motor Systems – Indian Case Studies*.

Course Name: Smart Grid

Course Code: EDPM 103A

Contact: 3L:0T:0P

Total Contact Hours: 42

Credit: 3

Standard: PG (M.Tech)

Prerequisite: Basic understanding of power systems, electrical networks, and power electronics.

Course Objectives

Obj.1: Introduce the evolution, architecture, and core technologies of smart grids in modern power systems.

Obj.2: Develop the ability to analyze integration of renewables, distributed energy resources, and advanced controls within smart grids.

Obj.3: Foster understanding of communication, automation, and cybersecurity aspects of smart grid operation.

Obj.4: Enable application of advanced management, optimization, metering, and protection techniques for smart grids.

Course Outcomes

CO1: Describe the architecture, features, challenges, and benefits of smart grids in comparison with conventional grids.

CO2: Analyze and evaluate the role of automation, monitoring, and advanced technologies within smart grids.

CO3: Interpret and implement strategies for integrating distributed generation, renewables, and storage systems in smart grid networks.

CO4: Apply knowledge of communication protocols, information management, and cybersecurity for secure and efficient smart grid operation.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	3	3	-	-	2	-	2
CO2	3	3	3	3	2	3	-	2	-	2
CO3	3	3	2	2	2	-	-	2	3	3
CO4	2	3	3	3	3	2	2	3	2	3

Course Content

Module 1: Introduction & Evolution of Smart Grids (8L)

Definition and evolution of the electric grid; Concept, architecture, and functions of smart grids. Comparison with conventional grids, need for smart grids, challenges and opportunities. Overview of new grid functionalities and case studies.

Module 2: Smart Grid Technologies & Components (8L)

Smart meters, advanced metering infrastructure (AMI), smart appliances, automated meter reading (AMR). Substation and feeder automation, intelligent electronic devices (IEDs), smart sensors, and GIS applications. Demand-side management, outage management, and home/building automation.

Module 3: Distributed Generation, Integration & Power Quality (10L)

Integration of renewable energy sources and distributed generation; Issues in microgrids, storage systems and their control. Power quality challenges and mitigation. Protection, control, and management strategies.

Module 4: Communication Networks & Cybersecurity (8L)

Communication requirements in smart grids: architectures, standards and protocols, networked operation and automation. Role of IoT, web services, and cloud computing. Cybersecurity principles and risk mitigation.

Module 5: Advanced Applications & Future Trends (8L)

Wide area monitoring, protection and control (WAMPAC), PMUs, synchrophasors, and SCADA integration. Advanced grid analytics, optimization, decision support, and energy management systems. Future trends, research, and policy issues.

Text Books

1. James Momoh, “Smart Grid: Fundamentals of Design and Analysis,” Wiley-IEEE Press.
2. Janaka Ekanayake et al., "Smart Grid: Technology and Applications," Wiley.
3. Stuart Borlase, “Smart Grid: Infrastructure, Technology, and Solutions,” CRC Press.

Reference Books

1. A. G. Phadke and J. S. Thorp, “Synchronized Phasor Measurements and Their Applications,” Springer.
2. Prabha Kundur, “Power System Stability and Control,” McGraw Hill.
3. Smart Grid Handbook for Regulators and Policy Makers, ISGF India.

Course Name: Power System Operation & Control

Course Code: EDPM 103B

Contact: 3L:0T:0P

Total Contact Hours: 42

Credit: 3

Standard: PG (M.Tech)

Prerequisite: Basics of Power Systems and Electrical Machines

Course Objectives

Obj.1: Introduce fundamental concepts of power system operation and control.

Obj.2: Explain power system economic operation including load dispatch and unit commitment.

Obj.3: Develop understanding of power system stability and control mechanisms.

Obj.4: Enable knowledge of modern control techniques for reliable and secure power system operation.

Course Outcomes

CO1: Describe the principles and challenges of power system operation and control.

CO2: Analyze economic load dispatch, unit commitment, and operation under constraints.

CO3: Understand techniques of voltage and frequency control in power systems.

CO4: Apply power system stabilizing methods and adaptive control for system reliability.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Introduction to Power System Operation (8L)

Overview of power system operation. Power system control centers and their functions. Role of system operators, supervisory control and data acquisition (SCADA) systems. Operational constraints and challenges.

Module 2: Load Frequency Control (LFC) and Economic Load Dispatch (9L)

Fundamentals of LFC, control area concept, response characteristics of generators. Speed governing system. Economic load dispatch problem: formulation and solution methods, including penalty factors and transmission losses.

Module 3: Unit Commitment and Scheduling (8L)

Unit commitment problem, constraints, and solution techniques. Hydrothermal scheduling. Effects of spinning reserve, security constraints. Role of automation in scheduling and dispatch.

Module 4: Voltage Control and Reactive Power Management (8L)

Voltage profile and reactive power control techniques. Automatic voltage regulators. Tap-changing transformers, capacitor banks, and synchronous condensers. Voltage stability concepts.

Module 5: Power System Stability and Control Techniques (9L)

Rotor angle stability: small and large disturbances. Transient stability studies. Power system stabilizers and their design. Modern control techniques in power systems including adaptive and robust control.

Text Books

1. P. Kundur, Power System Stability and Control, McGraw-Hill.
2. Allen J. Wood and Bruce F. Wollenberg, Power Generation, Operation, and Control, Wiley.
3. Hadi Saadat, Power System Analysis, McGraw-Hill.

Reference Books

1. J. Duncan Glover, Thomas Overbye, Mulukutla S. Sarma, Power System Analysis and Design, Cengage Learning.
2. L.P. Singh, Power System Analysis, New Age International.
3. B.R. Gupta, Power System Analysis and Design, S. Chand Publications.

Course Name: Grid Integrated RES through Net Metering

Course Code: EDPM 103C

Contact: 3L:0T:0P

Total Contact Hours: 42

Credit: 3

Standard: PG (M.Tech)

Prerequisite: Fundamentals of Power Systems and Renewable Energy Technologies

Course Objectives

Obj.1: Understand the principles of renewable energy sources (RES) integration into power grids.

Obj.2: Examine the concepts and technical aspects of net metering and energy management.

Obj.3: Analyze the operational challenges and grid codes related to RES integration.

Obj.4: Explore smart grid interaction, protection, and control techniques for integrated RES.

Course Outcomes

CO1: Explain the fundamentals of integrating renewable energy sources into power systems.

CO2: Analyze net metering principles, policies, and billing mechanisms.

CO3: Evaluate technical and operational challenges in integrating RES with the grid.

CO4: Apply protection, control, and smart grid strategies for efficient RES integration.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	2	2	-	2	-	3
CO2	3	3	3	3	2	2	-	2	-	2
CO3	3	3	2	2	3	2	-	2	3	3
CO4	3	2	3	3	3	3	-	3	2	3

Course Content

Module 1: Introduction to Renewable Energy Sources & Grid Integration (8L)

Overview of renewable energy sources (solar, wind, biomass, small hydro). Basics of grid integration, grid codes, and standards. Importance of grid stability and power quality.

Module 2: Net Metering Principles and Policies (8L)

Concept of net metering and net billing. Types of net metering systems. Regulatory frameworks and policies at national and international levels. Financial and environmental benefits.

Module 3: Technical Aspects of RES Integration (9L)

Power electronic interfaces: inverters, controllers, and standards. Synchronization, islanding, and load management. Impact of RES on voltage, frequency, and harmonic distortion.

Module 4: Protection and Control in Integrated Systems (8L)

Protection schemes for distributed generation (DG). Coordination of protective devices, fault detection techniques, and relay settings. Control strategies to maintain grid reliability and safety.

Module 5: Smart Grid Technologies & Future Trends (9L)

Role of smart grids in RES integration. Advanced metering infrastructure (AMI), demand response, and energy storage systems. Emerging technologies, research directions, and global trends.

Text Books

1. Muhammad H. Rashid, Power Electronics Handbook, Academic Press.
2. James G. Kirtley, Electric Power Systems, McGraw-Hill.
3. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, Wiley.

Reference Books

1. Stuart Borlase, Smart Grids: Infrastructure, Technology, and Solutions, CRC Press.
2. Ali Keyhani, Design of Smart Power Grid Renewable Energy Systems, Wiley.
3. Surya Santoso & David W. McAllister, Renewable Energy Integration, Springer.

Course Name: Mathematical Methods for Power Engineering

Course Code: EDPM 103D

Contact: 3L:0T:0P

Total Contact Hours: 42

Credit: 3

Standard: PG (M.Tech)

Prerequisite: Fundamentals of linear algebra, calculus, and electrical engineering mathematics.

Course Objectives

Obj.1: Equip students with fundamental mathematical tools essential for power system modeling and analysis.

Obj.2: Develop skills in analytical and numerical methods for solving power engineering problems.

Obj.3: Apply mathematical transforms and optimization techniques in power system operations.

Obj.4: Prepare students for advanced research and design in power engineering through mathematical rigor.

Course Outcomes

CO1: Understand and apply matrix theory, vector spaces, and eigenvalue techniques for power system analysis.

CO2: Solve differential equations and apply transform methods relevant to dynamic and steady-state power system problems.

CO3: Use numerical methods effectively for load flow, fault analysis, and other power system calculations.

CO4: Employ optimization methods such as linear and dynamic programming for economic operation and planning of power systems.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	2	-	2	-	3
CO2	3	3	3	3	2	2	-	2	3	2
CO3	3	3	2	3	3	2	-	3	2	3
CO4	3	2	3	3	3	3	-	3	3	3

Course Content

Module 1: Matrix Theory and Vector Spaces

Vector spaces and subspaces, linear independence, basis and dimension, rank of matrices, eigenvalues and eigenvectors, matrix diagonalization, Jordan canonical form, and applications in power systems.

Module 2: Ordinary Differential Equations

Formulation and solution of first and higher-order ODEs, systems of linear differential equations, state-space representation, application to modeling power system dynamics and transients.

Module 3: Transform Techniques

Laplace transform and inverse, properties and applications to power system transients, Fourier series and Fourier transform, signal representation, frequency analysis, and harmonic distortion.

Module 4: Numerical Methods

Numerical methods for roots of algebraic and transcendental equations (bisection, Newton-Raphson), numerical differentiation and integration, iterative methods for load flow and fault analysis.

Module 5: Optimization Techniques

Linear programming, quadratic programming, dynamic programming concepts, formulation of economic dispatch and unit commitment problems, solution algorithms.

Module 6: Stability Analysis and Eigenvalue Techniques

Small signal stability, eigenvalue and eigenvector computations, modal analysis, participation factor analysis, applications in transient and voltage stability studies.

Text Books

1. K. D. Sen, Mathematical Methods in Power Systems, Wiley Publishing.
2. H. S. Kasana, Mathematical Methods for Engineers and Scientists, New Age International.
3. S. S. Rao, Engineering Optimization Theory and Practice, Wiley.

Reference Books

1. W. D. Stevenson, Elements of Power System Analysis, McGraw-Hill.
2. P. S. R. Murthy, Numerical Methods in Engineering and Science, New Age Publications.
3. J. N. Sharma, Advanced Engineering Mathematics, Krishna Prakashan Media.

Course Name: Advanced Power Electronics for Renewable and Non-Renewable Generation

Course Code: EDPM 104A
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Basic knowledge of Power Electronics, Power Systems, and Electrical Machines

Course Objectives

Obj.1: Introduce advanced concepts of power electronic converters and their role in renewable and conventional power generation.
Obj.2: Develop understanding of control strategies for power converters in grid-connected and standalone systems.
Obj.3: Explain integration of renewable sources using power electronics interfaces.
Obj.4: Enable application of power electronic converters in improving system efficiency, power quality, and reliability.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the role of power electronics in renewable and non-renewable energy conversion systems.
CO2: Analyze operation and control of advanced DC–DC and DC–AC converters.
CO3: Evaluate power converter topologies for grid integration and hybrid systems.
CO4: Apply converter control techniques for improving performance and stability of power generation systems.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Introduction to Power Electronics in Energy Systems (8L)

Overview of power electronics in generation, transmission, and utilization, Comparison of renewable and non-renewable power generation, Need for power electronic interfaces in modern energy systems, Classification of converters and their applications in power generation systems.

Module 2: Advanced DC–DC Converters (9L)

Operation, analysis, and design of isolated and non-isolated DC–DC converters, Soft-switching converters (ZVS, ZCS techniques), Bidirectional converters for energy storage integration, Control of DC–DC converters in renewable systems (solar PV, fuel cell).

Module 3: Inverters and Grid Interface Converters (8L)

PWM inverters, multilevel inverter topologies, and control schemes, Grid-connected inverter operation under balanced and unbalanced conditions , Synchronization techniques, phase-locked loops (PLL), Harmonic compensation and reactive power control.

Module 4: Converter Control and Modulation Techniques (8L)
Current and voltage control of converters, Digital control methods, Space Vector Modulation (SVM), Control under varying irradiation, temperature, and load conditions, Dynamic performance evaluation of converters.

Module 5: Power Electronics for Hybrid and Non-Renewable Systems (9L)
Integration of multiple energy sources through DC and AC buses, Power electronic systems in wind, solar, hydro, and thermal generation, FACTS devices and HVDC converters for power flow control, Applications in hybrid renewable microgrids and distributed generation systems.

Text Books

1. Ned Mohan, Tore M. Undeland, and William P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley.
2. Rashid M.H., *Power Electronics: Devices, Circuits, and Applications*, Pearson.
3. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Pearson.

Reference Books

1. L. Umanand, *Power Electronics: Essentials and Applications*, Wiley.
2. Robert W. Erickson and Dragan Maksimovic, *Fundamentals of Power Electronics*, Springer.
3. Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends,* Academic Press.
4. Fang Lin Luo and Hong Ye, *Advanced DC/DC Converters*, CRC Press.
5. Marian K. Kazimierczuk, *Pulse-Width Modulated DC–DC Power Converters*, Wiley.

Course Name: Wireless Power Transfer

Course Code: EDPM 104B
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Basics of Electromagnetic Fields, Power Electronics, and Electrical Machines

Course Objectives

Obj.1: Introduce the fundamental principles and technologies used for wireless power transfer (WPT).
Obj.2: Develop understanding of inductive, capacitive, and resonant coupling mechanisms.
Obj.3: Analyze design, modeling, and control aspects of WPT systems for various applications.
Obj.4: Explore modern developments and research trends in dynamic charging, high-power WPT, and communication-assisted energy transfer.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the physical principles and classifications of wireless power transfer techniques.
CO2: Analyze the performance of inductive and resonant WPT systems.
CO3: Design and evaluate power electronic circuits for efficient wireless energy transfer.
CO4: Apply WPT technologies in electric vehicles, biomedical devices, and renewable energy systems.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Introduction to Wireless Power Transfer (8L)
Historical background and motivation, Conventional vs. wireless power delivery, Types of WPT: Inductive, capacitive, resonant, microwave, and laser-based systems, Applications: Consumer electronics, electric vehicles (EVs), biomedical implants, IoT devices.

Module 2: Inductive and Capacitive Coupling Techniques (8L)
Principle of inductive coupling, Coil design, mutual inductance, and coupling coefficient, Power transfer efficiency and alignment issues, Capacitive power transfer: design equations, advantages, and limitations.

Module 3: Resonant Inductive Coupling (9L)
Resonant compensation topologies (Series–Series, Series–Parallel, LCC), Frequency tuning and impedance matching, Resonant converters and control methods, Modeling and simulation of resonant WPT circuits.

Module 4: Power Electronics and Control in WPT Systems (8L)
Inverter and rectifier design for WPT, ZVS/ZCS resonant converters, Bidirectional power flow and load regulation, Communication and control for dynamic power transfer (EV charging).

Module 5: Emerging WPT Technologies and Applications (9L)
Microwave and laser power beaming, Dynamic wireless charging for electric vehicles, Biomedical WPT systems for implants and sensors, Standardization, safety, and EMI/EMC considerations, Recent research trends and case studies.

Text Books

1. A. P. Hu and M. Budhia, *Wireless Power Transfer – Principles and Engineering Explorations*, Springer.
2. C. K. Lee and S. Y. R. Hui, *Wireless Power Transfer for Electric Vehicles and Mobile Devices*, Wiley.
3. N. Tesla, *Experiments with Alternate Currents of High Potential and High Frequency*, Courier Corporation.

Reference Books

1. K. T. Chau and W. Li, *Wireless Power Transfer: Fundamentals and Technologies*, Wiley.
2. B. W. Flynn and P. M. Mitcheson, *Inductive Power Transfer for Wireless Charging*, IET.
3. Sanjay K. Singh, *Wireless Power Transfer: Principles and Engineering Applications*, McGraw-Hill.
4. Journal articles and IEEE Transactions on Power Electronics, Industrial Electronics, and Transportation Electrification.

Course Name: Control of Electric Drives

Course Code: EDPM 104C
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Power Electronics, Electrical Machines, and Control Systems

Course Objectives

Obj.1: To provide an in-depth understanding of the principles and control strategies of electric drives.
Obj.2: To analyze the dynamics of electrical machines under various control schemes.
Obj.3: To explain modern control techniques for DC and AC motor drives.
Obj.4: To enable students to design and implement drive control systems for industrial and renewable applications.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Describe the fundamentals and characteristics of different types of electric drives.
CO2: Analyze dynamic models of DC and AC drives under various control modes.
CO3: Apply advanced control techniques for speed and torque control of electric motors.
CO4: Evaluate performance of electric drives used in industrial automation and renewable systems.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Fundamentals of Electric Drives (8L)
Introduction to electric drives and their components, Classification and characteristics of electric drives. Dynamics of motor–load systems, Four-quadrant operation and load torque characteristics, Speed-torque conventions and drive selection criteria.

Module 2: DC Drives – Modeling and Control (8L)
DC motor dynamics and transfer function, Controlled rectifier-fed DC drives, Chopper-fed DC drives. Speed and torque control using current and voltage feedback loops, Armature voltage and field control methods.

Module 3: Induction Motor Drives (9L)
Modeling of induction motors in d–q reference frame, Scalar control (V/f control), Vector control (Field-Oriented Control), Direct torque control (DTC) principles and implementation, Inverter-fed induction motor drives.

Module 4: Synchronous and Special Drives (8L)
Permanent Magnet Synchronous Motor (PMSM) drives, Brushless DC motor (BLDC) control. Switched Reluctance Motor (SRM) drives, Sensorless control techniques, Applications in EVs and renewable energy systems.

Module 5: Digital Control and Recent Advances (9L)
Digital implementation of drive control algorithms, Microcontroller/DSP-based control architectures. Artificial intelligence and fuzzy/neural controllers in drive systems, Energy efficiency and performance optimization, Case studies: industrial and renewable drive systems.

Text Books

1. G.K. Dubey, *Fundamentals of Electrical Drives*, Narosa Publishing House.
2. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Pearson.
3. R. Krishnan, *Electric Motor Drives – Modeling, Analysis, and Control*, Pearson.

Reference Books

1. Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Academic Press.
2. M.D. Singh and K.B. Khanchandani, *Power Electronics*, Tata McGraw-Hill.
3. Vedam Subrahmanyam, *Electric Drives: Concepts and Applications*, Tata McGraw-Hill.
4. R. Krishnan, *Permanent Magnet Synchronous and Brushless DC Motor Drives*, CRC Press.
5. V. Subrahmanyam, *Control of Electrical Drives*, New Age International.

Course Name: High Power Converters

Course Code: EDPM 104D
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Power Electronics, Power Semiconductor Devices, and Electrical Machines

Course Objectives

Obj.1: To introduce the principles, design, and control of high-power electronic converters used in industrial and utility applications.
Obj.2: To understand converter topologies for high-voltage and high-current operation.
Obj.3: To analyze control, protection, and thermal management of high-power converters.
Obj.4: To study modern converter technologies used in renewable energy systems, motor drives, and HVDC transmission.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the classification and operation of high-power converter topologies.
CO2: Analyze switching, commutation, and control techniques used in high-power converters.
CO3: Evaluate converter performance under various loading and supply conditions.
CO4: Apply advanced converter configurations in industrial drives, renewable integration, and HVDC systems.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Introduction to High Power Conversion Systems (8L)
Overview of power converter requirements in high-voltage and high-current applications, Power semiconductor devices for high power (IGBT, GTO, IGCT, SiC, and GaN), Thermal design, cooling, and protection schemes, Commutation and switching phenomena in high-power circuits.

Module 2: Line-Commutated Converters (LCC) (8L)
Operation and analysis of single-phase and three-phase controlled rectifiers, Effect of source inductance, overlap angle, and power factor, Performance and control of converters in four quadrants, Applications in DC motor drives and HVDC links.

Module 3: Voltage Source and Current Source Converters (VSC & CSC) (9L)
Principle of operation and characteristics, PWM techniques for high-power converters, Voltage and current control strategies, Application in variable speed drives and renewable energy systems.

Module 4: Multilevel Converters (9L)
Need for multilevel operation – reduction in harmonics and device stress, Diode-clamped, flying capacitor, and cascaded H-bridge topologies, Modulation techniques (SPWM, SVM), Control and balancing of DC-link voltages, Applications in FACTS and renewable integration.

Module 5: Advanced Topics and Applications (8L)
Matrix converters – principles and modulation, Modular multilevel converters (MMC), High-power converter design for wind and solar systems, Converters in energy storage, microgrids, and transportation systems, Fault-tolerant design, EMI/EMC, and standards for high-power systems.

Text Books

1. Bin Wu, *High-Power Converters and AC Drives*, Wiley-IEEE Press.
2. Rashid M.H., *Power Electronics: Devices, Circuits, and Applications*, Pearson.
3. L. Gyugyi and A. Edris, *The Evolving Power Electronics Base of the Electric Power System*, Wiley-IEEE.

Reference Books

1. Ned Mohan, *Power Electronics: Converters, Applications and Design*, Wiley.
2. Bimal K. Bose, *Power Electronics and Motor Drives – Advances and Trends*, Academic Press.
3. Fang Lin Luo and Hong Ye, *Advanced DC/DC Converters*, CRC Press.
4. Robert W. Erickson and Dragan Maksimovic, *Fundamentals of Power Electronics*, Springer.
5. L. Umanand, *Power Electronics: Essentials and Applications*, Wiley.

Course Name: Research Methodology and IPR

Course Code: MLC 101
Contact: 2L:0T:0P
Total Contact Hours: 28
Credit: 2
Standard: PG (M.Tech)
Prerequisite: Basic understanding of engineering research and academic writing.

Course Objectives

Obj.1: To introduce the fundamentals of research methodology and its application in engineering and technology.
Obj.2: To develop skills in research design, data analysis, and technical documentation.
Obj.3: To familiarize students with intellectual property rights (IPR) and patenting processes.
Obj.4: To encourage ethical practices and innovative thinking in research and development.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the importance, characteristics, and process of conducting scientific research.
CO2: Formulate research problems and design appropriate methodologies.
CO3: Apply statistical tools and techniques for data collection and analysis.
CO4: Demonstrate knowledge of intellectual property rights and patent filing procedures.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	2	2	2	3	-	2
CO2	3	3	3	2	2	3	2	3	2	3
CO3	3	3	3	3	3	2	2	3	2	3
CO4	3	3	2	3	3	2	3	3	3	3

Course Content

Module 1: Introduction to Research Methodology (6L)

Meaning and objectives of research; Types of research — basic, applied, exploratory, and experimental. Research approaches and process, Criteria for good research, Identification and formulation of research problems, Literature survey, hypothesis, and research gap identification.

Module 2: Research Design and Data Collection (6L)

Research design – meaning, need, and features, Sampling methods and data collection techniques. Measurement scales and validity , Quantitative and qualitative research , Data classification, tabulation, and graphical representation.

Module 3: Data Analysis and Interpretation (6L)
Descriptive and inferential statistics Correlation and regression analysis, Hypothesis testing – t-test, chi-square test, ANOVA, Use of software tools (MATLAB, SPSS, Excel) for analysis, Technical report writing and referencing styles (APA, IEEE).

Module 4: Intellectual Property Rights (5L)
Introduction to IPR: Patents, copyrights, trademarks, industrial designs, geographical indications, Patent filing process and procedures in India, Patent databases and search tools, International IPR systems (WIPO, PCT, TRIPS), IP management and technology transfer.

Module 5: Research Ethics and Emerging Trends (5L)
Research ethics, plagiarism, and academic integrity, Publication ethics and peer review process, Research funding agencies in India (DST, SERB, AICTE, CSIR), Emerging research domains in engineering and technology, Case studies on ethical and unethical research practices.

Text Books

1. C. R. Kothari and Gaurav Garg, *Research Methodology: Methods and Techniques*, New Age International Publishers.
2. Ranjit Kumar, *Research Methodology: A Step-by-Step Guide for Beginners*, SAGE Publications.
3. Neeraj Pandey and Khushdeep Dharni, *Intellectual Property Rights*, PHI Learning.

Reference Books

1. Garg, Karadia, Agarwal, Agarwal, *An Introduction to Research Methodology*, RBSA Publishers.
2. Mayall, *Industrial Design*, McGraw Hill.
3. Halbert, *Resisting Intellectual Property*, Routledge.
4. Deborah E. Bouchoux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets*, Cengage Learning.
5. P. Narayanan, *Patent Law*, Eastern Law House.

Course Name: Soft Computing Techniques Lab

Course Code: EDPM 191
Contact: 0L:0T:4P
Total Contact Hours: 28
Credit: 2
Standard: PG (M.Tech)
Prerequisite: Basic knowledge of MATLAB / Python programming and fundamentals of Artificial Intelligence, Neural Networks, and Optimization.

Course Objectives

Obj.1: To provide hands-on experience in implementing soft computing algorithms for real-world engineering problems.
Obj.2: To develop simulation and modeling skills using neural networks, fuzzy logic, and evolutionary computation.
Obj.3: To enable students to apply hybrid intelligent systems in optimization and control applications.
Obj.4: To familiarize students with MATLAB/Python toolboxes and custom coding for soft computing techniques.

Course Outcomes

After successful completion of this lab course, students will be able to:

CO1: Design and simulate basic neural network models for function approximation and pattern recognition.
CO2: Implement fuzzy logic systems for decision-making and control problems.
CO3: Apply genetic algorithms and evolutionary computation techniques for optimization.
CO4: Integrate hybrid soft computing methods for solving power system and control engineering problems.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	2	2	-	2	2	3
CO2	3	3	3	3	2	2	-	2	2	3
CO3	3	3	3	3	3	2	1	2	3	2
CO4	3	3	3	3	3	2	2	3	3	3

List of Suggested Experiments

1. **Introduction to MATLAB/Python environment** – Familiarization with neural network and fuzzy logic toolboxes.
2. **Implementation of McCulloch–Pitts and Perceptron Networks** for basic logic functions (AND, OR, NOT).
3. **Training of Feedforward Neural Network** using backpropagation for nonlinear function approximation.
4. **Design of Radial Basis Function (RBF) Network** for pattern classification.
5. **Implementation of Self-Organizing Map (SOM)** for data clustering.

6. **Development of Fuzzy Inference System (FIS)** for control of a simple process (e.g., temperature or speed control).
7. **Design of Fuzzy Logic Controller** using Mamdani and Sugeno models.
8. **Implementation of Genetic Algorithm (GA)** for function optimization and parameter tuning.
9. **Application of Particle Swarm Optimization (PSO)** to solve an engineering optimization problem.
10. **Hybrid Neuro-Fuzzy System** implementation for nonlinear function modeling.
11. **Case Study:** Soft computing-based fault detection or load forecasting in power systems.
12. **Mini Project:** Development and presentation of a soft computing model for a selected real-world engineering problem.

Software / Tools Required

- MATLAB with Neural Network, Fuzzy Logic, and Global Optimization Toolboxes
- OR Python with libraries: *NumPy, SciPy, scikit-fuzzy, TensorFlow / PyTorch, DEAP (for GA)*

Course Assessment

- **Lab Performance & Attendance:** 30%
- **Experiment Record & Viva:** 30%
- **Mini Project / Case Study:** 40%

Text Books

1. S. N. Sivanandam and S. N. Deepa, *Principles of Soft Computing*, Wiley.
2. J.-S. R. Jang, C.-T. Sun, and E. Mizutani, *Neuro-Fuzzy and Soft Computing*, Pearson.
3. D. E. Goldberg, *Genetic Algorithms in Search, Optimization and Machine Learning*, Addison-Wesley.

Reference Books

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications*, PHI.
2. Timothy J. Ross, *Fuzzy Logic with Engineering Applications*, Wiley.
3. Simon Haykin, *Neural Networks and Learning Machines*, Pearson.
4. Kalyanmoy Deb, *Optimization for Engineering Design: Algorithms and Examples*, PHI.

Course Name: Energy-Efficient Motors Lab

Course Code: EDPM192

Contact: 2P

Credit: 2

Standard: PG M. Tech

Prerequisite: Electrical Machines I & II, Fundamentals of Power Electronics and Drives, Basic MATLAB/Simulink Modelling and Analysis.

Course Objectives

1. To study the efficiency, regulation, and loss behavior of electrical machines under realistic operating conditions.
2. To analyze transformer and machine performance under harmonic, unbalanced, and variable-frequency supply.
3. To perform advanced characterization of DC, induction, and synchronous machines using modern instrumentation and simulation.
4. To develop analytical and simulation skills for performance evaluation and energy-efficiency improvement.
5. To correlate experimental results with theoretical and simulation models to derive optimization strategies.

Course Outcomes

After completing the course, students will be able to:

CO1: Conduct advanced performance tests on transformers and electrical machines under various supply and load conditions.

CO2: Evaluate efficiency, voltage regulation, and loss components using experimental and analytical approaches.

CO3: Apply MATLAB/Simulink to model and validate experimental results of electrical machines.

CO4: Interpret harmonic effects, unbalanced loading, and machine parameters in terms of energy efficiency and reliability.

CO5: Prepare comprehensive technical reports and correlate experimental data with industry standards for energy-efficient operation.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	3	2	3	-	-	-	2
CO2	3	3	2	3	3	-	-	-	-	-
CO3	2	2	3	3	-	-	-	-	-	-
CO4	3	3	2	3	3	-	-	-	-	-
CO5	2	2	2	2	3	2	-	-	-	2

List of Experiments

1. Efficiency & Voltage Regulation of a Single-Phase Transformer under Non-Sinusoidal Supply
2. Parallel Operation of Two Single-Phase Transformers under Unbalanced and Nonlinear Load
3. Back-to-Back (Sumpner's) Test on Single-Phase Transformer with Temperature Rise Analysis
4. Vector Group Identification and Phase Displacement Study of Three-Phase Transformer
5. Swinburne's Test on DC Shunt Motor with Efficiency Prediction under Variable Supply Voltage
6. Brake Test on DC Series Motor and Full Speed–Torque Characteristics
7. Voltage Build-Up of DC Shunt Generator – Effect of Field Resistance and Residual Magnetism
8. Circle Diagram of Three-Phase Induction Motor – Analytical & Experimental Validation
9. Speed Control of Three-Phase Induction Motor by V/f Method and Performance Evaluation
10. Separation of Losses in Three-Phase Induction Motor (Core, Rotor, Mechanical, Stray)
11. Load Test on Wound-Rotor Induction Motor with External Rotor Resistance Control
12. Open-Circuit & Short-Circuit Characteristics of a Three-Phase Alternator and Voltage Regulation
13. Determination of Direct-Axis (Xd) and Quadrature-Axis (Xq) Reactances by Slip Test
14. V-Curve and Inverted V-Curve of a Synchronous Motor for Power Factor Control

Course Name: Thesis Component – I

Course Code: EDPM 182
Contact: 0L:0T:8P
Total Contact Hours: 56
Credit: 0
Standard: PG (M.Tech)
Prerequisite: Completion of first semester courses and basic understanding of research methodology.

Course Objectives

Obj.1: To identify and formulate a research problem relevant to electrical or power systems engineering.
Obj.2: To develop analytical and simulation-based skills for problem-solving.
Obj.3: To perform literature review, define objectives, and prepare a detailed research proposal.
Obj.4: To train students in technical documentation and presentation of research outcomes.

Course Outcomes

After successful completion of this course, students will be able to:

CO1: Identify a suitable research topic based on current challenges and literature survey.
CO2: Formulate clear research objectives, methodology, and scope of the proposed work.
CO3: Develop preliminary models, simulation tools, or experimental setups for the research problem.
CO4: Prepare and present a comprehensive report and defend the proposed work effectively.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	3	3	3	3	2	3	3	3
CO2	3	3	3	3	3	3	2	3	3	3
CO3	3	3	3	3	3	2	3	3	3	3
CO4	3	3	3	3	3	3	3	3	3	3

Course Content / Activities

The course emphasizes **independent research initiation** and is structured as follows:

1. Selection of Research Topic (Weeks 1–2)

- Identification of current research areas in electrical / power systems / renewable energy / automation / control systems.
- Topic finalization in consultation with the supervisor and departmental review committee.

2. Literature Survey (Weeks 3–5)

- Comprehensive study of relevant journals, conference papers, patents, and technical reports.
- Preparation of annotated bibliography and identification of research gaps.

3. Problem Formulation and Objectives (Weeks 6–8)

- Problem definition, hypothesis formulation, and setting clear research objectives.
- Identification of required hardware, software, and data sources.

4. Research Methodology and Design (Weeks 9–11)

- Selection of analytical, experimental, or simulation-based methodology.
- Preliminary modeling, algorithm development, or system design.
- Simulation or small-scale experimental trials to validate feasibility.

5. Report Preparation and Presentation (Weeks 12–14)

- Compilation of progress report including problem statement, objectives, literature review, and proposed methodology.
- PowerPoint presentation and viva-voce before departmental evaluation committee.

Assessment Scheme

Evaluation Component	Marks	Remarks
Literature Review & Topic Relevance	20	Based on depth and quality of references
Problem Definition & Methodology	25	Evaluation by internal guide
Progress Review & Implementation	25	Mid-term presentation
Final Report & Viva-Voce	30	Departmental evaluation committee

Total: 100 Marks

Expected Outcomes

- Detailed project synopsis and feasibility report ready for **Thesis Component II (EDPM 283)**.
- Demonstrated understanding of research design, literature review, and data analysis framework.
- Research proposal presentation approved by departmental faculty panel.

Reference Guidelines

1. IEEE/Elsevier/Springer Research Articles (2020–2025).
2. C.R. Kothari & G. Garg, *Research Methodology: Methods and Techniques*, New Age International.
3. Deborah E. Bouchoux, *Intellectual Property: The Law of Trademarks, Copyrights, Patents, and Trade Secrets*, Cengage Learning.
4. Bimal K. Bose, *Modern Power Electronics and AC Drives*, Pearson.
5. IEEE Transactions on *Power Systems*, *Energy Conversion*, *Industrial Electronics*, and *Smart Grid*.

Semester II

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit	Faculty
1	Core 3	EDPM 201	Digital Protection of Power Systems	3	0	0	3	BD
2	Core 4	EDPM 202	FACTS and Custom Power Devices	3	0	0	3	BD
3	PE 3	EDPM 203	a) Power System Transient b) Power Quality Improvement Techniques c) Electric Vehicles d) Battery Management Systems (BMS)	3	0	0	3	DU
4	PE 4	EDPM 204	(a) Electrical Power Distribution Systems (b) SCADA System and Applications (c) Advanced Embedded and Micro-Controller Based Systems (d) EHV AC Power Transmission	3	0	0	3	MS
5	Minor Project	EDPM 281	Literature Review & Research Dissemination of Minor Project with Seminar	0	0	4	2	AKS
6	Lab 3	EDPM 291	Power System Digital Protection Lab	0	0	4	2	BD
7	Lab 4	EDPM 292	(a) Electrical Power Distribution System Lab (b) PLC & SCADA Lab (c) Microcontroller Lab (d) Power Systems Computation Lab	0	0	4	2	MS
8	Audit-II	EDPM 282	Thesis Component II	2	0	0	0	SP

Total: L=14, T=0, P=12, Credit=18

Course Name: Digital Protection of Power Systems

Course Code: EDPM 201
Contact: 3L:0T:0P
Total Contact Hours: 42
Credit: 3
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Power System Protection, Electrical Machines, and Power Electronics.

Course Objectives

Obj.1: To introduce the concept and architecture of digital protection in modern power systems.
Obj.2: To develop an understanding of numerical relay design and algorithms for fault detection.
Obj.3: To explain digital signal processing (DSP) applications in power system protection.
Obj.4: To explore communication-based and adaptive protection techniques for grid reliability.

Course Outcomes

After successful completion of the course, students will be able to:

CO1: Explain the working principles and configuration of digital/numerical protection systems.
CO2: Analyze protection algorithms for fault detection, classification, and location.
CO3: Apply DSP techniques and microprocessor-based relaying in system protection.
CO4: Evaluate adaptive and communication-assisted protection schemes for smart grids.

CO–PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	-	2	2	-	2
CO2	3	3	3	3	2	3	-	2	2	3
CO3	3	3	2	2	3	2	1	2	3	2
CO4	2	3	3	3	3	2	2	3	3	3

Course Content

Module 1: Fundamentals of Digital Protection (8L)
Overview of conventional vs. digital relaying, Architecture and functional blocks of digital protection systems, Role of microprocessor and microcontroller-based relays, Sampling theorem, aliasing, and signal digitization in power system applications, Numerical relay hardware and firmware components.

Module 2: Algorithms for Digital Protection (9L)
Digital filtering techniques: DFT, FFT, and recursive filters, Fundamental phasor estimation and harmonic rejection, Overcurrent and distance protection algorithms, Travelling wave-based fault detection, Least squares and Kalman filter-based methods for signal estimation.

Module 3: Digital Relay Protection Schemes (8L)
Protection of transmission lines, transformers, and generators using numerical relays, Pilot protection schemes and directional comparison relays, Differential protection using digital relays. Protection coordination and relay setting optimization.

Module 4: Digital Signal Processing in Protection (8L)

DSP architecture and its application in real-time relaying, Sampling, quantization, and anti-aliasing filters. Discrete-time convolution and correlation in fault analysis, Data windowing and event recording in protective relays, Synchrophasor-based protection concepts.

Module 5: Communication and Adaptive Protection (9L)

Communication-assisted relaying (SCADA, IEC 61850, and substation automation), Adaptive protection in smart grids and distributed generation systems, Wide Area Measurement System (WAMS) and PMU-based protection, Cybersecurity in digital protection systems, Recent trends: AI and machine learning-based protection schemes.

Text Books

1. Arun G. Phadke and James S. Thorp, *Computer Relaying for Power Systems*, Wiley-IEEE Press.
2. Badri Ram and D. N. Vishwakarma, *Power System Protection and Switchgear*, McGraw-Hill.
3. Y.G. Paithankar and S.R. Bhide, *Fundamentals of Power System Protection*, PHI Learning.

Reference Books

1. A.G. Phadke and J.S. Thorp, *Synchronized Phasor Measurements and Their Applications*, Springer.
2. S. Venkata, *Computer Relaying for Power Systems*, IEEE Press.
3. Gerhard Ziegler, *Numerical Distance Protection: Principles and Applications*, Siemens AG.
4. H. J. Altuve Ferrer and E. O. Schweitzer, *Modern Solutions for Protection, Control and Monitoring of Electric Power Systems*, Schweitzer Engineering Laboratories (SEL).
5. IEEE Transactions on *Power Delivery* and *Smart Grid*.

Course Name: FACTS and Custom Power Devices
Course Code: EDPM 202
Contact: 3L:0T:0P
Total Contact Hours: 42
Credits: 3
Standard: PG (M.Tech)
Prerequisite: Power system analysis, electrical machines, and basic power electronics

Course Objectives

1. Introduce the concept and importance of Flexible AC Transmission Systems (FACTS) in modern power systems.
2. Explain the working principles of various FACTS controllers and custom power devices.
3. Develop the ability to analyze and simulate the dynamic performance of FACTS devices in power networks.
4. Apply FACTS and custom power devices for voltage stability, power quality improvement, and system reliability.

Course Outcomes (COs)

CO1	Understand the fundamentals of FACTS devices and their impact on power system operation.
CO2	Analyze the operation of series, shunt, and combined FACTS controllers.
CO3	Apply knowledge of custom power devices (D-STATCOM, DVR, UPFC) for power quality enhancement.
CO4	Model and simulate FACTS and custom power devices for dynamic and steady-state power system studies.

CO–PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	3	2	3	2	–	2	–	3
CO2	3	3	3	3	2	2	–	2	3	2
CO3	3	3	2	3	3	2	–	3	2	3
CO4	3	2	3	3	3	3	–	3	3	3

Note: "3" = High correlation, "2" = Medium, "–" = No correlation

Course Content

Module 1: Introduction to FACTS

Concept, need, and objectives of FACTS devices, Benefits of FACTS: increased power transfer, voltage stability, system security, Classification of FACTS controllers.

Module 2: Series and Shunt Compensation

Variable Impedance type: TCSC, SSSC, Variable Phase Angle type: TCPAR, IPFC, Voltage Control type: STATCOM, SVC, Comparison of series vs shunt devices.

Module 3: Combined Compensation and UPFC

Unified Power Flow Controller (UPFC), Interline Power Flow Controller (IPFC), Control strategies and modelling of UPFC

Module 4: Custom Power Devices for Distribution Systems

D-STATCOM, DVR, active filters, Distribution system voltage sag, swell, flicker mitigation, Power quality improvement techniques.

Module 5: Control and Modeling of FACTS Devices

Control techniques: PI, PWM, and advanced control, Steady-state and dynamic modeling in power systems, Simulation of FACTS devices using MATLAB/PSCAD/DIgSILENT

Module 6: Applications of FACTS Devices

Load flow control, voltage regulation, and loss minimization, Transient and dynamic stability improvement, Integration with renewable energy sources

Textbooks

1. N. G. Hingorani and L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press.
2. K. R. Padiyar, *FACTS Controllers in Power Transmission and Distribution*, New Age International.
3. R. Mohan Mathur and R. K. Varma, *Thyristor-Based FACTS Controllers for Electrical Transmission Systems*, IEEE Press.

Reference Books

1. P. Kundur, *Power System Stability and Control*, McGraw-Hill.
2. H. Saadat, *Power System Analysis*, McGraw-Hill.
3. J. Arrillaga, *Power System Quality Assessment*, Wiley.

Course Name: Power System Transients
Course Code: EDPM 203A
L-T-P: 3-0-0
Credit: 3
Level: PG (M.Tech)
Prerequisite: Power System Analysis, Electrical Machines, Transmission Line Theory

Course Objectives

Upon successful completion, students will be able to:

1. Understand the fundamentals of power system transients and their classifications.
2. Analyze the causes and effects of switching, lightning, and fault-induced transients.
3. Model transmission lines, transformers, and power system components for transient studies.
4. Apply simulation and analytical techniques to predict and mitigate transient phenomena.

Course Outcomes (COs)

CO1 Classify and explain different types of power system transients.

CO2 Model transmission lines, transformers, and other components for transient analysis.

CO3 Analyze switching, lightning, and fault-induced transients in power systems.

CO4 Apply computational and simulation tools (e.g., EMTP, MATLAB/Simulink) to study transients.

CO5 Design mitigation techniques for overvoltages and system protection.

CO–PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	–	–	–	2	–	3
CO2	3	2	3	2	–	–	–	2	–	3
CO3	3	3	2	2	–	–	–	3	–	3
CO4	3	3	3	2	–	–	–	3	–	3
CO5	3	3	3	2	–	–	–	3	–	3

Note: “3” = High correlation, “2” = Medium, “–” = No correlation

Course Content

Module 1: Introduction to Power System Transients (6 L)

Definition of power system transients, Classification of transients: switching, lightning, fault-induced, Importance of studying transients for system stability, insulation, and protection, Overview of transient phenomena: causes, characteristics, impact on power systems.

Module 2: Modeling of Power System Components (8 L)

Transmission lines: modeling short, medium, and long lines for transient analysis, Transformer models: equivalent circuits, leakage inductance, magnetizing inductance under transient conditions, Generator models: transient reactances, dynamic behavior during disturbances, Load modeling: static and dynamic loads for transient evaluations, Network representation: nodal analysis, bus admittance, incidence matrices used in transient studies.

Module 3: Switching Transients (6 L)

Capacitor bank switching: inrush currents, voltage transients, charging phenomena, Line energization: overvoltages due to transient recovery and system resonance, Auto-reclosing transients: effects on system surges, reclosing strategies, Ferranti effect: voltage rise in long transmission lines during light loading, Overvoltages: magnitude and causes in switching operations, System resonance: electrical resonance phenomena causing amplification of transients, Mitigation techniques: controlled switching, use of surge arresters, optimal switching time.

Module 4: Lightning and Grounding Transients (8 L)

Lightning phenomenon: physics of lightning strokes, types of strokes, Surge propagation: traveling waves, reflection, refraction along power lines, Stroke modeling: statistical and deterministic models for lightning currents, Grounding systems: structure, ground resistance, ground potential rise during surges, Shielding of lines: overhead ground wires, shielding effectiveness, Surge protection devices: arresters, rods, and their placement in the system, Insulation coordination: selection of insulation levels based on expected transient overvoltages.

Module 5: Fault-Induced Transients (6 L)

Symmetrical faults: three-phase short circuits, transient behavior, Unsymmetrical faults: single line-to-ground, line-to-line, double line-to-ground faults, Transient currents and voltages during faults: subtransient, transient, and steady-state components, Transient recovery voltage (TRV): characteristics, importance for breaker operation, Protection implications: impact on relay settings, breaker ratings, and fault isolation schemes

Module 6: Simulation and Mitigation Techniques (8 L)

EMTP/ATP: simulation environment for electromagnetic transients, MATLAB/Simulink: model-based tools for transient analysis and visualization, Overvoltage mitigation: design and selection of surge arresters, grounding improvements, Use of reactors: current limiting and damping of resonance effects, Protective relays: coordination, settings for transient events, Analysis of simulation results for effective transient control and system protection.

Textbooks / References

1. Allan Greenwood, *Electrical Transients in Power Systems*, Wiley, 2nd Edition, 1991
2. M. G. Adamiak, *Power System Transients – Theory and Applications*, IEEE Press
3. P. Kundur, *Power System Stability and Control*, McGraw-Hill, 1994
4. W. H. Kersting, *Distribution System Modeling and Analysis*, CRC Press, 3rd Edition, 2017
5. C. L. Wadhwa, *Electrical Power Systems*, New Age International, 5th Edition

Course Name: Power Quality Improvement Techniques
Course Code: EDPM 203B
L-T-P: 3-0-0
Credit: 3
Level: PG (M.Tech)
Prerequisite: Electrical Power Systems, Power Electronics, and Fundamentals of Power Quality

Course Objectives

Upon successful completion, students will be able to:

1. Understand the causes, types, and effects of power quality (PQ) problems in electrical systems.
2. Learn measurement and analysis techniques to evaluate PQ disturbances.
3. Explore mitigation and compensation methods using passive and active power conditioning devices.
4. Apply advanced PQ improvement techniques for industrial and distributed power systems.

Course Outcomes (COs)

CO1	Identify and analyze various power quality issues such as harmonics, voltage sags, swells, flicker, and transients.
CO2	Evaluate the impact of PQ disturbances on electrical systems and loads.
CO3	Design and implement PQ improvement solutions using passive and active filters, compensators, and custom power devices.
CO4	Apply modern control strategies and PQ enhancement techniques in industrial and distributed systems.

CO–PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	2	2	–	–	–	2	–	3
CO2	3	2	3	2	–	–	–	2	–	3
CO3	3	3	2	2	–	–	–	3	–	3
CO4	3	3	3	2	–	–	–	3	–	3

Note: "3" = High correlation, "2" = Medium, "–" = No correlation

Course Content

Unit 1: Introduction to Power Quality (6 L)

- Definition and significance of PQ
- Common PQ disturbances: voltage sags, swells, interruptions, transients, flicker, and harmonics
- PQ standards: IEEE 1159, IEC 61000 series

Unit 2: Power Quality Measurement and Analysis (8 L)

- Measurement instruments: PQ analyzers, harmonic analyzers, flicker meters, disturbance recorders
- PQ indices: THD, TDD, RMS variation, flicker severity
- Data acquisition and interpretation

Unit 3: Passive Compensation Techniques (8 L)

- Shunt and series passive filters
- Design considerations for harmonic mitigation
- Limitations of passive filters in dynamic systems

Unit 4: Active Power Conditioning Techniques (10 L)

- Shunt and series active filters
- Custom power devices: DVR, D-STATCOM, UPQC
- Control strategies for voltage regulation, harmonic compensation, and reactive power support

Unit 5: Applications and Case Studies (10 L)

- PQ improvement in industrial systems with nonlinear loads
- PQ solutions in distributed generation and renewable energy systems
- Integration of smart PQ devices with IoT and real-time monitoring
- Practical case studies and simulation examples

Textbooks / References

1. J. Arrillaga, N. R. Watson, *Power System Quality Assessment*, Wiley, 2003
2. R. C. Dugan, M. F. McGranaghan, S. Santoso, H. W. Beaty, *Electrical Power Systems Quality*, McGraw-Hill, 2nd Edition, 2012
3. H. Akagi, E. H. Watanabe, M. Aredes, *Instantaneous Power Theory and Applications to Power Conditioning*, Wiley, 2017
4. IEEE Std. 1159, *Recommended Practice for Monitoring Electric Power Quality*
5. IEC 61000 series, *Electromagnetic Compatibility (EMC) Standards*

Course Name: Electric Vehicles
Course Code: EDPM 203
L-T-P: 3-0-0
Credit: 3
Level: PG (M.Tech)
Prerequisite: Electrical Machines, Power Electronics, and Battery Systems

Course Outcomes (COs)

CO1	Understand the fundamentals of Electric and Hybrid Electric Vehicles (E/HEVs) and their classification.
CO2	Analyze vehicle dynamics and propulsion system requirements for electric mobility.
CO3	Study the working principles of various electric drive-train components such as motors, converters, and controllers.
CO4	Evaluate different energy storage technologies, charging systems, and their integration with renewable sources.
CO5	Assess the environmental, economic, and grid-level impacts of large-scale EV deployment.

CO–PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	3	2	–	–	–	–
CO2	3	3	3	3	3	2	–	2	–	–
CO3	3	2	3	3	2	2	–	–	–	–
CO4	3	3	3	2	3	2	–	–	–	–
CO5	3	3	2	3	3	3	–	2	–	2

Note: "3" = High correlation, "2" = Medium, "–" = No correlation

Course Content

Module 1: Introduction to Electric Vehicles (6 L)

Evolution of Electric and Hybrid Electric Vehicles, Comparison with conventional vehicles, Basic architecture of E/HEVs, Hybrid configurations: series, parallel, series-parallel, Advantages, challenges, and current trends.

Module 2: Vehicle Dynamics and Performance (6 L)

Vehicle dynamics fundamentals: motion equations, driving/braking forces, Tractive effort, aerodynamic drag, rolling resistance, gradient resistance, Energy consumption analysis and efficiency evaluation for different driving cycles, Performance optimization for EVs.

Module 3: Electric Propulsion Systems (8 L)

Electric drives: DC, Induction, PMSM, BLDC, and SRM, Power electronic converters and control systems for EV propulsion, Regenerative braking and drive efficiency optimization,

Module 4: Energy Storage Systems (8 L)

Battery types: Lead-acid, NiMH, Li-ion, Battery characteristics, capacity, charge/discharge profiles, Battery Management Systems (BMS), Supercapacitors, flywheels, fuel cells, hybrid storage systems, Battery modeling, thermal management, and safety.

Module 5: Charging Systems and Infrastructure (6 L)

Conductive, inductive, and wireless charging methods, Fast charging technologies and standards , (CHAdeMO, CCS, IEC), Smart charging and Vehicle-to-Grid (V2G) concepts, Grid integration and renewable energy-based EV charging stations, Case studies (India and worldwide)

Module 6: Policy, Environmental, and Future Trends (6 L)

Government policies, incentives, and regulatory frameworks, Environmental impact: emissions, lifecycle analysis, recyclability, Economic analysis: cost of ownership, operational savings, Emerging trends: autonomous EVs, IoT-based fleet management, AI applications

Textbooks

1. Iqbal Husain, *Electric and Hybrid Vehicles: Design Fundamentals*, CRC Press, 3rd Edition, 2021
2. Ali Emadi, *Advanced Electric Drive Vehicles*, CRC Press, 2014
3. James Larminie & John Lowry, *Electric Vehicle Technology Explained*, Wiley, 2nd Edition, 2012

Reference Books

1. Mehrdad Ehsani, Yimin Gao, Sebastien E. Gay, Ali Emadi, *Modern Electric, Hybrid Electric, and Fuel Cell Vehicles*, CRC Press, 2nd Edition, 2009
2. Chris Mi, M. Abul Masrur, David Wenzhong Gao, *Hybrid Electric Vehicles: Principles and Applications with Practical Perspectives*, Wiley, 2nd Edition, 2017
3. Rui Xiong, *Battery Management and Control Strategies for Electric Vehicles*, Springer, 2019

Course Name: Battery Management System
Course Code: EDPM 203 D
L-T-P: 3-0-0
Credit: 3
Level: PG (M.Tech)
Prerequisites: Basic knowledge of electrical circuits, power electronics, and electrochemical energy storage

Course Objectives

Upon successful completion, students will be able to:

1. Gain comprehensive knowledge of lithium-ion cell types, datasheet interpretation, dimensions, and operational characteristics.
2. Understand battery pack design with emphasis on electrical, mechanical, and thermal optimization.
3. Familiarize with Battery Management Systems (BMS), including standalone and master–slave configurations, and their functional aspects.
4. Comprehend state-of-charge (SOC) and state-of-health (SOH) estimation techniques using advanced methodologies and practical tools.

Course Outcomes (COs)

CO1	Interpret lithium-ion cell datasheets effectively for informed decision-making.
CO2	Design efficient battery packs considering performance and safety requirements.
CO3	Configure and implement robust battery management systems, including cell balancing and protection mechanisms.
CO4	Apply SOC and SOH estimation techniques to evaluate battery health and performance accurately.

CO–PO Mapping

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	1	–	–	–	–	–	–	3
CO2	2	2	1	1	–	–	–	–	–	3
CO3	3	2	1	1	–	–	–	–	–	3
CO4	3	2	1	1	–	–	–	–	–	3

Note: "3" = High correlation, "2" = Medium, "1" = Low, "–" = No correlation

Course Content

Unit 1: Introduction to Lithium-Ion Cells (8 L)

Lithium-ion cell types and chemistries, Datasheet reading: dimensions, max charge/discharge currents, lifecycle characteristics, Dependence of cycle life, SOC, and SOH on operational parameters, Battery pack design: electrical, mechanical, and thermal optimization for performance and safety.

Unit 2: Battery Management Systems (8 L)

Introduction to BMS: overview and importance, Types: standalone and master–slave configurations, Functionalities: Cell balancing (active and passive), Protection mechanisms: undervoltage, overvoltage, overcurrent, overtemperature, undertemperature, High-side and low-side FET configurations, Precharge and predischarge circuits.

Unit 3: SOC and SOH Estimation Techniques (8 L)

Estimation methodologies: open-circuit voltage tracking, impedance tracking, Extended Kalman Filter (EKF), Commercial battery monitors and protectors: LTC3300-X, LT8584, Renesas ISL94216A, Overview of safety and testing standards: AIS-038, AIS-156.

Unit 4: Standards and Practical Integration (9 L)

Application of AIS-038 and AIS-156 standards for EV battery systems, Integration of BMS with EV powertrains and renewable energy systems, Safety protocols, diagnostics, and reliability improvement measures, Emerging trends: intelligent BMS with IoT and AI for predictive maintenance.

Textbooks and References

1. John Warner, *The Handbook of Lithium-Ion Battery Pack Design: Chemistry, Components, Types and Terminology*, Elsevier, 2015
2. Sandeep Dhameja, *Electric Vehicle Battery Systems*, Newnes, 2002
3. Datasheets: LTC3300-X, ISL94216A
4. Standards: AIS-038, AIS-156
5. Texas Instruments Documents:
    - BQ79606A-Q1 Evaluation Module User Guide
    - BQ79606A-Q1 Datasheet

Course Name: Electrical Power Distribution Systems
Course Code: EDPM204A

Contact:
3L:0T:0
P **Total Contact Hours:** 36
Credit: 3

Standard: PG M.Tech

Prerequisite: Fundamental knowledge of power systems, electrical machines, and network analysis.

Course Objectives

The objectives of this PG M.Tech course, reflecting current industry needs, are to:

Obj.1: Impart in-depth knowledge of the structure, components, and characteristics of electrical distribution systems.

Obj.2: Develop skills in designing and planning of primary and secondary distribution networks.

Obj.3: Enable students to analyze distribution system performance, including voltage drop, power loss, and power quality.

Obj.4: Familiarize students with the design of distribution substations, automation, and system protection.

Obj.5: Introduce modern concepts like smart grids and the integration of distributed generation (DG) in distribution networks.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Analyze and classify different types of distribution systems, feeders, and load characteristics.

CO2: Design primary and secondary distribution networks considering optimal feeder routing and conductor sizing.

CO3: Evaluate voltage regulation, power factor correction, and power loss in distribution systems.

CO4: Explain the functioning of distribution substations, protective devices, and their coordination.

CO5: Assess the impact of distribution automation, SCADA, and distributed generation on system reliability and efficiency.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	-	-	-	-	-	1
CO2	3	3	3	2	2	-	-	-	-	1
CO3	3	3	2	3	2	-	-	-	-	2
CO4	3	2	2	-	-	-	-	-	-	1
CO5	3	3	2	2	3	2	-	-	-	3

Course Content

Module 1: Distribution System Fundamentals (7L)

Load modeling and characteristics. Coincidence factor, contribution factor, loss factor. Classification of loads. Distribution system planning. Design of sub-transmission lines, distribution substations, and feeders.

Module 2: Design of Distribution Feeders (8L)

Design considerations of distribution feeders. Radial, loop, and ring main sys- tems. Conductor size selection. Analysis of feeders; voltage drop and power loss calculations. Voltage level and power factor correction.

Module 3: Distribution Substations (7L)

Types of substations. Bus-bar arrangements in substations. Substation layout. Major equipment in a distribution substation: transformers, circuit breakers, re-closers, sectionalisers, and fuses.

Module 4: System Analysis and Protection (7L)

Coordination of protective devices. Fault analysis in distribution systems. Application of circuit breakers and fuses. Grounding systems. Power quality issues: voltage sag, swell, harmonics, and their mitigation.

Module 5: Modern Trends in Distribution Systems (7L)

Distribution Automation Systems (DAS). SCADA in distribution management. Introduction to Distributed Generation (DG) and its impact on the grid. Con- cepts of Microgrids and Smart Grids.

Text Books

1. Turan Gonen, *Electric Power Distribution System Engineering*, CRC Press.
2. A. S. Pabla, *Electric Power Distribution*, McGraw Hill.
3. V. Kamaraju, *Electrical Power Distribution Systems*, McGraw Hill.

Reference Books

1. T. A. Short, *Electric Power Distribution Handbook*, CRC Press.
2. James A. Momoh, *Electric Power Distribution, Automation, Protection, and Control*, CRC Press.

Course Name: SCADA System and Applications

Course Code: EDPM204B

Contact: 3L:0T:0

P **Total Contact Hours:** 36

Credit: 3

Standard: PG M.Tech

Prerequisite: Understanding of control systems, industrial instrumentation, and basic computer networking.

Course Objectives

The objectives of this PG M.Tech course, reflecting current industry needs, are to:

Obj.1: Introduce the fundamental concepts and architecture of Supervisory Control and Data Acquisition (SCADA) systems.

Obj.2: Explain the functions and characteristics of SCADA hardware components like RTUs, PLCs, and Master Stations.

Obj.3: Develop an understanding of various communication protocols and networking technologies used in SCADA systems.

Obj.4: Explore the application of SCADA in various industries, with a special focus on power system automation.

Obj.5: Create awareness about the cybersecurity challenges and standards relevant to SCADA systems.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Explain the architecture, components, and evolution of modern SCADA systems.

CO2: Differentiate between the roles of PLCs, RTUs, and MTUs in an industrial automation context.

CO3: Analyze SCADA communication protocols such as Modbus, DNP3, and IEC 60870.

CO4: Design a basic SCADA system for a given power system or industrial process application.

CO5: Identify potential cybersecurity vulnerabilities in SCADA networks and suggest relevant mitigation measures.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	2	-	-	-	-	-	-	-	1
CO2	3	2	2	-	2	-	-	-	-	1
CO3	3	3	2	2	3	-	-	-	-	2
CO4	3	3	3	2	3	-	-	-	-	2
CO5	2	2	2	-	2	3	-	2	-	3

Course Content

Module 1: Introduction to SCADA (7L)
Evolution of SCADA. Fundamental principles. SCADA system architecture (Mono- lithic, Distributed, Networked). SCADA system components: Human-Machine Interface (HMI), Master Terminal Unit (MTU), Remote Terminal Unit (RTU).

Module 2: SCADA Hardware and Software (8L)
Detailed study of RTUs and PLCs. MTU functions and hardware. HMI - features, design, and implementation. Data logging, trend analysis, alarm processing, and reporting.

Module 3: Communication Technologies (7L)
SCADA communication requirements. Communication media (wired, wireless). Network topologies (Point-to-point, Star, Multi-drop). Industrial communication protocols: Modbus, DNP3, IEC 60870-5 series. TCP/IP for SCADA.

Module 4: SCADA System Applications (7L)
Application of SCADA in power systems: Substation Automation, Feeder Automation, Grid Management. Applications in other industries: oil and gas, water treatment, manufacturing. Case studies.

Module 5: SCADA Security (7L)
Vulnerabilities of SCADA systems. Potential cyber-attack vectors. SCADA se- curity standards (e.g., IEC 62351, ISA/IEC 62443). Defense-in-depth strategies, firewalls, and intrusion detection systems for industrial control systems.

Text Books

1. David Bailey, Edwin Wright, *Practical SCADA for Industry*, Newnes.
2. Stuart A. Boyer, *SCADA: Supervisory Control and Data Acquisition*, ISA.
3. Ronald L. Krutz, *Securing SCADA and Industrial Control Systems*, Wiley.

Reference Books

1. Gordon Clarke, Deon Reynders, *Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems*, Newnes.
2. Robert Radvanovsky, Jacob Brodsky, *Handbook of SCADA/Control Systems Security*, CRC Press.

Course Name: Advanced Embedded and Micro-Controller Based Systems
Course Code: EDPM204C

Contact:
3L:0T:0
P **Total Contact Hours:** 36
Credit: 3

Standard: PG M.Tech

Prerequisite: Proficiency in C/C++ programming, fundamental knowledge of microprocessor microcontroller architecture (e.g., 8051/AVR/PIC), and digital electronics.

Course Objectives

The objectives of this PG M.Tech course, reflecting current industry needs, are to:

Obj.1: Introduce advanced 32-bit microcontroller architectures, specifically ARM Cortex-M series.

Obj.2: Develop proficiency in designing multi-tasking embedded systems using Real-Time Operating Systems (RTOS).

Obj.3: Provide hands-on concepts for interfacing microcontrollers with various peripherals using standard communication protocols.

Obj.4: Cover the principles of embedded system design, including power management, debugging, and testing.

Obj.5: Explore the role of embedded systems in the Internet of Things (IoT) ecosystem.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Differentiate between various advanced microcontroller architectures and select an appropriate one for a given application.

CO2: Design and implement multi-threaded applications using RTOS concepts like tasks, semaphores, and message queues.

CO3: Interface microcontrollers with sensors and actuators using communication protocols like I2C, SPI, and CAN.

CO4: Analyze and optimize embedded systems for performance, power consumption, and reliability.

CO5: Develop a system-level design for an IoT-enabled embedded device.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	-	2	-	-	-	-	2
CO2	3	3	3	2	3	-	-	-	-	2
CO3	3	2	3	-	3	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	2
CO5	3	3	3	2	3	2	-	-	-	3

Course Content

Module 1: Advanced Microcontroller Architecture (8L)

Comparison of CISC and RISC architectures. Introduction to ARM architecture, processor families (Cortex-M, Cortex-A). ARM Cortex-M architecture in detail: registers, memory map, instruction set, interrupt handling.

Module 2: Real-Time Operating Systems (RTOS) (8L)

Operating system concepts for embedded systems. Task scheduling algorithms. Inter-task communication: semaphores, mutexes, message queues. Memory management. Introduction to a popular RTOS (e.g., FreeRTOS): kernel structure and API.

Module 3: Embedded Communication Protocols (7L)

Peripheral interfacing. Synchronous and asynchronous communication. In-depth study of serial protocols: I2C, SPI, UART. Introduction to industrial and auto- motive protocols: CAN bus, LIN bus.

Module 4: Embedded System Design and Debugging (7L)

Hardware-software co-design. Low-power design techniques. System-on-Chip (SoC) concepts. Debugging techniques: In-Circuit Emulators (ICE), JTAG, Serial Wire Debug (SWD). Testing and validation of embedded systems.

Module 5: Embedded Systems for IoT (6L)

Introduction to the Internet of Things (IoT). Role of embedded systems in IoT. Wireless communication protocols for IoT: Wi-Fi, Bluetooth Low Energy (BLE), LoRaWAN. IoT communication protocols: MQTT, CoAP.

Text Books

1. Joseph Yiu, *The Definitive Guide to ARM Cortex-M3 and Cortex-M4 Processors*, Newnes.
2. Frank Vahid, Tony Givargis, *Embedded System Design: A Unified Hardware/Software Introduction*, Wiley.
3. Richard Barry, *Mastering the FreeRTOS Real Time Kernel*, Real Time Engineers Ltd.

Reference Books

1. David E. Simon, *An Embedded Software Primer*, Pearson Education.
2. Raj Kamal, *Embedded Systems: Architecture, Programming and Design*, McGraw Hill.
3. Peter Marwedel, *Embedded System Design: Embedded Systems Foundations of Cyber-Physical Systems*, Springer.

Course Name: EHV AC Power Transmission
Course Code: EDPM204D

Contact:
3L:0T:0
P **Total Contact Hours:** 36
Credit: 3

Standard: PG M.Tech

Prerequisite: Strong foundation in power system analysis, transmission & distribution, and electromagnetic field theory.

Course Objectives

The objectives of this PG M.Tech course, reflecting current industry needs, are to:

Obj.1: Provide a comprehensive understanding of the need, challenges, and principles of Extra High Voltage (EHV) AC transmission.

Obj.2: Enable students to calculate and analyze the electrical parameters of EHV lines, including bundled conductors.

Obj.3: Impart knowledge of high voltage phenomena such as corona, electrostatic fields, and their effects.

Obj.4: Cover the principles of insulation coordination, overvoltage protection, and voltage control in EHV systems.

Obj.5: Introduce the design aspects of EHV substations and the role of Flexible AC Transmission Systems (FACTS).

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Analyze the electrical parameters of EHV AC transmission lines, accounting for bundling and high-voltage effects.

CO2: Evaluate the impact of corona, audible noise, radio interference, and electrostatic fields associated with EHV lines.

CO3: Design appropriate insulation coordination and overvoltage protection schemes for EHV systems.

CO4: Assess the necessity and impact of series and shunt compensation on power transfer capability and voltage stability.

CO5: Explain the design principles of EHV substations and the application of FACTS devices for power flow control.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	2	2	-	-	-	-	-	1
CO2	3	3	-	2	-	2	-	-	-	2
CO3	3	3	3	2	2	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	2
CO5	3	2	2	-	2	-	-	-	-	3

Course Content

Module 1: Introduction and Line Parameters (8L)

Need for EHV transmission. Standard transmission voltages. Conductor configuration and bundling. Calculation of inductance and capacitance for bundled conductor lines. Resistance and skin effect at high frequencies.

Module 2: Voltage Gradients and Corona Effects (8L)

Electric field and voltage gradients of conductors. Surface voltage gradient on single, two, and multi-conductor bundles. Corona phenomenon: critical disruptive voltage, visual critical voltage. Corona loss. Audible noise and radio interference from EHV lines.

Module 3: Overvoltages and Insulation Coordination (7L)

Causes of overvoltages: lightning and switching surges. Characteristics of switching surges. Protection against overvoltages: surge arresters, shielding wires. Principles of insulation coordination. BIL and SIL of equipment.

Module 4: Voltage Control and Compensation (7L)

Power transfer capability. Voltage regulation and control. Reactive power com- pensation. Series and shunt compensation. Static VAR Compensators (SVC) and their applications. Thyristor Controlled Series Capacitor (TCSC).

Module 5: EHV Substation Design and FACTS (6L)

Design considerations for EHV AC substations. Bus-bar arrangements. Ground- ing and shielding of substations. Introduction to Flexible AC Transmission Sys- tems (FACTS). Overview of STATCOM and UPFC.

Text Books

1. Rakosh Das Begamudre, *Extra High Voltage AC Transmission Engineering*, New Age International.
2. K. R. Padiyar, *HVDC Power Transmission Systems: Technology and System Interactions*, New Age International.
3. S. Rao, *EHV-AC, HVDC Transmission & Distribution Engineering*, Khanna Publishers.

Reference Books

1. P. Kundur, *Power System Stability and Control*, McGraw-Hill.
2. N. G. Hingorani & L. Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, IEEE Press.
3. C. L. Wadhwa, *High Voltage Engineering*, New Age International.

EDPM 281 – Literature Review & Research Dissemination of Minor Project with Seminar

L-T-P: 0-0-3 | **Credit:** 0 | **Total Hours:** 36 (Practical/Seminar-based)
Standard: PG (M.Tech)
Prerequisite: Basic understanding of research methodology, technical writing, and subject-specific fundamentals.

Course Objectives

1. Develop the ability to critically review scientific and technical literature relevant to the minor project topic.
2. Enhance skills in summarizing, synthesizing, and presenting technical information.
3. Familiarize students with effective seminar presentation techniques and research dissemination practices.
4. Prepare students for formal reporting and publication of research findings in professional or academic forums.

Course Outcomes

CO1 Conduct a comprehensive literature review relevant to the chosen minor project.

CO2 Analyze and synthesize information from multiple sources to identify research gaps.

CO3 Prepare structured seminar presentations with clarity, technical depth, and visual aids.

CO4 Demonstrate effective communication of research findings to academic and professional audiences.

CO5 Document findings in a concise report format following standard academic conventions.

Course Content

1. **Literature Review Techniques (12L)**

   Sources of technical literature: Journals, conference proceedings, patents, technical reports, and standards, Systematic review methods, citation management tools (e.g., Mendeley, Zotero), Critical analysis, comparison, and synthesis of research findings.

2. **Research Documentation (8L)**

   Structuring a technical report: Abstract, introduction, literature survey, methodology, findings, conclusion, Referencing styles (IEEE, APA, etc.), Plagiarism awareness and ethical considerations in research.

3. **Seminar Preparation & Presentation Skills (8L)**

   Slide preparation and effective use of visual aids, Verbal and non-verbal communication techniques, Handling Q&A sessions and audience engagement.

4. **Research Dissemination (8L)**

   Seminar presentation practice sessions, Peer and faculty feedback integration, Preparing for publication in journals or conferences.

Assessment Components

Literature Review Report: 30%

Seminar Presentation: 40%

Participation and Discussion: 10%

Final Submission of Consolidated Report: 20%

Textbooks / References

1. Fink, A., *Conducting Research Literature Reviews: From the Internet to Paper*, Sage Publications, 5th Edition.
2. Booth, A., Sutton, A., & Papaioannou, D., *Systematic Approaches to a Successful Literature Review*, Sage Publications, 2nd Edition.
3. Alley, M., *The Craft of Scientific Presentations*, Springer, 2nd Edition.
4. Day, R. A., *How to Write and Publish a Scientific Paper*, Cambridge University Press.
5. IEEE / APA Publication Guidelines for technical papers.

EDPM 291 – Power System Digital Protection Lab

L-T-P: 0-0-3 | **Credit:** 2 | **Total Hours:** 36 (Laboratory-based)
Standard: PG (M.Tech)
Prerequisite: Basic knowledge of power system protection, electrical machines, and digital protection concepts (EDPM 201 recommended).

Course Objectives

1. Provide hands-on experience with digital and numerical relays in power systems.
2. Familiarize students with the configuration, testing, and operation of protective devices.
3. Develop skills in fault analysis, relay coordination, and protection scheme implementation.
4. Integrate theoretical knowledge from digital protection courses with practical experimentation.

Course Outcomes

CO1	Demonstrate the working and testing of digital relays for different power system components.
CO2	Configure overcurrent, distance, and differential protection relays using laboratory equipment or simulation tools.
CO3	Analyze system faults and evaluate the performance of protection schemes.
CO4	Develop skills to coordinate protective devices and optimize relay settings for safe operation.
CO5	Prepare detailed lab reports documenting observations, analyses, and conclusions.

Laboratory Modules / Experiments

1. **Introduction to Digital/Numerical Relays**
   - Hardware and software interface.
   - Functional blocks and configuration.
2. **Testing Overcurrent and Time-Delay Relays**
   - Characteristic curves and pickup settings.
   - Fault simulation and relay response analysis.
3. **Distance Protection Experiments**
   - Relay settings for transmission line protection.
   - Testing with short-circuit scenarios.
4. **Differential Protection of Transformers and Generators**
   - Relay connection schemes.
   - CT/PT ratio verification and protection coordination.
5. **Communication-Assisted Protection & Synchrophasor Applications**
   - IEC 61850 communication-based relay testing (simulation).
   - Phasor measurement unit (PMU) data analysis.
6. **Relay Coordination and Optimization**
   - Setting coordination between primary and backup relays.
   - Time grading and selectivity evaluation.
7. **Simulation-Based Experiments (Optional / Supplementary)**
   - MATLAB/Simulink or ETAP-based digital protection simulations.
   - Fault analysis and relay performance verification.

Assessment Components

- Lab Performance and Record: 50%
- Viva-Voce / Practical Demonstration: 30%
- Simulation / Additional Assignments: 20%

Textbooks / References

1. Arun G. Phadke and James S. Thorp, *Computer Relaying for Power Systems*, Wiley-IEEE Press.
2. Badri Ram and D. N. Vishwakarma, *Power System Protection and Switchgear*, McGraw-Hill.
3. Gerhard Ziegler, *Numerical Distance Protection: Principles and Applications*, Siemens AG.
4. S. R. Bhide and Y. G. Paithankar, *Fundamentals of Power System Protection*, PHI Learning.
5. Simulation manuals: MATLAB/Simulink, ETAP Relay Testing modules.

Course Name: Electrical Power Distribution System Lab
Course Code: EDPM292A
Contact: 0L:0T:4P
Total Contact Hours: 24
Credit: 2
Standard: PG M.Tech
Prerequisite: Fundamental knowledge of Power System Analysis, Electrical Machines, and proficiency with simulation tools like MATLAB/Simulink or similar platforms.

Course Objectives

The objectives of this PG M.Tech lab course are to:

Obj.1: Provide hands-on experience in modeling and simulating modern electrical power distribution networks.

Obj.2: Develop skills in analyzing distribution system performance, including load flow, fault conditions, and voltage stability.

Obj.3: Impart practical knowledge of protection schemes and coordination in radial and looped distribution systems.

Obj.4: Investigate the impact of Distributed Generation (DG) and renewable energy integration on system operation.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Model various components of a distribution system using industry-standard simulation software.

CO2: Analyze load flow, voltage profiles, and power losses in radial and weakly-meshed distribution feeders.

CO3: Simulate and evaluate the effects of various symmetrical and unsymmetrical faults on the system.

CO4: Design and verify overcurrent protection coordination schemes for distribution feeders.

CO5: Assess the technical impacts of integrating distributed generation sources on system performance.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	-	-	-	3	-	-	-	-	-
CO2	3	3	-	-	2	-	-	-	-	-
CO3	3	3	-	2	-	-	-	-	-	-
CO4	-	2	3	-	2	-	-	-	-	-
CO5	-	3	-	2	-	2	-	-	-	-

List of Experiments

1. Introduction to Power System simulation software (e.g., ETAP/PSCAD/MATLAB Simulink) for distribution system analysis. (Detailed Study)
2. Modeling of distribution system components: overhead lines, underground cables, and distribution transformers. (Simulation)
3. Load flow analysis of a radial distribution feeder to determine voltage profiles and line losses. (Numerical Calculation & Simulation)
4. Effect of capacitor placement on voltage improvement and loss reduction in a distribution network. (Detailed Study & Simulation)
5. Simulation of symmetrical (3-phase) faults at various locations in a distribution feeder. (Calculation & Simulation)
6. Simulation of unsymmetrical faults (LG, LL, LLG) and analysis of fault currents and voltages. (Calculation & Simulation)
7. Time-Current Characteristic (TCC) analysis and coordination of overcurrent relays for a radial feeder. (Simulation)
8. Study of feeder reconfiguration techniques for power loss minimization. (Detailed Study & Simulation)
9. Analysis of the impact of Distributed Generation (DG) penetration on the voltage profile and fault levels of a distribution network. (Simulation)
10. Harmonic analysis in a distribution system with non-linear loads. (Simulation & Analysis)

Reference Books

1. Turan Gonen, *Electric Power Distribution System Engineering*, CRC Press.
2. A. S. Pabla, *Electric Power Distribution*, McGraw Hill Education.
3. Hadi Saadat, *Power System Analysis*, McGraw Hill.
4. Relevant Software Manuals (e.g., ETAP, PSCAD, MATLAB/Simulink).

Course Name: PLC & SCADA Lab
Course Code: EDPM292B
Contact: 0L:0T:4P
Total Contact Hours: 24
Credit: 2
Standard: PG M.Tech
Prerequisite: Basic knowledge of digital electronics, logic circuits, and fundamental programming concepts.

Course Objectives

The objectives of this PG M.Tech lab course are to:

Obj.1: Provide comprehensive hands-on training on Programmable Logic Controllers (PLCs) and their programming.

Obj.2: Develop skills in interfacing PLCs with real-world sensors, actuators, and other I/O devices.

Obj.3: Introduce the architecture and configuration of Supervisory Control and Data Acquisition (SCADA) systems.

Obj.4: Enable students to design and implement integrated automation solutions for industrial processes using PLC and SCADA.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Develop and debug ladder logic programs for industrial control applications.

CO2: Implement time-based and event-based control sequences using PLC timers and counters.

CO3: Design and configure Human Machine Interface (HMI) screens for process visualization and control.

CO4: Establish communication between PLC and SCADA systems for data monitoring and supervisory control.

CO5: Integrate PLC, HMI, and SCADA to create a complete automation solution for a given process.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	-	3	-	2	-	-	-	-	-
CO2	3	2	-	-	2	-	-	-	-	-
CO3	-	2	3	-	2	-	-	-	-	-
CO4	2	-	-	3	3	-	-	-	-	-
CO5	-	2	3	-	3	-	-	-	-	-

List of Experiments

1. Introduction to PLC hardware, I/O modules, and programming environment (e.g., TIA Portal, RSLogix). (Detailed Study)
2. Implementation of basic logic gates (AND, OR, NOT, NAND, NOR, XOR) using

ladder logic. (Programming)

3. Development of ladder logic for motor control circuits: Direct-On-Line (DOL) and Star- Delta starters. (Programming)
4. Application of ON-delay, OFF-delay, and retentive timers for sequential process control (e.g., traffic light control). (Programming)
5. Application of Up-Down counters for object counting and process batching. (Programming & Calculation)
6. Interfacing and programming of analog I/O modules for level or temperature control. (Detailed Study & Programming)
7. Introduction to SCADA software and creation of a new project with graphic screens and tag database. (Detailed Study)
8. Design of an HMI/SCADA screen for a tank filling process with level indication, alarms, and controls. (Design & Simulation)
9. Configuration of communication between PLC and SCADA software (e.g., using Mod- bus/OPC). (Implementation)
10. Mini-project: Integration of PLC and SCADA for controlling and monitoring a simulated industrial process. (Project-based Learning)

Reference Books

1. W. Bolton, *Programmable Logic Controllers*, Newnes.
2. John W. Webb, Ronald A. Reis, *Programmable Logic Controllers: Principles and Appli- cations*, Prentice Hall.
3. David Bailey, Edwin Wright, *Practical SCADA for Industry*, Newnes.
4. Frank D. Petruzella, *Programmable Logic Controllers*, McGraw-Hill Education.

Course Name: Microcontroller Lab
Course Code: EDPM292C
Contact: 0L:0T:4P
Total Contact Hours: 24
Credit: 2
Standard: PG M. Tech
Prerequisite: Proficiency in C/C++ programming, knowledge of digital logic design and basic electronics.

Course Objectives

The objectives of this PG M. Tech lab course are to:

Obj.1: Provide in-depth practical experience with 32-bit ARM-based microcontroller architecture and toolchains.

Obj.2: Develop proficiency in configuring and utilizing various on-chip peripherals like GPIO, Timers, ADC, and communication interfaces.

Obj.3: Introduce advanced concepts such as interrupt handling and Direct Memory Access (DMA).

Obj.4: Enable students to design, implement, and debug embedded systems for real-world applications.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Write, compile, and debug embedded C programs for an ARM Cortex-M based microcontroller.

CO2: Configure GPIOs for digital input/output and interface with LEDs, buttons, and sensors.

CO3: Implement timing, delay, and PWM generation using hardware timers and counters.

CO4: Utilize serial communication protocols (UART, I2C, SPI) to interface with peripheral devices and other systems.

CO5: Design an interrupt-driven embedded system to handle asynchronous events efficiently.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	-	-	-	3	-	-	-	-	-
CO2	2	2	-	3	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-
CO4	3	-	-	2	3	-	-	-	-	-
CO5	-	2	3	2	-	-	-	-	-	-

List of Experiments

1. Introduction to the ARM development environment (e.g., Keil MDK, STM32CubeIDE) and debugging tools. (Detailed Study)

2. General Purpose I/O (GPIO) Programming: Blinking an LED and reading a push-button switch. (Programming)

3. External Interrupt Programming: Toggling an LED state using a button press interrupt. (Programming)

4. Timer and Counter Programming: Generating a precise time delay and a square wave. (Programming & Calculation)

5. Pulse Width Modulation (PWM) generation using timers to control the brightness of an LED or speed of a DC motor. (Programming)

6. Analog-to-Digital Converter (ADC) Interfacing: Reading an analog sensor (e.g., potentiometer, LDR) and displaying the value. (Programming)

7. Universal Asynchronous Receiver-Transmitter (UART) Communication: Transmitting sensor data to a PC terminal. (Programming)

8. Inter-Integrated Circuit (I2C) Communication: Interfacing with an I2C-based sensor (e.g., MPU-6050 accelerometer/gyroscope). (Detailed Study & Programming)

9. Serial Peripheral Interface (SPI) Communication: Interfacing with an SPI-based device (e.g., LCD Display or SD card module). (Detailed Study & Programming)

10. Mini-project: Design and implement a small embedded system integrating multiple peripherals (e.g., a simple data logger). (Project-based Learning)

Reference Books

1. Joseph Yiu, *The Definitive Guide to ARM® Cortex®-M3 and Cortex®-M4 Processors*, Newnes.

2. Muhammad Ali Mazidi, Shujen Chen, *STM32 ARM Programming for Embedded Systems*, MicroDigitalEd.

3. Manufacturer's Datasheets and Reference Manuals for the specific microcontroller (e.g., STMicroelectronics, NXP).

4. Derek Molloy, *Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux*, Wiley.

Course Name: Power Systems Computation Lab
Course Code: EDPM292D
Contact: 0L:0T:4P
Total Contact Hours: 24
Credit: 2
Standard: PG M.Tech
Prerequisite: Strong foundation in Power System Analysis, Matrix Algebra, Numerical Methods, and proficiency in MATLAB/Python programming.

Course Objectives

The objectives of this PG M.Tech lab course are to:

Obj.1: Provide practical experience in developing computer programs for solving complex power system problems.

Obj.2: Reinforce theoretical concepts of power system analysis through algorithmic implementation.

Obj.3: Develop skills in implementing numerical algorithms for load flow, fault analysis, and economic operation.

Obj.4: Familiarize students with computational techniques for analyzing power system stability.

Course Outcomes

Upon successful completion of this course, students will be able to:

CO1: Develop algorithms and write computer programs for the formation of bus admittance (Y-Bus) and bus impedance (Z-Bus) matrices.

CO2: Implement iterative numerical methods (Gauss-Seidel, Newton-Raphson) to solve the power flow problem.

CO3: Write programs to compute fault currents for various symmetrical and unsymmetrical faults in a power system.

CO4: Develop computational solutions for economic load dispatch problems with and without transmission losses.

CO5: Implement numerical integration techniques to solve the swing equation for transient stability analysis.

CO-PO Mapping

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	3	3	-	-	2	-	-	-	-	-
CO2	3	3	2	-	-	-	-	-	-	-
CO3	3	3	-	-	2	-	-	-	-	-
CO4	3	2	-	-	2	-	-	-	-	-
CO5	3	2	-	2	-	-	-	-	-	-

List of Experiments

(All experiments to be performed using MATLAB/Python/C++)

1. Write a program for the formation of the Bus Admittance Matrix (Y-Bus) from system data. (Numerical Calculation & Programming)
2. Write a program to solve the power flow problem for a given system using the Gauss-Seidel method. (Programming)
3. Write a program to solve the power flow problem for a given system using the Newton-Raphson method. (Programming)
4. Write a program for the formation of the Bus Impedance Matrix (Z-Bus) using the bus building algorithm. (Detailed Study & Programming)
5. Write a program to calculate symmetrical fault currents and post-fault bus voltages using the Z-Bus matrix. (Numerical Calculation & Programming)
6. Write a program to compute unsymmetrical fault (LG, LL, LLG) currents using symmetrical components. (Programming)
7. Write a program for economic dispatch of thermal units without considering transmission losses. (Numerical Calculation & Programming)
8. Write a program for economic dispatch of thermal units including transmission losses using B-coefficients. (Programming)
9. Write a program to solve the swing equation using a step-by-step method (e.g., Euler's or Runge-Kutta method) to determine the critical clearing time. (Detailed Study & Simulation)
10. Perform N-1 contingency analysis on a small power system to identify critical outages. (Detailed Study & Programming)

Reference Books

1. John J. Grainger, William D. Stevenson, Jr., *Power System Analysis*, McGraw-Hill.
2. I.J. Nagrath, D.P. Kothari, *Modern Power System Analysis,* Tata McGraw-Hill.
3. Hadi Saadat, *Power System Analysis*, McGraw Hill.
4. Prabha Kundur, *Power System Stability and Control*, McGraw-Hill.

EDPM 282 – Thesis Component II
L-T-P: 0-0-6 | **Credit:** 10|
Total Hours: 72 (Project / Research-based)
Standard: PG (M.Tech)
Prerequisite: Completion of **EDPM 182 – Thesis Component I** or equivalent minor project work.

Course Objectives

1. Guide students to conduct independent research building on their Thesis Component I.
2. Develop advanced problem-solving and analytical skills in power systems or related areas.
3. Prepare students for high-quality technical documentation and thesis reporting.
4. Enhance abilities in research dissemination through seminars, technical presentations, and publications.

Course Outcomes

CO1 Formulate and implement research methodology for the chosen thesis topic.

CO2 Perform advanced modeling, simulation, or experimental investigations in power engineering.

CO3 Analyze and interpret research results, drawing valid technical conclusions.

CO4 Prepare a comprehensive thesis report following academic and professional standards.

CO5 Present research findings effectively through seminars, workshops, or conferences.

Course Content / Activities

1. **Research Work and Development (40–50 Hours)**
   - Deepening the research problem identified in Thesis Component I.
   - Advanced modeling, simulation, experiments, or field studies.
   - Data collection, analysis, and validation.
2. **Thesis Documentation (10–15 Hours)**
   - Structuring thesis: Abstract, Introduction, Literature Review, Methodology, Results, Discussion, Conclusion, References.
   - Referencing and plagiarism awareness.
3. **Seminar / Progress Presentations (10–15 Hours)**
   - Periodic progress seminars to faculty and peers.
   - Incorporating feedback for improvement.
   - Final seminar presentation of research findings.
4. **Thesis Submission and Evaluation**
   - Submission of final thesis document in prescribed format.
   - Evaluation by internal and external examiners (if applicable).
   - Viva-voce examination.

Assessment Components

- Research Progress Reports / Logbook: 20%
- Seminar Presentations (Interim and Final): 30%
- Thesis Report Submission: 40%
- Viva-Voce / Defense: 10%

Textbooks / References

1. Kothari, C. R., *Research Methodology: Methods and Techniques*, New Age International.

2. Day, R. A., *How to Write and Publish a Scientific Paper*, Cambridge University Press.
3. Recent journals and conference papers relevant to the thesis topic.
4. Institution-specific thesis and dissertation formatting guidelines.

Semester III

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit	Faculty
1	PE 5	EDPM 301	(a) Restructured Power Systems (b) Advanced Embedded and Micro-Controller Based Systems (c) Power System Planning & Reliability (d) Engineering Optimization	3	0	0	3	GR
2	OE	EDPM 302	(a) Data Analytics in Power Systems & Devices (b) Safety and Risk Management in Power Systems and Electrical Devices (c) Energy Management and Auditing (d) Green Technology and Waste Management	2	0	0	3	SP
3	Major Project	EDPM 381	Phase – I Dissertation	0	0	20	10	

Total: L=6, T=0, P=20, Credit=16

EDPM 320A – Data Analytics in Power Systems & Devices

L-T-P: 3-0-0 | **Credit:** 3 | **Total Contact Hours:** 42
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Power Systems, Electrical Machines, Measurement Systems, and Basic Statistics.

Course Objectives

1. Introduce the concepts of data analytics and its importance in modern power systems.
2. Develop skills in handling, processing, and analyzing large-scale power system data.
3. Familiarize students with predictive analytics, anomaly detection, and condition monitoring techniques for electrical devices.
4. Apply machine learning and statistical techniques to enhance power system operation, reliability, and maintenance.

Course Outcomes

CO1	Understand the principles of data analytics and its application in power systems.
CO2	Collect, preprocess, and visualize power system data effectively.
CO3	Apply statistical and machine learning techniques for fault detection, load forecasting, and condition monitoring.
CO4	Analyze device-level data for predictive maintenance and reliability enhancement.
CO5	Develop data-driven decision-making frameworks for power system operation and management.

Course Content

Module 1: Introduction to Data Analytics in Power Systems (6L)

Importance and applications of data analytics in power systems, Sources of data: Smart meters, SCADA, PMUs, IoT-enabled devices, Overview of data analytics pipeline: acquisition, cleaning, processing, visualization.

Module 2: Data Preprocessing and Visualization (8L)

Data cleaning, normalization, and transformation techniques, Handling missing data and outliers, Visualization tools and dashboards for power system data (MATLAB, Python, Power BI).

Module 3: Statistical Analysis Techniques (8L)

Descriptive and inferential statistics, Correlation, regression, and hypothesis testing, Time-series analysis for load forecasting and power quality assessment.

Module 4: Machine Learning for Power Systems (10L)

Supervised learning: classification, regression, decision trees, SVM, neural networks, Unsupervised learning: clustering, PCA, anomaly detection, Applications: fault detection, predictive maintenance, energy consumption analysis.

Module 5: Condition Monitoring and Predictive Analytics for Devices (10L)

Monitoring of transformers, generators, motors, and power electronics devices, Health index, remaining useful life estimation, Case studies: detection of insulation degradation, overloading, and abnormal operating conditions.

Textbooks

1. G. K. Venayagamoorthy, *Smart Grid, Big Data, and Analytics*, CRC Press, 2020.
2. N. Amjady, *Forecasting in Power Systems Using Data Analytics*, Springer, 2018.
3. W. H. Inmon, *Building the Data Warehouse*, Wiley, 4th Edition.

Reference Books

1. H. Singh, *Machine Learning in Electrical Power Systems*, CRC Press, 2021.
2. A. Kusiak, *Data Mining in Renewable Energy Systems*, Elsevier, 2019.
3. M. Kezunovic, *Intelligent Systems for Power Engineering*, Wiley-IEEE Press.

EDPM 302B – Safety and Risk Management in Power Systems and Electrical Devices

L-T-P: 3-0-0 | **Credit:** 3 | **Total Contact Hours:** 42
Standard: PG (M.Tech)
Prerequisite: Basic knowledge of Electrical Power Systems, Electrical Machines, and Electrical Safety Practices.

Course Objectives

1. Provide an in-depth understanding of safety standards, risk assessment, and hazard identification in power systems.
2. Develop skills to analyze and mitigate electrical hazards in high-voltage and low-voltage systems.
3. Familiarize students with safety regulations, personal protective equipment (PPE), and safety protocols in power engineering.
4. Introduce systematic risk management approaches including hazard identification, probability analysis, and consequence assessment.

Course Outcomes

CO1	Understand electrical hazards, safety standards, and regulatory requirements.
CO2	Identify and evaluate potential risks in power systems and electrical devices.
CO3	Apply safety management systems and risk mitigation strategies in practical scenarios.
CO4	Develop procedures and protocols to ensure operational safety in power systems.
CO5	Integrate safety and risk management practices in the design and operation of electrical installations.

Course Content

Module 1: Fundamentals of Electrical Safety (8L)

Types of electrical hazards: shock, arc flash, fire, mechanical, Physiological effects of electric current on humans, Safety codes and standards: IEC, IEEE, NFPA 70E, IS 5216.

Module 2: Hazard Identification and Risk Assessment (8L)

Risk analysis methods: HAZOP, FMEA, Fault Tree Analysis, Probability and consequence evaluation, Identification of high-risk areas in substations, transmission, and distribution systems.

Module 3: Safety Management Systems (8L)

Safety policies and procedures for power plants and industrial electrical systems, Role of PPE and insulating devices, Lockout-Tagout (LOTO) procedures and confined space safety.

Module 4: Protection and Mitigation Techniques (9L)

Protective devices: circuit breakers, fuses, relays, surge protection, Arc flash hazard analysis and mitigation, Emergency response planning, incident investigation, and reporting.

Module 5: Regulatory, Legal, and Environmental Aspects (9L)

National and international electrical safety regulations, Compliance audits and certification processes, Environmental hazards associated with electrical systems and sustainable safety practices.

Textbooks

1. Philip Kiameh, *Electric Power Distribution Handbook*, McGraw-Hill, 3rd Edition, 2018.
2. Kenneth G. Mastrullo, *Electrical Safety Handbook*, McGraw-Hill, 4th Edition.
3. Surya Santoso, *Power System Safety and Reliability*, Wiley, 2020.

Reference Books

1. National Fire Protection Association (NFPA), *NFPA 70E: Standard for Electrical Safety in the Workplace*.
2. IEC 60364: *Electrical Installations for Buildings – Safety Requirements*.
3. W. D. Stevenson, *Elements of Power System Analysis*, McGraw-Hill.
4. R. K. Rajput, *Electrical Safety and Risk Assessment in Industrial Power Systems*, Laxmi Publications.

EDPM 302C – Energy Management and Auditing

L-T-P: 3-0-0 | **Credit:** 3 | **Total Contact Hours:** 42
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Electrical Power Systems, Electrical Machines, and Basic Electrical Measurements.

Course Objectives

1. Introduce principles and practices of energy management in industrial, commercial, and utility systems.
2. Develop skills to measure, monitor, and analyze energy consumption and identify efficiency improvement opportunities.
3. Familiarize students with energy auditing techniques, standards, and energy conservation measures.
4. Prepare students to implement energy management systems (EnMS) aligned with ISO 50001 standards.

Course Outcomes

CO1 Understand the concepts of energy management, energy efficiency, and energy conservation.

CO2 Conduct energy audits for industrial and commercial installations effectively.

CO3 Analyze energy consumption data and identify areas for optimization.

CO4 Evaluate energy-saving technologies and their economic feasibility.

CO5 Implement energy management systems and propose strategies for sustainable energy utilization.

Course Content

Module 1: Introduction to Energy Management (6L)

Importance of energy management in power systems and industry, Energy scenario: global and national perspectives, Energy efficiency and energy conservation concepts, Role of energy managers and policies supporting energy management.

Module 2: Energy Monitoring and Measurement (8L)

Energy monitoring techniques and instrumentation, Measurement of electrical energy consumption, power factor, and load profiling, Data acquisition and analysis for energy management.

Module 3: Energy Audit (8L)

Types of energy audits: preliminary, detailed, and investment-grade audits, Methodology of energy auditing in electrical systems, Energy audit instruments and software tools.

Module 4: Energy Conservation Measures (10L)

Electrical energy conservation in motors, transformers, lighting, HVAC systems, Power factor improvement and reactive power management, Optimization of industrial processes for energy efficiency, Case studies of successful energy conservation projects.

Module 5: Energy Management Systems and Standards (10L)

Introduction to Energy Management Systems (EnMS), ISO 50001: requirements, implementation, and certification, Benchmarking, key performance indicators (KPIs), and energy reporting, Integration of renewable energy and smart grid concepts in energy management.

Textbooks

1. W.R. Murphy, *Energy Management*, Butterworth-Heinemann, 8th Edition.
2. Paul O'Callaghan, *Energy Management and Control*, Elsevier, 2016.
3. F. C. W. R. Weidner, *Handbook on Energy Audit and Management*, McGraw-Hill.

Reference Books

1. IEC 60364, *Electrical Installations for Buildings – Safety and Energy Management Requirements*.
2. B. S. Sonal, *Energy Audit: Principles and Practice*, TERI Press.
3. Ibrahim Dincer, Marc A. Rosen, *Exergy, Energy, and Sustainability: A Thermodynamic Approach*, Elsevier.
4. S. C. Tripathy, *Energy Efficiency in Electrical Utilities*, Wiley.

EDPM 302D – Green Technology and Waste Management

L-T-P: 3-0-0 | **Credit:** 3 | **Total Contact Hours:** 42
Standard: PG (M.Tech)
Prerequisite: Fundamentals of Electrical Power Systems, Renewable Energy, and Environmental Engineering.

Course Objectives

1. Introduce principles of green technologies and sustainable development in power and industrial systems.
2. Provide knowledge of waste management techniques, including generation, collection, treatment, and disposal.
3. Develop skills to assess environmental impact and implement eco-friendly practices in electrical and energy systems.
4. Familiarize students with policies, regulations, and standards for environmental protection and sustainable resource management.

Course Outcomes

CO1	Understand the principles of green technology, sustainability, and circular economy.
CO2	Identify types of waste (solid, liquid, electronic) and their impact on the environment.
CO3	Apply waste management techniques including reduction, reuse, recycling, and recovery.
CO4	Evaluate energy-efficient and renewable technologies for sustainable power generation.
CO5	Integrate green technology solutions in industrial and power systems to reduce environmental footprint.

Course Content

Module 1: Introduction to Green Technology (8L)

Concept of sustainability and environmental management, Green technologies in power systems and industry, Renewable energy integration and energy efficiency measures, Life cycle assessment (LCA) and environmental impact assessment (EIA).

Module 2: Waste Generation and Characterization (8L)

Types of waste: municipal, industrial, e-waste, hazardous, biomedical, Sources and composition of electrical and electronic waste, Physical, chemical, and biological characteristics of waste.

Module 3: Waste Treatment and Management Techniques (10L)

Collection, segregation, and storage methods, Mechanical, thermal, chemical, and biological treatment processes, Recycling, recovery, and reuse methods, Safe disposal of hazardous and electronic waste.

Module 4: Energy and Resource Efficiency (8L)

Energy conservation and waste-to-energy technologies, Integration of renewable energy with waste management systems, Smart grid and sustainable infrastructure considerations.

Module 5: Policies, Regulations, and Case Studies (8L)

National and international environmental standards and regulations, ISO 14001 Environmental Management System, Circular economy concepts and sustainable development goals (SDGs), Case studies of green technology implementation in power systems and industrial sectors.

Textbooks

1. A. K. Chopra, *Green Technologies and Sustainable Development*, Springer, 2021.
2. V. K. Ahluwalia, *Waste Management: Concepts and Techniques*, McGraw-Hill, 2019.
3. R. K. Sharma, *Environmental Engineering and Waste Management*, Laxmi Publications, 2020.

Reference Books

1. M. Kehres, *Sustainable Energy and Waste Management*, Elsevier, 2018.
2. B. Morris, *Green Technology in Power Systems*, CRC Press, 2019.
3. ISO 14001: *Environmental Management Systems – Requirements with Guidance for Use*.
4. C. A. Worrell, *Industrial Waste Management and Sustainable Practices*, Wiley, 2020.

Semester IV

Sr. No.	Core/ Elective	Code	Course Name	L	T	P	Credit
1	Major Project	EDPM 481	Phase – II Dissertation	0	0	32	16

Total: L=0, T=0, P=32, Credit=16

SEMESTER-IV

EDPM 481 – Phase II Dissertation

L-T-P: 0-0-12 | **Credit:** 16 | **Total Contact Hours:** 180
Standard: PG (M.Tech)
Prerequisite: Successful completion of EDPM 381 – Phase I Dissertation.

Course Objectives

1. Guide students in the full execution of their research work, including modeling, simulation, experiments, and analysis.
2. Develop advanced research, problem-solving, and critical thinking skills in power systems, electrical devices, and related areas.
3. Prepare students to document, present, and defend their research findings according to academic and professional standards.
4. Facilitate publication of research outcomes in conferences or journals where feasible.

Course Outcomes

CO1	Implement the research methodology proposed in Phase I for solving the identified problem.
CO2	Conduct detailed analysis, simulations, or experiments to generate meaningful results.
CO3	Critically evaluate results, identify limitations, and refine the methodology if required.
CO4	Prepare a comprehensive dissertation document including literature review, methodology, results, discussions, and conclusions.
CO5	Present and defend research work effectively before a faculty committee and peers.

Course Content

Phase II Activities:

1. Implementation of research plan including detailed modeling, simulation, or experimentation.
2. Data collection, validation, and rigorous analysis of results.
3. Comparison with theoretical, simulation, or experimental benchmarks.
4. Refinement of models or techniques based on analysis.
5. Compilation of final dissertation report adhering to departmental guidelines.
6. Seminar presentations and pre-submission review.
7. Final defense and viva voce before a panel of experts.
8. Optional: Preparation of research articles for conferences or journals.

Assessment

- Progress evaluation and interim reports: 20%
- Experimental/simulation work and results: 30%
- Dissertation report quality: 30%
- Final presentation and viva voce: 20%

Reference Guidelines

1. IEEE, Elsevier, Springer journals for recent research papers.
2. Departmental dissertation formatting and submission guidelines.
3. Standard textbooks and reference materials relevant to the research topic.