Semester II

Sr No	Course Code	Course Title	TOTAL Hours			Credits	Maximum Marks		Total	Minimum Passing Marks	No. of Hrs for ESE
			L	T	P		Continual Assessment	End Sem Examination			
1	26PE201T	Advanced Power Electronics	4	-	0	4	40	60	100	50	3
2	26PE201P	Advanced Power Electronics Lab	0	-	2	1	25	25	50	25	-
3	26PE202T	Advanced Control of HVDC & FACTS Technologies	4	-	0	4	40	60	100	50	3
4	26PE203T	Program Elective – III	4	-	0	4	40	60	100	50	3
5	26PE204T	Program Elective – IV	4	-	0	4	40	60	100	50	3
6	26PE205P	Technical Seminar – II & IPR	-	-	6	3	100	-	100	50	-
7	26PE206P	Mini Project -II	-	-	6	3	100	-	100	50	-
Total			16	-	14	23	385	265	650	325	-

Program Elective-III	
26PE203T (i)	Advanced Power System Protection and Switchgear with AI Applications
26PE203T (ii)	IoT and It's Applications in Energy Sector
Program Elective-IV	
26PE204T (i)	Smart Grid Technologies with Cloud Integration
26PE204T (ii)	VLSI Design Automation

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE201T	Advanced Power Electronics	4	--	--	4	40	60	100

Course Objectives	Course Outcomes
This course is intended to 1. To understand the characteristics, ratings, limitations and testing of various power semiconductor switches. 2. To understand the performance and design of low frequency switched and high frequency switched power electronic converters for various applications. 3. To understand the analysis of switched converters.	A student who successfully fulfil the course requirements will be able to 1. Select semiconductor switches for various power electronics converters. 2. Analyze operation of power electronics converters and SMPS power supplies. 3. Analyze operation of Two level and various types of Multilevel Inverters. 4. Understand the harmonics in inverter and harmonics reduction techniques.

Unit I	**[12 Hrs]**
Overview of power semiconductor devices: Review of power semiconductor devices: Thyristor, IGBT, MOSFET, IGCT, GTO and their driver circuits, role of SiC and GaN in power semiconductor technology, Protection of semiconductor devices.	
Unit II	**[12 Hrs]**
Phase angle controlled Converters: Phase angle AC-DC and AC to AC converters, Dual converters, Cycloconverters, Chopper Converters and their applications. Introduction to Multiphase Converters.	
Unit III	**[12Hrs]**
Switched Mode Converter: Various Topologies of SMPS / DC-DC PWM Converters, AC to DC PWM converters: Buck, Boost, Buck-Boost, Bridge type dc-dc converters, High Power Factor Converter and their applications.	
Unit IV	**[12 Hrs]**
Soft Switching Converter: Working Principles, topologies and analysis of Resonant converters, Quasi- resonant converters and their applications.	
Unit V	**[12Hrs]**
Inverters: Single Phase and Three Phase Inverters, voltage and current source Inverters, Harmonic Reduction Techniques, Advanced PWM Techniques, Multilevel Inverters: Principles, Topologies, Control and their applications, Introduction to Matrix Converters.	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics Circuits Devices and Applications	M. H. Rashid	Third	Pearson
2	Power Electronics	M. D. Singh & K. B. Khanchandani	Second	Tata McGraw Hill

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics: Converters, Applications, and Design	Ned Mohan, Tore M. Undeland, William P. Robbins	Third	John Wiley & Sons
2	Power Electronics	P. C. Sen.	Second	Tata McGraw Hill
3	Power Electronics and AC Drives	B. K. Bose	First	Prentice Hall

		July 2026	1.0	Applicable for 2026-27
Chairman - BoS	Dean – Academics	Date of Release	Version	

ST. VINCENT PALLOTTI COLLEGE OF ENGINEERING & TECHNOLOGY, NAGPUR

(An autonomous institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M.Tech. Scheme of Examination & Syllabus 2026-2027

POWER ELECTRONICS AND POWER SYSTEMS

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE201P	Advanced Power Electronics Lab	--	--	2	1	25	25	50

Course Objectives	Course Outcomes
1. To introduce students to understand construction, operation and characteristics of various power semiconductor switches. 2. To understand basic operation of various conversion circuit such as AC-DC and DC-AC. 3. To understand conversion of fixed AC voltage to variable AC voltage 4. To understand operation and application of DC to DC conversion system	1. To obtain and analyze the characteristics of power semiconductor devices 2. To analyze AC regulators and its applications. 3. To demonstrate the working of controlled AC to DC converters with various load. 4. To demonstrate the working of DC to AC and DC-DC conversion 5. To handle and use important test equipment such as DSO

Experiment No.	Title of the Experiment
1	To study characteristics of power semiconductor switches
2	To study commutation circuits (Class A, Class B, Class C, Class D, Class E and Class F).
3	To plot waveform for AC phase control circuit using TRIAC and its application
4	To control output voltage of single phase fully controlled bridge converter for R & RL loads
5	To observe the output waveform of Mc-Murray Bedford Inverter
6	To plot output voltage waveform of single phase Cyclo Converter
7	To obtain the variable DC output voltage from fixed input DC voltage using jones chopper
8	To simulate single phase fully control converter using MATLAB
9	To simulate DC-DC conversion circuit using MATLAB
10	To simulate DC-AC conversion circuit using MATLAB

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics circuits Devices and Applications	M. H. Rashid	Third	Pearson
2	Power Electronics	M. D. Singh & K. B. Khanchandani	Second	Tata McGraw Hill
3	Power Electronics	P. C. Sen		Tata McGraw Hill
4	Power Electronics Principles and Applications	Joseph Vithyathil		Tata McGraw Hill

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Power Electronics	Ned Mohan, Tora M. Udeland, William P. Riobbins		John Wiley & Sons
2	Power Electronics and AC Drives	B. K. Bose		Prentice Hall, NJ (1985)

		July 2026	1.0	Applicable for 2026-27
Chairman - BoS	Dean – Academics	Date of Release	Version	

FIRST SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE202T	Advanced Control of HVDC & FACTS Technologies	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
1. To understand advanced control strategies for HVDC transmission systems under steady-state and dynamic conditions. 2. To study modelling and control of modern FACTS devices for power system stability, damping, and power flow control. 3. To develop the ability to design, simulate, and analyse advanced controllers for HVDC and FACTS systems.	**Students will be able to** 1. Explain the need for advanced control of HVDC and FACTS systems and their role in modern grids. 2. Model and analyse HVDC and FACTS systems under dynamic and transient conditions. 3. Design advanced controllers for HVDC and FACTS devices to improve stability and performance. 4. Evaluate the effectiveness of different control strategies for HVDC and FACTS through simulations and case studies. 5. Summarize and interpret emerging trends, research directions, and challenges in HVDC and FACTS control technologies.

Unit I	**[12 Hrs]**
Introduction and Fundamentals Overview: Role of HVDC and FACTS in modern power grids. Control objectives: Voltage, reactive power, power flow, damping, frequency support. Basic models and controls: LCC and VSC converters: Steady-state and dynamic models. HVDC control modes: Constant current (CC), Constant extinction angle (CEA), Constant DC voltage. FACTS control basics: Shunt (SVC/STATCOM) and series (TCSC/SSSC) principles.	
Unit II	**[12 Hrs]**
Advanced HVDC Control Strategies Advanced LCC-HVDC control-Minimum extinction angle control, power modulation. Control under disturbances: Overvoltage, commutation failures. VSC-HVDC systems: Vector control in dq-frame-Direct power control (DPC), phase-locked loops (PLL)-Fault ride-through capability and black-start support. Multi-terminal HVDC (MTDC):MTDC configurations and hierarchical control (primary/secondary/tertiary).	
Unit III	**[10 Hrs]**
Advanced Control of Shunt FACTS Devices SVC and STATCOM dynamic control: Control of reactive power and voltage in transient and dynamic conditions. STATCOM control strategies: Hysteresis control, predictive control, and voltage balancing under unbalanced conditions. Stability improvements: Low-frequency oscillation damping, low-voltage ride-through Harmonics and filter design for STATCOM/SVC.	
Unit IV	**[12Hrs]**
Advanced Control of Series and Combined FACTS Devices TCSC and SSSC: Control of series compensation for power flow and damping oscillations SSR mitigation with TCSC. UPFC and IPFC: Control principles of combined series-shunt devices -Coordinated control of active and reactive power, voltage, and power flow paths-. Adaptive and predictive control techniques for FACTS.	
Unit V	**[12 Hrs]**
Simulation, Modeling and Case Studies Dynamic simulation and control design: Small-signal and EMT models of HVDC and FACTS systems. Eigenvalue analysis and controller tuning. Supplementary damping controllers: Design of power oscillation damping (POD) controllers for HVDC and FACTS. Case studies: Coordinated control of HVDC and FACTS for renewable integration-Wide-area monitoring and control for flexible AC/DC grids. Emerging trends: AI/ML-based control, cyber-physical security in control systems.	

Text Books

S. N	Title	Authors	Edition	Publisher
1	HVDC Power Transmission Systems	K. R. Padiyar		New Age International
2	Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems	Narain G. Hingorani and Laszlo Gyugyi		Wiley India
3	HVDC and FACTS Controllers: Applications of Static Converters in Power Systems	Vijay K. Sood		Springer (Atlantic Publisher , Delhi)

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	High Voltage Direct Current Transmission	Arrillaga		IET
2	Thyristor-Based FACTS Controllers for Electrical Transmission Systems	R. Mohan Mathur & Rajiv K. Varma		Wiley-IEEE Press

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE203T (i)	PE – III Advanced Power System Protection and Switchgear with AI Applications	4	-	-	4	40	60	100

Course Objectives	Course Outcomes
This course is intended 1. To introduce the fundamentals of power system protection, electrical faults, and the role of protective relays and instrument transformers. 2. To provide a detailed understanding of overcurrent, differential, and motor protection schemes using numerical relays. 3. To explore protection strategies for power system components including generators, transformers, buses, and transmission lines. 4. To familiarize students with advanced circuit breaker technologies, switchgear equipment, and industry-standard testing procedures. 5. To integrate Artificial Intelligence (AI) and Machine Learning (ML) techniques into fault detection, predictive maintenance, and substation automation. 6. To enable hands-on implementation of AI/ML algorithms using Python for practical fault classification and diagnostic applications in electrical systems.	**Students will be able to** 1. Explain the fundamentals of power system protection, instrument transformers, and overvoltage protection techniques. 2. Analyze and apply protection schemes like overcurrent, differential, and motor protection using numerical relays. 3. Evaluate protection mechanisms for generators, transformers, bus bars, and transmission systems including AI/ML-based methods. 4. Design and simulate AI/ML models for electrical fault detection, motor health prediction, and relay decision-making. 5. Understand, select, and evaluate electrical switchgear and circuit breaker technologies and interpret testing protocols.

Unit I	**[12 Hrs]**
Protection Basics & Instrument Transformers: - Overview of Power System, Need for Power System Protection, Types of Electrical Faults, Protective Relay, Types of Protection, Primary and Back-Up Protection, Components of Protection System & Classification of Protective Schemes, Basics of Instrument Transformers, Modelling of CTs Instrument Transformers, Instrument Transformer Saturation and DC Offset Current, Knee Point, Optical Instrument Transformer (Advanced Technology), Instrument Transformer Connection & Testing, Causes of Over voltages, Lightning Phenomena, Overvoltage due to Lightning, Protection of Transmission Lines against Direct Lightning Strokes, Protection of Stations and Sub-stations from Direct Strokes. Introduction to AI & ML techniques, Introduction to Python Programming and Electrical- Faults-Detection-and- Classification-using-Machine-Learning	
Unit II	**[12 Hrs]**
Overcurrent, Differential and Motor Protection Schemes, Numerical Relays: - Introduction to Overcurrent Protection, Fundamental Principles of Overcurrent Relays, Relays used in Overcurrent Protection, Overcurrent Relay settings Principles, Introduction to Differential relays, Applications of Differential Relay, Pilot Wire Differential Relays Device 87L, Ground Fault Protection, Motor Protection Requirements, Negative Phase Sequence Protection of AC Motors (Advanced concepts), Single Phasing of AC Motors, Phase Reversal Protection of AC Motors, Under Voltage Protection of AC Motors, Comprehensive Motor Protection with numerical relay, Introduction to Numerical Protection, Different types of Numerical Protection, Application of Artificial Intelligence to Power System Protection (Advanced Technology), Application of Artificial Neural Network (ANN) to Overcurrent Protection Directional Relay (Advanced Technology), Substation Automation (Advanced Technology). Electric Motor Fault Detection using Machine Learning, Predictive-Maintenance-of-Motor using Machine Learning	
Unit III	**[12 Hrs]**

Generation, Transmission and Distribution Protection (Part-I): - Introduction to Distance Protection, Impedance / MHO Distance Relay, Distance Relay using Quadrilateral Characteristics, Setting of Distance Relays for Zone Protection, Distance Protection Schemes for Transmission Lines, Distance Pilot Scheme Protection of Transmission Lines, Carrier Assisted Distance Protection, Introduction to Generator Protection, Classification of Generator Protection, Generator Differential Protection, Backup Impedance Protection, Negative Phase Sequence Protection (Advanced concepts), Generator Stator Earth Fault Protection, Generator Under Frequency Protection, Protection Requirements of Transformers, Types of Faults, Typical Protective Schemes for Industrial Power Transformers, Differential Protection of Transformers, Restricted Earth Fault Protection, Overcurrent & Overload Protection, Buchholz Protection, Sudden-Pressure Relay, T Protection of Shunt Reactors.

Deep Neural Network Based Fault Classification and Location Detection in Power Transmission Line

Unit IV **[12 Hrs]**

Generation, Transmission and Distribution Protection (Part-II): - Bus Protection Schemes, Bus Differential Relaying Schemes, Bus Differential Protection with Overcurrent Relays, Bus Protection with Percentage Restrained Differential Relays, Bus High- Impedance Voltage Differential Protection (Advanced concepts), Alternative Bus Protective Schemes, Introduction and Rate of Frequency Decline, Restoring Service, Introduction to Unit Protection of Feeders, Circulating Current System, Phase Comparison Protection Scheme, Introduction to Protection Signaling and Tripping, Digital / Numerical Current Differential Protection System, Carrier Unit Protection Schemes, Examples of Unit Protection Schemes, Formulating a Load Shedding Scheme.

Transformer Inter-Turn Fault Detection using Artificial Intelligence

Unit V **[12 Hrs]**

Electrical Switchgears & Testing: - Low Voltage Switch Gear Equipment, Medium Voltage Switch Gear Equipment, High Voltage Switch Gear Equipment, Short Circuit Currents and Switching Duties, Concept of Circuit Interruption, Introduction to Circuit Breakers, Rating of Circuit Breaker, Classification of Circuit Breakers, Air Circuit Breakers, Oil Circuit Breakers, SF6 Circuit Breakers, Vacuum Circuit Breakers, High Voltage DC (HVDC) Circuit Breakers, Gas Insulated Substation / Switch gears (Advanced Technology), Automatic High speed Reclosing of Circuit Breakers (Advanced Technology).

Type Test, Routine Test & Factory Acceptance test for Electrical Equipment like Circuit breaker, Transformer, Isolators, Cables etc.

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Switchgear and Protection	Sunil S. Rao	Latest	Khanna publication
2	Power system protection and Switchgear	B Ram, D Vishwakarma	Latest	Tata McGraw Hill
3	Fundamental of power system protection	Y. Paithankar, S. Bhide	Latest	Prentice hall

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	The art and science of protective relaying	C. Russell Mason	Latest	Willey
2	Protective Relaying Vol. I & II	Warrington	Latest	Springer
3	Switchgear Handbook	R. T. Lythall	Latest	Butterworth, London

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE204T(ii)	PE-III VLSI Design Automation	4	--	--	4	40	60	100

Course Objectives	Course Outcomes
This course is intended for students to understand the: ● Fundamental Knowledge of VLSI CAD tools chain and physical design flow. ● Supporting knowledge of Algorithmic Graph Theory & Combinatorial Optimization. ● Techniques of Partitioning, floor-planning, placement and placement and routing. ● Basic information about static Timing Analysis to analyze designed circuits.	**After completion of the course students will be able to:** ● Describe the VLSI design flow and various VLSI design styles in detail. ● Use algorithmic graph theory and combinatorial optimization techniques, as per requirement, to correctly formulate and solve VLSI design problems. ● Explain the algorithms for partitioning, floor planing, placement and routing of VLSI circuits and use them to solve simple VLSI design problems. ● Describe the process of Static Timing Analysis of VLSI circuits.

Unit I	[12 Hrs]
Introduction to VLSI CAD VLSI design methodologies, use of VLSI CAD tools, VLSI Physical Design flow. Algorithmic Graph Theory & Combinatorial Optimization: Graph Terminology, Computational Complexity, depth First Search, Breadth First search, Dijkstra's Shortest path algorithm, Krusal and Prim's algorithm for Minimum Spanning trees, Travelling Salesman problem, Integer Linear Programming, (ILP), Simulated Annealing (SA) **Partitioning :** Introduction, Types of Partitioning, Classification of partitioning algorithms.	
Unit II	[12 Hrs]
Floor Planning Introduction, Rectangular Dual Graph (RDG), Sliced and non-sliced floor planning, Polish expression, Normalized Polish expression, Simulated Annealing.	
Unit III	[12 Hrs]
Placement Introduction, Classification of Placement Algorithms: Simulated Annealing/ Timber wolf algorithm (SA/TW), Simulated Evolution (SE), Force Directed Placement algorithm, Partition based placement algorithms.	
Unit IV	[12 Hrs]
Routing Gird routing : Maze running algorithms, Line Searching algorithms, Steiner Tree algorithms, Global Routing; Graph models, routing algorithms, Detailed Routing : Two-layer Channel routing algorithms: Left Edge Algorithms, Constraint-graph based algorithms, Greedy channel routerm hierarchical channel router, Switchbox routing, Clock Routing and Power / Ground Routing. Static Timing Analysis and Timing Closure	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Algorithms for VLSI Design Automation	Sabih H. Gerez	4th	Wiley
2	Algorithms for VLSI Physical Design Automation	Naveed Sherwani, Kulwer	Latest	Academic Publication

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	An introduction to VLSI Physical Design	Majid Sarrafzadesh and C. K. Wong	Latest	McGraw Hill,
2	Introduction to Algorithms	Thomas Corment et.al.	Latest	The MIT Press

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE204T (i)	PE-IV Smart Grid Technologies with Cloud Integration	4	--	--	4	40	60	100

Course Objectives	Course Outcomes
This course is intended for students to understand the: 1. Create an awareness and understanding of the fundamental concepts of Smart Grid, challenges, and benefits of implementing smart grid technologies in the context of the existing power grid infrastructure. 2. Rationalize the concept, architecture, and control of DC / AC microgrids and Distributed Energy Resources in Smart Grid environment with demonstration of Smart Homes. 3. Illustrate the state-of-art Smart Grid Technologies in transmission and distribution system such as AMI, DMS, Substation Automation, Reactive Power Control, Energy Management, etc 4. Describe a comprehensive overview of all aspects of smart grid including communication technologies, physical and cyber security aspects, and cloud computing approach with suitable illustrations.	**After completion of the course students will be able to:** 1. Deliberate and critically analyze the benefits of smart grid, polices, governing standards and developments in National and International Scenario. 2. Design and develop a comprehensive distribution management system (DMS) that incorporates modelling and analysis tools, fault detection and localization, and integration with advanced technologies. 3. Implement a demand-side management project in a smart home incorporating Automated Metering Infrastructure and explore the role of artificial intelligence for optimizing energy consumption and peak load management. 4. Develop the architecture of AC /DC microgrids and discuss its operation, control strategy, protection and security aspects when integrated with distributed energy resources supported with simulation studies. 5. Evaluate the effectiveness of all Communication technologies with physical and cyber security threats to make the Grid smarter and their related challenges.

Unit I **[12 Hrs]**

Introduction to Smart Grid: Introduction to Power Grid and Need for Migration to Smart Grid: Traditional means of Energy Generation, Transmission and Distribution in India, Basic components of power system or Constituents of a present-day power system, Power System Control Centre (PSCC) and its Historical Evolvement, Evolution of National Grid in India, Electric Power Generation and Consumption Scenario in India, Need and Properties of Smart Grid. Smart Grid Architecture, Domains, and key Functionalities: Traditional vs Smart Grid, Architecture and conceptual model of smart grid, Smart Grid Standards, key functionalities and components of Smart Grid, National and international initiatives of smart grid, Smart Grid Pilot project - A Case Study.

Unit II **[12 Hrs]**

Smart Meters, Distribution Automation and DMS in Smart Grid: Smart Metering and Phasor Measurement Unit: Advanced Metering Infrastructure: key characteristics and components, Conventional Billing System and Smart Meter Billing System, Smart Meters: Technology, Features and Communication, Data Management and Analytics in Advanced Metering, Cybersecurity in Advanced Metering Systems, Case Study: Ukraine Power Grid Cyber Attack Detection and Mitigation. Distribution Automation in Smart Grid: Faults and Failures in Smart Grid, Power Reliability and Blackout management in Smart Grid, Self-Healing of Smart Grid, Substation Automation System and Equipment, Fault Location, Isolation and Restoration. Distribution Management System in Smart Grid: Importance of DMS in smart grid technology, Customer Data Management and Integration, Billing and Payment Systems, Modelling and Analysis Tools (Load flow analysis, Fault Detection, Voltage Control and Power Quality Analysis) for DMS, Applications of DMS, Integration with advanced technologies, Case Study on successful implementation of DMS in smart grid.

Unit III **[12 Hrs]**

Energy Management in Smart Grid: Smart Grid Control of Reactive Power: Understanding effect of Reactive Power on Power consumption, Reactive Power Compensation Devices- SVC, STATCOM, Reactors, Synchronous Condensers, Smart Grid Control of reactive power in system, Smart Distribution, Reactive Power Optimization in Smart Grid. Smart Homes: Benefits of Smart Home, Smart Home Devices, Automatic Meter Reading, Sustainability/ Carbon Footprint, Standards for Smart Home & Building, Case Studies. Energy Management System in Smart Grid: Need of Energy Management System, Demand Side Management and techniques of implementation, Benefits and challenges of implementing Demand Side Management in power system, Implementation of Demand Response management Project, Role of Artificial Intelligence in Demand side Management, Demonstration of Demand side methodology using Machine learning.

Unit IV **[12 Hrs]**

Distributed Energy Resources and Microgrid: Distributed Energy Resources: Forecasting and Integration: Categorization of Distributed Energy Resources, Types and Components of Solar PV Generation, Classification of Wind Turbines, Wind Power Plant Technologies, Wind Power Generation Forecasting with Demonstration of Machine Learning Model, Virtual Power Plant, Plugin Hybrid Electric Vehicles in Smart Grid, Integration of Wind power plant to existing grid: Unit Commitment Process, Economic Dispatch Process and Uncertainty of Wind Energy. Integration of Distributed Energy Resources and Microgrid: IEEE Standards for integration of distributed energy resources, Demonstration of DER Integration using Novel Method, Loss Sensitivity Method, Voltage Sensitivity Analysis Method, Overview of Microgrid with key functions of their major components, Microgrid Topologies, Microgrid Stability, Power Electronics in Microgrids, Modelling and Simulation of a Microgrid System, India's first solar village - A Case Study of microgrid.

Unit V **[12 Hrs]**

Smart Grid Communication Technologies and Security: Smart Grid Communication Technologies: Smart Grid Domains and Interoperability, Information Exchange between Domains of Smart Grid, Smart Grid Communication Standards, Layered Architecture of Smart Grid Infrastructure, Smart Grid Communication Networks, Wired Communication Technologies, Wireless Communication Technologies. Smart Grid Privacy and Security: Security

Challenges of Smart Grid Communication Networks, Smart Grid Threat, and Risk Assessment, Resilience Against Physical Attack, Smart grid security, Security Schemes for Smart Grid Communication over Public Network, Security Schemes for Private Network - AMI Context. Cloud Computing Approach for Smart Grid: Models of Cloud Computing, Cloud Computing Service Types, Cloud Computing Deployment Types and Architecture, Smart Grid Applications in Cloud Computing Environment.

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Electric Power Distribution	Pabla A.S.	4th	Tata McGraw Hill
2	Smart Grid: Technology and	Janaka Ekanayake, Nick Jenkins, Kithsiri	Latest	Wiley

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Learning Material for Electrical Power Distribution	Dr. M. K. Khedkar	Latest	
2	Smart Grid: Fundamentals of Design and Analysis	James A. Momoh.	Latest	

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE204T(ii)	PE-IV IoT and It's Applications in Energy Sector	4	--	--	4	40	60	100

Course Objectives	Course Outcomes
This course is intended for students to understand the: ● Understand the fundamentals of the Internet of Things (IoT), including its architecture, physical and logical design, and core functional blocks. ● Explore various IoT communication protocols and interfaces, with an emphasis on both wireless (e.g., Wi-Fi, Zigbee, LoRa) and wired (e.g., RS485, Ethernet) connectivity options. ● Gain insights into the role of IoT in the energy **sector**, particularly how IoT can support energy efficiency, demand response, and real-time monitoring and management. ● Study the architecture and components of IoT systems specifically designed for energy infrastructure, including the integration of sensors, actuators, communication networks, and distributed control. ● Examine various real-world applications of IoT in energy systems, such as smart grids, smart metering, transactive energy models, and its impact on residential, commercial, and industrial sectors.	**After completion of the course students will be able to:** ● Understand the basic blocks and applications of IoT. ● Understand different communication protocols used in IoT systems. ● Understand the necessity of IoT in energy sector ● Understand the architecture of IoT system used for energy infrastructure. ● Appreciate the use of IoT in various energy related applications.

Unit I	[12 Hrs]
Introduction to IoT : Defining IoT, Characteristics of IoT, Physical design of IoT, Logical design of IoT, Functional blocks of IoT, Communication models & Application, Programming Interface, Benefits of IoT.	
Unit II	
IoT Connectivity : Wireless communication: RF, Wi-Fi, ZIGBEE, Bluetooth Low energy, LORA, Wired communication: RS485, Ethernet.	
Unit III	[12 Hrs]
IoT as a Solution to Energy - Management : Introduction to Energy-Management Change Drivers, The Need for a Technical solutions, eIoT as an Energy-Management.	
Unit IV	[12 Hrs]
IoT Within Energy Infrastructure : Introduction to Network-Enabled Physical Devices: Sensors and Actuators, Communication Networks, Distributed Control and Decision making, Architectures and Standards, Socio-Technical Implications of eIoT.	
Unit V	[12 Hrs]
Energy Applications of eIoT : Concept of Transactive Energy, Potential eIoT Energy-Management Use Cases, Applications for Utilities and Distribution System Operators, Energy IoT applications in Industrial, Commercial Applications and Residential sector. Role of IoT in transformation of Future grid.	

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Internet of Things	Sabih H. Gerez	Latest	Wiley
2	eIoT- The Development of the Energy Internet of Things in Energy Infrastructure	Steffi O. Muhanji, Alison E. Flint, Amro M. Farid	Latest	Springer Open access publication

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE206P	Technical Seminar – II & IPR	-	-	6	3	50	50	100

Course Objectives	Course Outcomes
1. To recognize the importance of IP and to educate the pupils on basic concepts of Intellectual Property Rights. 2. To identify the significance of practice and procedure of Patents. 3. To make the students to understand the statutory provisions of different forms of IPRs in simple forms. 4. To make the students to understand the statutory provisions of different forms of IPRs in simple forms.	On successful completion of this course the student should be able to: 1. Distinguish and Explain various forms of IPRs. 2. Identify criteria to fit one's own intellectual work in particular form of IPRs. 3. Apply statutory provisions to protect particular form of IPRs. 4. Analyze rights and responsibilities of holder of Patent, Copyright, Trademark, Industrial Design etc. 5. Identify procedure to protect different forms of IPRs national and international level.

Module I **[9 Hrs]**

Introduction to IPRs: Importance of human creativity and its recognition and protection. Concepts of Property and Rights. History of IPRs. Different forms of IPRs. Role of IPRs in R and D.

Patents: Meaning of Patent, Object and Value of Patent law. Advantages of Patent to the invertors. Criteria for Patentability. Software and Business Methods Patents. Govt. use of inventions, infringement of Patent and remedies for infringement. Compulsory license.

Module II **[9 Hrs]**

Patent Drafting: Scope of invention, definitions, types of specification, descriptions, drawing, claim drafting and improvement.

Filing Requirement of patent: Work flow chart in obtaining Patents, Forms to be submitted, assignment requirements, filing mechanism through Individual patent office and PCT route. Importance of PTC, claiming priority from either route. Request for re -examination and revocation. Term of Patent and Patent renewal.

Searching of Prior art: Prior art- Tangible versus Intangible prior art. Search strategy: key words, structures, sequences, use operators, database for searching- free and paid, disclosed versus claimed matters.

Module III **[9 Hrs]**

Trade-Marks: Meaning and functions of Trade Marks. Concept of Distinctiveness and Trade Marks registration. Trade Marks- Challenges in Non-Conventional Marks. Infringement of Trade Marks and remedies for infringement. Domain Names disputes and Well-Known Marks, Distinction between Trade names &Trade marks.

Industrial Design: Definition of a design. Concept of Novelty and Originality; Inclusive and Exclusive Designs; Functions of Designs. Industrial Design registration in India. Duplicity of registration, Infringement of Design and remedies for infringement.

Module IV **[9 Hrs]**

Copyright: Introduction. Nature of Copyright, Subject-matter, protection requirement in Copyright Law, Neighboring/Related Rights. Economic and Moral Rights of Authors. Copyright in the Digital Context. An overview of Copyright protection in India. Transfer of Copyright. Infringement of Copyright, Copyright- fair dealing and remedies. Comparison with Patent and Copyright.

Emerging Copyright works in which copy subsists: Snippet tax and Online Streaming Platforms, Sound related technology, Blockchain technology. Confidential Information and Trade Secrets: Introduction, Conditions of protection. Essentials for an action for breach of confidence, distinction between Confidential Information and General Information. Data protection laws in India: Cyber-Crimes under the IT Act. 2000.

Text Books

S. N.	Title	Authors	Edition	Publisher
1	Law Relating to Intellectual Property	B. L. Wadhera	6th Edition.2021	Universal Law Publishing
2	Intellectual Property Law	P. Naryan	3rd	Easern Law House

Reference Books

S. N.	Title	Authors	Edition	Publisher
1	Hand book Indian Patent Law and, Practice	N. R. Subbaram. S. Viswanathan	2008	Printers and Publishers Pvt, Ltd.
2	Intellectual Property Rights	Cornish		Universal publications

Chairman - BoS	Dean – Academics	JULY 2026 Date of Release	1.0 Version	Applicable for 2026-27

SECOND SEMESTER

Course Code	Course Name	Th	Tu	Pr	Credits	Evaluation		
						CA	ESE	Total
26PE206P	Mini Project-II	-	-	6	3	50	50	100

Course Objectives	Course Outcomes
This course is intended 1. Mini Project-II is aimed to bridge the gap between theoretical knowledge and practical application, fostering a well-rounded skill set that prepares students for success in their future engineering careers. 2. Mini Project-II can help to identify the problem based on the area of interest through proper literature survey and to foster innovation in design of products, processes or systems based on the identified problem. 3. Perform feasibility study by creative thinking and requirement analysis in finding viable solutions to engineering problems. 4. to make decent contribution to research.	On successful completion of this course the student should be able to: 1. Identify and define a relevant and significant problem or challenge in the relevant field. 2. Formulate research methodologies for the innovative and creative solutions. 3. Plan and execute tasks utilizing available resources within timelines, following ethical professional and financial norms. 4. Organize and communicate technical and scientific findings effectively in written reports, oral presentation, and visual aids

Engineering projects often simulate real-world engineering scenarios. This exposure allows students to become familiar with industry practices, standards, and expectations and preparing them for the challenges they might face in their future careers. Depending on the nature of the project, students may acquire practical skills related to specific tools, software, or equipment. This hands-on experience can be highly beneficial when transitioning to a professional engineering role.

Thesis work may be an expansion on past work in the field or an improvement to the existing state-of-the-art. It might also reaffirm the results of previous work or solve new problems, or develop new theories. In short, thesis is to contribute something new to the field with proper proof and analysis.