

# EE6624: ADVANCED TOPICS IN POWER AND ENERGY SYSTEMS

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## Effective Term

Semester B 2024/25

## Part I Course Overview

### Course Title

Advanced Topics in Power and Energy Systems

### Subject Code

EE - Electrical Engineering

### Course Number

6624

### 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 covers the latest development in power and energy systems, covering sustainable development goals perspective for the power sector, transition from traditional power systems into smart grid with renewable energy sources. It provides an overview of the electricity market development and opportunities for renewable energy sources. With increasing data availability, AI and data analytics are introduced for multiple services in today's energy systems. Other key topics include energy storage systems, microgrid, smart grid, DSO and peer to peer trading technologies.

### Course Intended Learning Outcomes (CILOs)

| CILOs | Weighting (if app.)   | DEC-A1 | DEC-A2 | DEC-A3 |   |
|-------|---|--------|--------|--------|---|
| 1     | Demonstrate an in-depth understanding of the power sector transition into smart grid and electricity market. Understand the driving factors and ultimate aims of SDG and ESG for sustainable development objectives | 20     | x      | x      |   |
| 2     | Power system analysis, steady state and dynamic, balanced and unbalanced system analysis, fault analysis; understand basics in system planning  | 20     | x      | x      | x |
| 3     | Renewable energy system modelling and analysis, wind power modelling, solar PV generation, microgrid and distribution network analysis  | 20     | x      | x      | x |
| 4     | Introduction to electricity market, spot market, ancillary services market, generation planning in an electricity market  | 20     | x      | x      | x |
| 5     | Analyse and evaluate the AI and data analytics based methods for smart grid and energy system analysis, basic functionalities such as demand forecast, pricing modelling and risk analysis for planning             | 20     | x      | 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, 5              | 2 hrs/wk |

|   |            |   |      |          |
|---|------------|---|------|----------|
| 2 | Laboratory | The students will gain hands-on experience for power system analysis including renewable generation | 2, 3 | 1 hrs/wk |
|---|------------|---|------|----------|

**Assessment Tasks / Activities (ATs)**

| ATs | CILO No.     | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|-----|--------------|---------------|--|
| 1   | 2 x Projects | 2, 3, 5       | 25                                     |
| 2   | Quiz 1 & 2   | 1, 2, 3, 4    | 25                                     |

**Continuous Assessment (%)**

50

**Examination (%)**

50

**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 &amp; 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 &amp; thereafter)

**Criterion**

Achievements in CILOs

**Excellent**

(A+, A, A-) High

**Good**

(B+, B, B-) Significant

**Fair**

(C+, C, C-) Moderate

**Marginal**

(D) Basic

**Failure**

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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

**Additional Information for AR****Constructive Alignment with Programme Outcomes****PILO**

1,2,3,4

**How the course contribute to the specific PILO(s)**

The course requires the analysis and the design of power system components and systems and therefore provides many opportunities for students to solve engineering problems by applying knowledge of mathematics, science, and engineering.

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Students are required to complete laboratory experiments to gain practical hands-on experience.

**Part III Other Information****Keyword Syllabus**

Power system analysis

AC power flow, DC power flow, steady state stability and dynamic stability, system fault analysis

1. Distribution network analysis

Distribution system configuration, balanced network analysis, unbalanced network analysis, distributed generation

2. Electricity market

Market structure, spot market, ancillary services market, risk management, renewable energy project planning in an electricity market

3. SDG and Carbon Markets

Understand SDG for sustainable development, study carbon trading and emission reduction mechanisms and emission assessment methods.

**Reading List****Compulsory Readings**

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

**Additional Readings**

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