EEPE4002 SMART GRID TECHNOLOGY (3-0-0)

Course objectives:

1. To understand the basic concepts and architecture of Smart Grids
2. To study communication and metering technologies used in modern power systems
3. To introduce monitoring, automation, and control techniques
4. To understand integration of distributed energy resources and electric vehicles
5. To study power quality issues and basic cybersecurity concept

Module I 6 Hours

Fundamentals of Smart Grid: Introduction to evolution of electric power systems, need for Smart Grid, features and characteristics, advantages and limitations, comparison between conventional and Smart Grid, concepts of reliability, resilience, self-healing, interoperability, and overview of Smart Grid architecture and components.

Module II5 Hours

Communication and Metering Technologies: Basic concepts of communication in Smart Grid, wired communication (power line communication, fiber optics), wireless communication (ZigBee, Wi-Fi, cellular), network structures (HAN, NAN, WAN), overview of communication standards, smart meters, Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI), and their functions and applications.

Module III 7 Hours

Smart Grid Monitoring and Metering Technologies: Introduction to monitoring technologies in Smart Grid, Intelligent Electronic Devices (IEDs), Phasor Measurement Units (PMU), Wide Area Monitoring Systems (WAMS), basic working principles and applications in system monitoring and control.

Module IV 7 Hours

Smart Grid Automation and Distributed Energy Systems: Substation automation, feeder automation, basic concepts of fault detection, isolation and service restoration, Geographic Information System (GIS), Outage Management System (OMS), Distributed Energy Resources (DERs), renewable energy integration, microgrid concept and operation, demand-side management (DSM), demand response (DR), and electric vehicles with basic vehicle-to-grid concepts.

Module V 5 Hours

Energy Storage, Power Quality and Cybersecurity: Overview of energy storage systems such as batteries and supercapacitors, role in Smart Grid, power quality issues including harmonics,
voltage sag and voltage swell, causes, effects and basic mitigation techniques, introduction to cybersecurity concepts, common threats and protection measures.

Course Outcomes (CO):

On completion of this course, students are able to:

CO1: Explain the basic concepts and architecture of Smart Grid
CO2: Describe communication and metering technologies used in Smart Grid
CO3: Understand monitoring and automation techniques
CO4: Explain integration of distributed energy resources and electric vehicles
CO:5 Identify power quality issues and basic cybersecurity concepts

Text Book(s):

1. Smart Grid: Technology and Applications, Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, and Akihiko Yokoyama, Wiley.

Reference Books(s):

1. Smart Grid: Fundamentals of Design and Analysis, James Momoh, Wiley.
2. Communication Systems for Smart Grid, A. G. Phadke and J. S. Thorp, Wiley-IEEE Press.
3. Power Quality in Power Systems, Ewald F. Fuchs, Academic Press.
4. NPTEL-https://nptel.ac.in/courses/108107113.