

COURSE TITLE	SMART GRID
COURSE CODE	01EE0717
COURSE CREDITS	3

Objective:

- 1 Main objective of subject is to introduce smart grid technologies & analyse issues in management, control and monitoring of grid with renewable energy source integration.

Course Outcomes: After completion of this course, student will be able to:

- 1 Explain various concepts of the smart grid technologies.
- 2 Compare different communication technologies used in smart grids.
- 3 Assess the effect of the microgrid and distributed energy resources as modern and hybrid power system.
- 4 Evaluate the operation of the smart grid based on the demand and load side management.
- 5 Analyze power quality issues caused by renewable energy integration and evaluate suitable power quality conditioners for mitigation.

Pre-requisite of course:Power System Analysis, Basics of communication

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	0	50	30	20	0	0

Contents : Unit	Topics	Contact Hours
1	Introduction What is smart grid? Difference between conventional & smart grid, smart grid architecture, Functions of smart grid components, Overview of the technologies required for the Smart Grid	4
2	Smart grid communication and measurement technologies Communication and measurement, Wide Area Monitoring system (WAMS), Phasor Measurement Units (PMU), smart meters, smart appliances, Communication technologies: IEEE 802 series, Mobile communications, Multiprotocol label switching and Power line communication	10
3	Distributed energy sources (DER) and Microgrid Distributed energy resources, Advantages and disadvantages of DER, DER integration to utility grid, Concept of microgrid, need & applications of micro grid, formation of microgrid, issues of interconnection, Islanding: need and benefits, different methods of islanding detection	10

Contents : Unit	Topics	Contact Hours
4	Demand side management of Smart Grid Demand response analysis of Smart Grid, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics and Challenges, Electric Vehicles and Vehicle-to-Grid Systems, Demand Side Ancillary Services Energy Management, Practical study of Smart Grid	10
5	Power quality management in smart grid Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring	8
Total Hours		42

Textbook :

- 1 Integration of Green and Renewable Energy in Electric Power Systems”, Ali K., M.N. Marwali, Min Dai, Wiley, 2010
- 2 The Smart Grid: Enabling Energy Efficiency and Demand Response, Clark W. Gellings, River Publishers, 2009

References:

- 1 Smart Grid: Technology and Applications, Smart Grid: Technology and Applications, Janaka Ekanayake, N. Jenkins, K. Liyanage, J. Wu, Akihiko Yokoyama, Wiley, 2012
- 2 Smart Grids, Smart Grids, Jean Claude Sabonnadiere, Nouredine Hadjsaid, Wiley Blackwell, 2012
- 3 Securing the Smart Grid, Securing the Smart Grid, Tony Flick and Justin Morehouse, Elsevier Inc., 2010
- 4 Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities, Smart Power: Climate Change, the Smart Grid, and the Future of Electric Utilities, Peter S. Fox-Penner, Island Press, 2010

Suggested Theory Distribution:

The suggested theory distribution as per Bloom’s taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	Understand	Apply	Analyze	Evaluate	Higher order Thinking / Creative
10.00	20.00	25.00	25.00	10.00	10.00

Instructional Method:

- 1 The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

Instructional Method:

- 2 The internal evaluation will be done on the basis of continuous evaluation of students in the classroom.
- 3 Students will use supplementary resources such as online videos, NPTEL videos, e-courses.

Supplementary Resources:

- 1 <https://nptel.ac.in/courses/108107113>
- 2 <https://www.edx.org/learn/smart-grids/delft-university-of-technology-smart-grids-the-basics>