Department of Electrical and Electronics Engineering

Faculty Name: **Dr Sathish K R**			Academic Year: 2024-25				
Department: Electrical & Electronics Engineering							
Course Code	Course Title	Core/Elective	Prerequisite	Number of Lecture Hours/Week			Total Hrs/ Sessions
				L	T	P	
21EE732	Smart Grid	Profession Elective		3	-	-	40

Course objectives:

1. To define smart grid and discuss the progress made by different stakeholders in the design and development of smart grid.
2. To explain the measurement techniques using PMUs and smart meters.
3. To discuss tools for the analysis of smart grid and design, operation and performance.
4. To discuss incorporating performance tools such as voltage and angle stability and state estimation into smart grid.
5. To discuss classical optimization techniques and computational methods for smart grid design, planning and operation.
6. To discuss the development of predictive grid management and control technology for enhancing the smart grid performance.
7. To discuss development of cleaner, more environmentally responsible technologies for the electric system.
8. To discuss the fundamental tools and techniques essential to the design of the smart grid.
9. To describe methods to promote smart grid awareness and enhancement.
10. To discuss methods to make the existing transmission system smarter by investing in new technology

Topics Covered as per Syllabus

Module-1	**Teaching Hours**
Smart Grid Architectural Designs: Introduction, Today's Grid versus the Smart Grid, Energy Independenc and Security Act of 2007: Rationale for the Smart Grid, Computational Intelligence, Power System Enhancemen Communication and Standards, Environment and Economics, General View of the Smart Grid Market Driver Stakeholder Roles and Function, Working Definition of the Smart Grid Based on Performance Measures, Representative Architecture, Functions of Smart Grid Components. **Smart Grid Communications and Measurement Technology:** Communication and Measurement, Monitorin PMU, Smart Meters, and Measurements Technologies, GIS and Google Mapping Tools, Multiagent Systems (MAS Technology, Microgrid and Smart Grid Comparison. **Performance Analysis Tools for Smart Grid Design:** Introduction to Load Flow Studies, Challenges t Load Flow in Smart Grid and Weaknesses of the Present Load Flow Methods, Load Flow State of the Art: Classica Extended Formulations, and Algorithms, Congestion Management Effect, Load Flow for Smart Grid Design, DSOP Application to the Smart Grid, Static Security Assessment (SSA) and Contingencies, Contingencies and The Classification, Contingency Studies for the Smart Grid	**08**
Teaching-Learning Process: Chalk and Board, PowerPoint Presentation	
Module-2: Stability Analysis Tools for Smart Grid: Introduction to Stability, Strengths and Weaknesses of Existing Voltage Stability Analysis Tools, Voltage Stability Assessment, Voltage Stability Assessment Techniques, Voltage Stability Indexing, Analysis Techniques for Steady-State Voltage Stability Studies, Application and Implementation Plan of Voltage Stability, Optimizing Stability Constraint through Preventive Control of Voltage Stability, Angle Stability Assessment, State Estimation.	

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		08
Teaching-Learning Process	Chalk and Board, PowerPoint Presentation	
Module-3		
Computational Tools for Smart Grid Design: Introduction to Computational Tools, Decision Support Tools, Optimization Techniques, Classical Optimization Method, Heuristic Optimization, Evolutionary Computational Techniques, Adaptive Dynamic Programming Techniques, Pareto Methods, Hybridizing Optimization Techniques, and Applications to the Smart Grid, Computational Challenges. **Pathway for Designing Smart Grid:** Introduction to Smart Grid Pathway Design, Barriers and Solutions to Smart Grid Development, Solution Pathways for Designing Smart Grid Using Advanced Optimization and Control Techniques for Selection Functions, General Level Automation, Bulk Power Systems Automation of the Smart Grid at Transmission Level, Distribution System Automation Requirement of the Power Grid, End-User/Appliance Level of the Smart Grid, Applications for Adaptive Control and Optimization.		**08**
Teaching-Learning Process	Chalk and Board, PowerPoint Presentation	
Module-4		
Renewable Energy and Storage: Renewable Energy Resources, Sustainable Energy Options for the Smart Grid, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues, Electric Vehicles and Plug-in Hybrids, PHEV Technology, Environmental Implications, Storage Technologies, Tax Credits. **Interoperability, Standards, and Cyber Security:** Introduction, Interoperability, Standards, Smart Grid Cyber Security, Cyber Security and Possible Operation for Improving Methodology for Other Users.		**08**
Teaching-Learning Process	Chalk and Board, Power Point Presentation	
Module-5		
Research, Education, and Training for the Smart Grid: Introduction, Research Areas for Smart Grid Development, Research Activities in the Smart Grid, Multidisciplinary Research Activities, Smart Grid Education, Training and Professional Development. **Case Studies and Testbeds for the Smart Grid:** Introduction, Demonstration Projects, Advanced Metering, Microgrid with Renewable Energy, Power System Unit Commitment (UC) Problem, ADP for Optimal Network Reconfiguration in Distribution Automation, Case Study of RER Integration, Test beds and Benchmark Systems, Challenges of Smart Transmission, Benefits of Smart Transmission. .		**08**
Teaching-Learning Process	Chalk and Board, Power Point Presentation	
Course outcomes:	**CO-1:** Discuss the progress in smart grid development by various stakeholders, measurement techniques using PMUs and smart meters, and tools for smart grid analysis, design, operation, and performance. **CO2:** Discuss classical optimization techniques and computational methods for smart grid design, planning and operation. **CO3:** Explain predictive grid management and control technology for enhancing the smart grid performance **CO4:** Develop cleaner, more environmentally responsible technologies for the electric system. **CO5:** Discuss essential tools for smart grid design and methods to enhance awareness and upgrade transmission systems with new technology.	
Assessment Details (both CIE and SEE) The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50). A student shall be deemed to have satisfied		

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the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50)in the semester-end examination(SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20 Marks (duration 01 hour)**

1. First test at the end of 5th week of the semester
2. Second test at the end of the 10th week of the semester
3. Third test at the end of the 15th week of the semester

Two assignments each of **10 Marks**

List of Text Books

1. Smart Grid, Fundamentals of Design and Analysis, James Momoh, Wiley, 1st Edition, 2012.

Activity-Based Learning (Suggested Activities in Class)/Practical-Based Learning

Activity-Based Learning, Quizzes, Seminars.

Semester-End Examination:

Theory SEE will be conducted by the University as per the scheduled timetable, with common question papers for the subject (duration 03 hours)

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

The Correlation of Course Outcomes (CO's) and Program Outcomes (PO's)

Subject Code:	21EE732	TITLE: Smart Grid					Faculty Name:			Dr. Sathish K R	
List of Course Outcomes	Program Outcomes										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO-1	3	3	-	-	-	-	-	-	-	-	-	3
CO-2	3	3	-	-	-	-	-	-	-	-	-	3
CO-3	3	3	-	-	-	-	-	-	-	-	-	3
CO-4	3	3	-	-	-	-	-	-	-	-	-	3
CO-5	3	3	-	-	-	-	-	-	-	-	-	3

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution '-'= No Contribution

The Correlation of Course Outcomes (CO's) and Program Specific Outcomes (PSO's)

Subject Code:	21EE732	TITLE: **Smart Grid**
List of Course Outcomes	PSO1	PSO2
CO-1	3	-
CO-2	3	-
CO-3	3	-
CO-4	3	-
CO-5	3	-

Note: 3 = Strong Contribution 2 = Average Contribution 1 = Weak Contribution '-'= No Contribution