EE6622: TOPICS IN SMART GRIDS

Effective Term
Semester B 2024/25

Part I Course Overview

Course Title
Topics in Smart Grids

Subject Code
EE - Electrical Engineering
Course Number
6622

Academic Unit
Electrical Engineering (EE)

College/School
College of Engineering (EG)

Course Duration
One Semester

Credit Units
3

Level
P5, P6 - Postgraduate Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course offers a comprehensive examination of smart grid technologies, which are transforming the landscape of electrical power systems. It includes the advanced infrastructure that enables real-time monitoring, efficient energy

distribution, and integration of renewable energy sources. Key topics include the deployment of advanced metering infrastructure, the interaction between electric vehicles and the grid, energy storage solutions, the importance of cybersecurity in maintaining grid integrity, etc. Students will gain insights into grid automation, microgrids, smart grid communication networks, and the application of big data and machine learning for optimizing grid operations.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Demonstrate a comprehensive understanding of the fundamental concepts, components, and benefits of smart grid systems compared with traditional power grids.	20	x		x
2	Power distribution system analysis, steady state, balanced and unbalanced system analysis.	20	x	x	x
3	Analyse the challenges and solutions related to the integration of renewable energy sources, such as solar and wind, into the smart grid, and assess their impact on grid stability and efficiency.	20	x	x	
4	Evaluate the technologies and strategies for energy storage and electric vehicle integration within the smart grid, including the principles of V2G (Vehicle-to-Grid) technology and demand response mechanisms.	20	x	x	
5	Apply big data analytics and machine learning techniques to smart grid operations.	20		x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	The students will learn key concepts of smart grid systems	1, 2, 3, 4, 5	2 hrs/wk
2	Tutorials	The students will work out key calculations in smart grid problems based on questions and problem solving	2, 3	0.5 hrs/wk

3	Laboratory	The students will gain hands-on experience for the smart grid optimization problems	3, 4	0.5 hrs/wk

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Project	2, 3, 5	10	
2	Quiz	1, 2	20	
3	Assignments (laboratory etc.)	3, 4	10	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

2

Additional Information for ATs

Remark:
To pass the course, students are required to achieve at least 30% in course work and 30% in the examination.

Assessment Rubrics (AR)

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Coursework (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Examination (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Assessment Task
Coursework (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Achievements in CILOs

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not even reaching marginal levels

Additional Information for AR

Constructive Alignment with Programme Outcomes

PILO	How the course contribute to the specific PILO(s)
1,2,3,4	The course requires the analysis and the project design of smart grid including power and ICT systems, and therefore provides many opportunities for students to solve engineering problems by applying knowledge of mathematics, science, and engineering.
3	Students are required to complete laboratory experiments as well as project to gain practical hands-on experience.

Part III Other Information

Keyword Syllabus

1. Advanced Metering Infrastructure (AMI)
Understand the role of smart meters and data acquisition technologies in enabling real-time energy consumption monitoring and communication, enhancing consumer energy management and grid efficiency.
2. Renewable Energy Integration
Analyze the challenges associated with integrating renewable energy sources like solar and wind into the grid, and study the technological and operational solutions that mitigate these challenges to ensure stable energy supply.
3. Electric Vehicles (EVs)
Investigate the infrastructure required for EV charging, the potential of Vehicle-to-Grid (V2G) technology, and how demand response strategies can optimize the interaction between electric vehicles and the grid.
4. Energy Storage Systems
Study various battery technologies and their applications in maintaining grid stability and efficiency, particularly in the context of balancing the intermittent nature of renewable energy sources.
5. Microgrids and Distributed Generation
Explore the design and operational principles of microgrids, understanding the benefits of decentralized energy systems and how they integrate with the main grid to enhance energy reliability and resilience
6. Big Data and Machine Learning in Smart Grids
Learn how big data analytics and machine learning techniques are applied to optimize grid operations, including predictive maintenance, energy distribution optimization, and enhancing overall grid performance.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Ekanayake, J. B., Jenkins, N., Liyanage, K. M., Wu, J., & Yokoyama, A. (2012).Smart grid: technology and applications. John Wiley & Sons.