



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: Masters

Branch: Electrical Engineering

Course / Subject Code: ME01000181

Course / Subject Name : Smart Grid

| | |
|-------------------------|--------------------------|
| w. e. f. Academic Year: | 2024-25 |
| Semester: | 1 st Semester |
| Category of the Course: | PEC |

| | |
|----------------------|---|
| Prerequisite: | Interconnected Power System. |
| Rationale: | The smart grid of the future is a complex electrical power system. Its study, design, and management requires the integration of knowledge from various disciplines including sustainability, technology and mathematics. This course, introduce the definition of a smart grid, its heterogeneity, dynamics, control, security and assessment strategies. The challenge of modeling such a system is also discussed. The course enables the learner to describe and assess a Smart Grid by adding controls, communication, and other digital elements to make it more flexible, robust, and efficient, as is required from an electrical power grid of the future. |

Course Outcome:

After Completion of the Course, Student will able to:

| No | Course Outcomes |
|----|---|
| 01 | To understand The concepts and design of Smart grid. |
| 02 | To understand the various communication and measurement technologies in smart grid. |
| 03 | To analyze the stability of smart grid. |
| 04 | To learn the renewable energy resources and storages integrated with smart grid. |

Teaching and Examination Scheme:

| Teaching Scheme(in Hours) | | | Total Credits L+T+ (PR/2) | Assessment Pattern and Marks | | | | Total Marks |
|---------------------------|---|----|------------------------------|------------------------------|-------------|-----------|----------------------|-------------|
| L | T | PR | | C | Theory | | Tutorial / Practical | |
| | | | ESE (E) | | PA / CA (M) | PA/CA (I) | ESE (V) | |
| 3 | 0 | 2 | 4 | 70 | 30 | 20 | 30 | 150 |



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Course Content:

| Unit No. | Content | No. of Hours | % of Weightage |
|----------|--|--------------|----------------|
| 1. | INTRODUCTION TO SMART GRID: Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid, Smart grid functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid, Concept of Resilient & Self-Healing Grid | 07 | 15% |
| 2. | WIDE AREA MONITORING SYSTEM: Fundamentals of synchro phasor technology, concept and benefits of wide area monitoring system, Structure and functions of Phasor Measuring Unit (PMU) and Phasor Data Concentrator (PDC) | 07 | 15% |
| 3. | INFORMATION AND COMMUNICATION TECHNOLOGY: Overview of smart grid communication system, Modulation and Demodulation techniques, Radio communication, Mobile communication, Power line communication, Optical fiber communication. Communication protocol for smart grid, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid. | 09 | 20% |
| 4. | SMART METERS: Introduction to Smart Meters, category of smart meters, Advanced Metering infrastructure (AMI) drivers and benefits, AMI protocols, AMI needs in the smart grid, Intelligent Electronic Devices(IED) & their application for monitoring & protection. | 11 | 25% |
| 5 | SMART GRID APPLICATIONS: Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service restoration, Protection in Smart grid environment. Outage management, Plug in Hybrid Electric Vehicles (PHEV), Demand Side Integration-Peak load, Outage and Power Quality management | 11 | 25% |
| | Total | 45 | 100 |



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Suggested Specification Table with Marks (Theory):

| Distribution of Theory Marks | | | | | |
|------------------------------|---------|---------|---------|---------|---------|
| R Level | U Level | A Level | N Level | E Level | C Level |
| 10 | 25 | 25 | 15 | 15 | 10 |

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

1. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Smart Grid: Technology and Applications, John Wiley & Sons.
2. Salman K. Salman, Introduction to the Smart Grid: Concepts, Technologies and Evolution, The Institution of Engineering and Technology (IET).
3. Smart Grid Primer, Published by Power Grid Corporation of India Limited, September 2013.
4. Smart Grids: Infrastructure, Technology and Solutions —Edited by Stuart Borlase, CRC Press Publication, 2013.
5. Smart Grids, Infrastructure, Technology and Solutions, S. Borlase, CRC Press, 2013, 1st Edition.

(b) Open source software and website:

1. <https://resourcecenter.smartgrid.ieee.org/>
2. <https://nptel.ac.in/courses/108/107/108107113>
3. https://onlinecourses.nptel.ac.in/noc23_ee60/preview.....

Suggested Course Practical List: If any

1. Design of virtual PMU in MATLAB
2. Optimal PMU placements for proper monitoring of power system
3. Simulation of Grid connected PV MPPT (P&O) single stage
4. To study wide area control of two area system
5. Relay coordination in smart grid protection scheme for Radial Circuit Topology
6. Relay coordination in smart grid protection scheme for Bidirectional Circuit Topology
7. Study and testing of islanding protection in microgrids
8. To study PLCC for remote measurement and control
9. To study about smart-substation
10. To study automation of the substation
