

Nirma University

Institute:	Institute of Technology, School of Engineering
Name of Programme:	B.Tech. in Electrical Engineering
Semester:	VII
Course Code:	4EE203ME25
Course Title:	Smart Grid
Course Type:	Department Elective-III
Year of Introduction:	2025 – 26

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Course Learning Outcomes (CLOs):

At the end of the course, students will be able to –

1. recognize the concept of smart grid and its advantages over conventional grid (BL3)
2. assess the automation in smart grid and compare the techniques (BL4)
3. appraise various sensing technologies, networking and communication technologies involved with the smart grid (BL3)
4. evaluate the power quality problems associated with the integration of renewable energy sources in smart grid (BL5)

Unit	Contents	Teaching hours (Total 45)
Unit-I Introduction	Evolution of electric grid, conventional electrical networks, motives behind developing the smart grid network, definitions, characteristics and benefits of the smart grid, present grid versus smart grid, functions of smart grid components, key challenges for smart grid, present development and international practices in smart grid	05
Unit-II Smart Grid Measurement and Automation	Wide Area Monitoring Systems (WAMS), Phasor Measurement Units (PMU), smart meters – key components of smart metering, smart appliances, Advanced Metering Infrastructure (AMI), GIS and Google Mapping Tools. Intelligent Grid Automation, substation automation equipment, home and building automation	10
Unit-III Smart Grid Communication Technologies	Classification of power system communication according to their functional requirements, communications infrastructure and protocols for smart metering, smart grid communication technologies – wireless and wired. Basics of Cloud Computing, cyber-attacks and power system security, smart grid cyber security	10
Unit-IV Power Quality Management in Smart Grid	Power Quality & Electromagnetic Compatibility (EMC) in smart grid, power quality issues of grid connected renewable energy sources, power quality conditioners for smart grid, web based power quality monitoring, power quality audit	08

Unit-V Smart Grid Systems

12

Renewable energy resources, sustainable energy options for the smart grid, issues associated with sustainable energy technology, electric vehicles and Plug-in Hybrids, impact of PHEV on the grid, environmental implications – climate change, implications of climate change. Smart switchgear, digital substations, reclosure systems. Storage technologies, benefits of Energy Storage Systems (ESS)

Self-Study:

The self-study contents will be declared at the commencement of semester. Around 10% of the questions will be asked from self-study contents.

Tutorial Work:

This shall consist of at least 6 tutorials based on the above syllabus.

Suggested Reading:

1. Salman K. Salman, *Introduction to the Smart Grid: Concepts, Technologies and Evolution*, The Institution of Engineering and Technology (IET).
2. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, *Smart Grid: Technology and Applications*, John Wiley & Sons.
3. James Momoh, *Smart Grid: Fundamentals of Design and Analysis*, John Wiley & Sons, IEEE Press
4. Clark W. Gellings, *The Smart Grid, Enabling Energy Efficiency and Demand Response*, CRC Press.
5. Ali Keyhani, *Design of smart power grid renewable energy systems*, Wiley IEEE
6. Relevant recent literature, journal articles, standards and codes