SEE8125: EMERGING ENERGY TECHNOLOGIES

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Emerging Energy Technologies

Subject Code
SEE - School of Energy and Environment
Course Number
8125

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
R8 - Research Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
SEE6118 Emerging Energy Technologies

Exclusive Courses
Nil

Part II Course Details

Abstract
The course aims to provide students with the fundamental knowledge on the emerging energy technologies. This includes technologies that are expected to be the next state-of-the-art in the near future, from innovative clean energy conversion

to energy storage. The acquired knowledge shall equip students for the rapidly evolving energy frontiers, and serve as a common ground for potential innovations in these technologies.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe basic principles in the conversion of fossil fuel (coal and natural gas) to ultraclean fuel, as well as their importance in the future energy equations; describe the process of carbon capture and storage and its importance in the integration of fossil fuel	20	x	x	
2	Describe the various means of solar energy conversion from first to third generation photovoltaic solar cells, and photoelectrochemical conversion; describe the working principles of different types of fuel cells.	30	x	x	x
3	Describe the principles of energy storage through lithium ion batteries and supercapacitors, and their advantages; describe the principles of hydrogen storage such as metal hydrides and carbon nanotubes	30	x	x	
4	Apply the principles to evaluate the performances and challenges in various technologies.	20		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	Regular lectures to enrich students with the required science fundamentals for the applications of emerging technologies in energy conversion and storage	1, 2, 3	

2	Tutorial	Mathematical-based in-class exercise to consolidate the skills of students in designing energy systems based on emerging technologies	2, 3, 4	
3	Topical Workgroup	In-depth understanding of selected technologies by problem-solving	2, 3, 4	
4	Presentation	General presentation to share research findings with classmates	2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Assignment	3, 4	85	-	Yes
2	Oral presentation	1, 2, 3, 4	15	-	Yes

Continuous Assessment (%)

100

Examination (%)

0

Minimum Continuous Assessment Passing Requirement (%)

30

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Ability to apply mathematical skills in designing energy storage and conversion systems based on emerging technologies

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

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

Criterion
Ability to convey research findings orally in a convincing and systematic manner

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
Assignment (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion
Ability to apply mathematical skills in designing energy storage and conversion systems based on emerging technologies

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate to Basic

Failure
(F) Not even reaching marginal levels

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

Criterion
Ability to convey research findings orally in a convincing and systematic manner

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Moderate to Basic

Failure

(F) Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Ultraclean fossil fuel conversion:
- Gas-to-liquid conversion
- Clean coal technologies
- Carbon capture and storage

Energy conversion:
- First, second and third generation solar cells
- Photoelectrochemical conversion
- Hydrogen fuel cells, direct methanol fuel cells, solid oxide fuel cells

Energy storage:
- Lithium-ion batteries
- Supercapacitor
- Hydrogen storage

Reading List

Compulsory Readings

	Title
1	Raimondi, F., Scherer, G.G., Kötz, R., Wokaun, A. Nanoparticles in energy technology: Examples from electrochemistry and catalysis, Angew. Chem. Int. Ed. 2005 44 2190.
2	Somorjai, G.A., Frei, H., Park, J.Y. Advancing the frontiers in nanocatalysis, biointerfaces and renewable energy conversion by innovations of surface techniques, J. Am. Chem. Soc. 2009 131 16589.
3	Kamat, P.V. Meeting the clean energy demand. Nanostructure architectures for solar energy conversion, J. Phys. Chem. C 2007 111 2834.
4	Winter, M., Brodd, R.J. What are batteries, fuel cells, and supercapacitors? Chem. Rev. 2004 104 4245.

Additional Readings

	Title
1	Nil