# EE6623: SUSTAINABLE ENERGY SYSTEMS

**Effective Term**
Semester A 2025/26

## Part I Course Overview

**Course Title**
Sustainable Energy Systems

**Subject Code**
EE - Electrical Engineering
**Course Number**
6623

**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 an in-depth exploration of sustainable energy systems, focusing on the development, integration, and management of renewable energy sources. As the world moves towards a low-carbon future, understanding the

principles and technologies behind sustainable energy is crucial. The course covers a broad range of topics, including the fundamentals of sustainability, various renewable energy technologies (such as solar, wind), and energy storage solutions. Additionally, it addresses the integration of renewable energy into existing power grids, the role of smart grids, and the policies and economics that drive the adoption of sustainable energy systems.

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | Demonstrate an in-depth understanding of the core principles of sustainability, including energy efficiency, carbon footprint reduction, and the integration of renewable energy technologies into the broader energy landscape. | 20 | x | | |
| 2 | Analyse and evaluate the design, operation, and performance characteristics of various renewable energy technologies, such as photovoltaic systems, wind turbines, hydroelectric power, biomass conversion processes, and geothermal energy extraction methods. | 30 | x | x | x |
| 3 | Assess the technical and operational challenges of integrating renewable energy sources into existing power grids, including the implementation of smart grid technologies, energy storage systems, and advanced grid management techniques to optimize energy distribution and reliability. | 30 | x | x | x |
| 4 | Critically analyse the economic viability, environmental impact, and social implications of sustainable energy systems, and evaluate the effectiveness of policies, regulations, and incentives designed to promote the adoption and integration of renewable energy technologies into national and global energy frameworks. | 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 sustainable energy systems | 1, 2, 3, 4 | 2 hrs/wk |
| 2 | Tutorials | The students will work out key calculations in renewable energy problems based on questions and problem solving | 2, 3 | 1 hrs/wk |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks ("-" for nil entry) | Allow Use of GenAI? |
|---|---|---|---|---|---|
| 1 | Project | 2, 3 | 10 | - | Yes |
| 2 | Quiz | 1, 2, 4 | 20 | - | No |
| 3 | Assignments | 2, 3 | 10 | - | Yes |

**Continuous Assessment (%)**

40

**Examination (%)**

60

**Examination Duration (Hours)**

2

**Minimum Continuous Assessment Passing Requirement (%)**

30

**Minimum Examination Passing Requirement (%)**

30

**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

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**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

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**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

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**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

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**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 design of engineering 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 a project to gain some practice with the concepts learnt. |

# Part III Other Information

**Keyword Syllabus**

1. Wind Turbine Technologies
Introduction to renewables and the wind resource. Examination of wind turbine components and design, types of generators, performance characteristics, site assessment and selection, and the impact of environmental factors on wind energy production.
2. Photovoltaic (PV) Systems
Introduction to the solar resource and study of photovoltaic technology, including solar cell materials and fabrication, efficiency factors, PV system design and sizing, and integration into the electrical grid.
3. Energy Storage Solutions for Renewable Systems
Overview of energy storage technologies, including batteries, pumped hydro, and compressed air energy storage; their role in supporting intermittent renewable energy sources; and strategies for effective storage system integration.
4. Grid Integration and Smart Grid Technologies
Challenges and solutions for integrating PV and wind energy systems into existing power grids, the role of smart grid technologies in enhancing grid stability and reliability, and advanced grid management techniques for optimal renewable energy utilization.
5. Carbon Policy and Carbon Markets
Examination of carbon policies and regulations, the functioning of carbon markets, mechanisms for trading carbon credits, and methods for tracking and reducing the carbon footprint of energy systems.

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | Nil |

**Additional Readings**

| | Title |
|---|---|
| 1 | Kutscher, C. F., & Milford, J. B. (2018). Principles of sustainable energy systems. CRC Press. |
| 2 | Gilbert M. Masters (2004). Renewable and Efficient Electric Power Systems. Wiley-Interscience. |