SEE4119: ELECTRICAL ENERGY CONVERSION

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Electrical Energy Conversion

Subject Code
SEE - School of Energy and Environment
Course Number
4119

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
SEE2001 Electromagnetic Principles for Energy Engineers or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract
This course aims to provide sound understanding of basic electric devices and technologies for electrical energy conversion. The course will emphasise on electric machines for electromechanical energy conversion, basic electric devices for power

conversion, renewable energy systems for electrical power generation, and electric vehicle technologies. Students will learn conventional electric motors and generators, as well as advanced electric machines. Also, students will study basic electric devices and power converters. Moreover, renewable energy systems and electric vehicle technologies will be discussed.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the transformers and electromechanical energy conversion principles.	10		x	
2	Describe the principles of electric machines.	25		x	
3	Describe the fundamentals of basic electric devices and power converters.	25		x	
4	Explain the mechanism of renewable energy systems for power generation.	20		x	
5	Describe the fundamentals of electric vehicles.	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	Students will engage in lectures with facilitated discussions to obtain key concepts and theories related to electrical energy conversion devices and systems.	1, 2, 3, 4, 5	2.5
2	Tutorial & Class demo	Students will engage in lectures and tutorials to solidify key concepts with practice.	1, 2, 3, 4, 5	0.5

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignments Several assignments will be given throughout the semester. Students need to complete the assignments to demonstrate their ability to apply their knowledge in electric machines, electric devices and power converters, renewable energy generation systems, and electric vehicle technologies.	1, 2, 3, 4, 5	40	-	Yes
2	Project Serval topics of electrical energy conversion systems will be provided. Students need to design and analyze the electrical energy conversion systems based on the provided topics.	2, 3, 4, 5	20	-	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Final exam will be given to test students' ability to apply their knowledge learned in electrical energy conversion devices, systems and technologies.

Examination duration: 2 hrs

Percentage of continuous assessment, examination, etc.: 60% by continuous assessment; 40% by examination

To pass a course, a student must do ALL of the following:

a. obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);
b. obtain at least 30% of the total marks allocated towards final examination (if applicable); and
c. meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Assignments

Criterion

Ability to evaluate and analyse questions related to electrical energy conversion devices, systems and technologies.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of electrical energy conversion devices, systems and technologies.

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of electrical energy conversion devices, systems and technologies.

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of electrical energy conversion devices, systems and technologies.

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of electrical energy conversion devices, systems and technologies.

Failure (F)

Poor analysis and problem solving skills and is barely able to demonstrate an understanding of electrical energy conversion devices, systems and technologies.

Assessment Task

2. Project

Criterion

Ability to analyse and solve practical problems related to electrical energy conversion devices, systems and technologies.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of electrical energy conversion devices, systems and technologies.

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of electrical energy conversion devices, systems and technologies.

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of electrical energy conversion devices, systems and technologies.

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of electrical energy conversion devices, systems and technologies.

Failure (F)

Poor analysis and problem solving skills and is barely able to demonstrate an understanding of electrical energy conversion devices, systems and technologies.

Assessment Task

3. Final exam

Criterion

Ability to analyse and solve practical problems related to electrical energy conversion devices, systems and technologies.

Excellent (A+, A, A-)

Excellent analysis and problem solving skills to demonstrate in-depth understanding of electrical energy conversion devices, systems and technologies.

Good (B+, B, B-)

Good analysis and problem solving skills to demonstrate good understanding of electrical energy conversion devices, systems and technologies.

Fair (C+, C, C-)

Acceptable analysis and problem solving skills to demonstrate adequate understanding of electrical energy conversion devices, systems and technologies.

Marginal (D)

Marginally acceptable analysis and problem solving skills to demonstrate some understanding of electrical energy conversion devices, systems and technologies.

Failure (F)

Poor analysis and problem solving skills and is barely able to demonstrate an understanding of electrical energy conversion devices, systems and technologies.

Part III Other Information

Keyword Syllabus

- Transformers and electromechanical energy conversion principles:
  - Equivalent circuit;
  - Current transformer; voltage transformer;
  - Variable voltage; variable current;
  - Frequency; electric power.
- Electric machines:
  - DC machine; brushed machine;
  - AC machine; brushless machine;
  - Synchronous machine; induction machine; permanent magnet machine;
  - Electromagnetic force (EMF); electromagnetic torque.
- Power electronics:
  - DC circuit; AC circuit;
  - Resistor; capacitor; inductor;

- Electric device; power device;
- Power converter; power inverter; rectifier.

- Renewable energy generation system:
  - Renewable energy; power generation;
  - In-direct drive system; direct-drive system;
  - Wind energy; solar energy; water energy;
  - Grid-off system; stand-alone system; grid-connected system.
- Electric vehicle (EV):
  - Battery EV; hybrid EV; fuel-cell EV;
  - EV development;
  - EV propulsion system;
  - EV charging and discharging;
  - Vehicle to grid (V2G).

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	A.E. Fitzgerald, C. Kingsley, and S.D. Umans, Electric Machinery, McGraw-Hill, sixth edition / seventh edition, 2003 / 2013
2	K.T. Chau, Electric Vehicle Machines and Drives: Design, Analysis and Application, Wiley-IEEE, 2015.
3	Bimal K. Bose, Power Electronics and Motor Drives: Advances and Trends, Academic Press, 2006 or 2020
4	D. Buchla, T. Kissell, T. Floyd, Renewable Energy Systems, Pearson, 2015.
5	C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, Oxford, 2001.
6	J. Larminie and J. Lowry, Electric Vehicle Technology Explained, Wiley, second edition, 2012.