Nirma University
Institute of Technology
Electrical Engineering Department

Course Policy

B. Tech. Semester-VII Academic Year: 2024-25 (Odd)

Course Code & Name	**:**	**2EEOE03 Introduction to Smart Grid**
Credit Details	**:**	L T P C 3 0 0 3
Course Co-ordinator	**:**	**Prof. Sarika S. Kanojia**
Contact No. & Email	**:**	07971652421 sarika.kanojia@nirmauni.ac.in
Office	**:**	D – 100 **Visiting Hours**: Friday 01:30 – 02:00 pm Odd Saturdays: 01:30 – 02:00 pm
Course Faculty :		
Prof. S.S.Kanojia Email: Sarika.kanojia@nirmauni.ac.in **C**ontact No. 079-71652421 Office: D-100 **Visiting Hours**: Tuesday 01:30 – 02:00 pm Odd Saturdays: 01:30 – 02:00 pm **Queries by emails are encouraged**		

1. Introduction to the Course

1.1 Importance of the course:

The course Introduction to Smart Grid is an open elective offered to Fourth Year B. Tech. students. It gives exposure to the topics such as grid evolution, smart grid Wide Area Monitoring System, Phasor Measurement Unit, Communication Technologies in Smart Grid, Power Quality issues, renewable sources integration, Energy Storage and Electric Vehicle technologies in smart grid. The understanding of this course is important as it gives you the exposure to understand various new technologies which are in trend and useful from future perspective to develop smart reliable and efficient power grid. The course finds applications in all branches of engineering and hence is essential for inter disciplinary learning and research.

1.2 Objective of the course:

The objective of this course is to provide a comprehensive knowledge of smart grid, associated issues and new technologies.

1.3 Pre-requisite:

The students are expected to have the prerequisite knowledge of fundamentals of electrical circuits and energy such as KCL, KVL, AC circuits, DC circuits, motors and generators

2. Course Outcomes (CO)

COs are clear statements of the expectations for student achievements in the course.
At the end of the course, a student will be able to –

1. compare conventional and smart power grid characteristics
2. apply engineering know-how to smart electrical grid
3. select and employ various sensing technologies, networking and communication technologies to electrical power grid.
4. identify problems and offer solution using computational techniques

3. Syllabus

Unit	Content	Teaching Hours
Unit –1	**Introduction to Conventional and Futuristic Electrical Power Systems** Basics of electrical systems, laws of physics, applicability of KVL and KCL, formation of grid and concept of infinite bus, control of active and reactive power, control of voltage and frequency, generators and loads and their requirements, Infrastructure of conventional electrical networks, Main characteristics of conventional electrical networks, generation –transmission and distribution – Indian scenario, EHVAC and HVDC systems etc. Comparison between Smart Grid and conventional electrical networks, Evolution of Electric Grid, motives behind developing the Smart Grid Network, Definitions, Characteristics and Benefits of the Smart Grid, Functions of Smart Grid Components, Key challenges for Smart Grid, Present development and International practices in Smart Grid	12
Unit –2	**Smart Grid Systems** 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. Storage Technologies, Benefits of Energy Storage Systems (ESS), prediction requirements in power systems and role of smart grids, analytics and data processing requirements, relevant case studies	13
Unit – 3	**Smart Grid Measurements and Communication Technologies** Smart Meters – Key Components of Smart Metering, Smart Appliances, Advanced Metering Infrastructure (AMI), GIS and Google Mapping Tools, Communications Infrastructure	12

	and Protocols for Smart Metering, IoT and smart grids, Wireless Sensor Networks, Smart Grid Communication Technologies – Wireless and Wired, Cyber Attacks and Power System Security, Smart Grid Cyber Security, Protection in power systems and recent developments	
Unit - 4	**AI, Machine Learning and Big Data in Smart Grids** Concepts such as MINLP Approach for Network Reconfiguration and Dispatch in Distribution Systems, Multi-Objective Optimization Methods for Solving the Economic Emission Dispatch Problem, State Estimation Paradigm Based on Artificial Dynamic Models, Cloud Computing for Smart Grid, Data Storage, The State-of-the-Art Processing Techniques of Big Data etc.	08

3.1. 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..

3.2. Suggested Readings

1. Salman K. Salman, Introduction to the Smart Grid: Concepts, Technologies and Evolution, The Institution of Engineering and Technology (IET).
2. Ahmed F Zobaa (ed.), Alfredo Vaccaro (ed.), Computational Intelligence Applications In Smart Grids-Enabling Methodologies For Proactive and Self-Organizing Power Systems, Imperial College Press.
3. Robert C. Qiu and Paul Antonik, Smart Grid using Big Data Analytics - A Random Matrix Theory Approach, Wiley.
4. Janaka Ekanayake, Kithsiri Liyanage, Jianzhong Wu, Smart Grid: Technology and Applications, John Wiley & Sons.
5. James Momoh, Smart Grid: Fundamentals of Design and Analysis, John Wiley & Sons, IEEE Press.
6. Clark W. Gellings, The Smart Grid, Enabling Energy Efficiency and Demand Response, CRC Press.
7. Ali Keyhani, Design of smart power grid renewable energy systems, Wiley IEEE
8. Siddhartha Kumar Khaitan, James D. McCalley, Chen-Ching Liu (ed.), Cyber Physical Systems Approach to Smart Electric Power Grid, Springer.
9. Relevant recent literature, journal articles, web resources, standards and codes
.Note: The latest edition of books and recent journals papers should be referred.

4. Term assignments

Students will be asked to write the answers to questions (circulated individually via email) and/or required.

5. Assessment Policy

5.1 Component wise Continuous Evaluation (CE) & Semester End Examination (SEE) weightage

Assessment scheme	CE(100 marks)		
	Class TEst (35 marks)	Sessional Exam (35 marks)	2- Assignment Term assignment (15%) and term paper(15%) 30% (30 marks)

5.2 Assessment Policy for Continuous Evaluation (CE)

Assessment of Continuous Evaluation comprises of four components.

1. Class Test and Sessional Exam will be conducted as per the academic calendar. The mode of conduction will be conveyed by exam section and will be of 35 marks.
2. There will be 2 term assignments each of 15 marks, and at the end of the course, marks obtained out of 30 will be converted according to weightage assigned. Assessment of each of the term assignment will be carried out based on parameters like originality and novelty in work (5 marks), involvement of the student (5 marks), timely submission neat and clean work (5 marks)..

5.3 Assessment Policy for Semester End Examination (SEE)

6. Teaching-learning methodology

1. Lectures: Primarily Chalk and black board or online through webex will be used to conduct the course. However, where required, Power Point Presentations (PPTs), Video Lectures, Simulations / Animations etc. will be used to enhance the teaching-learning process.

7. Active learning techniques

Active learning is a method of learning in which students are actively or experientially involved in the learning process. Following active learning techniques will be adopted for the course.

1. Problem solving using real data: students will be given the real data/specification to solve problem.
2. Think Pair Share: students ponder the answer to a question and then share their thoughts with classmates.
3. Discussion: discussion of fundamental concepts to enhance higher order thinking.
4. Muddiest Point: the least understood topic of the session will be explained in last 10 minutes of the session.
5. Learning through ICT Tools: participatory learning through course blog.

8. Academic Integrity Statement

Students are expected to carry out term assignment under Continuous Evaluation (CE) component. Copying in any form is not acceptable and will invite strict

disciplinary action. Evaluation of corresponding component will be affected proportionately in such cases. Turnitin software may be used to check plagiarism wherever applicable. Academic integrity is expected from students in all components of course assessment.