SEE4113: NANOTECHNOLOGY IN ENERGY CONVERSION AND STORAGE: CONCEPTS AND CREATIVE SCIENCE

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Nanotechnology in Energy Conversion and Storage: Concepts and Creative Science

Subject Code
SEE - School of Energy and Environment
Course Number
4113

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
SEE3101 Engineering Thermofluids II or equivalent

Precursors
Nil

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

The course aims to educate students on the basic and creative concepts of energy technologies in the aspect of Nanotechnology. By covering the different areas of emerging technologies from fossil fuel conversion, ultraclean fuel production and utilisation, solar photovoltaic conversion to hydrogen and energy storage, the course prepares students for these revolutionary technologies. Understanding the fundamental concepts of these technologies allow students to be creative towards the development in these areas. Importantly, rather than focusing solely on ultimately renewable energy solutions, the course incorporates the complementary views on fossil but ultraclean fuel technologies, as well as their importance as intermediate energy solutions. Such knowledge shall equip students with holistic views on various energy solutions, with implications of assisting them in managing these technologies in their future professions.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the urgency of Energy solutions and the expectations of Nanotechnology in providing long term innovative and creative solutions to these problems	15	x		
2	Design various nanomaterials as building blocks of Nanotechnology and develop basic understanding in the relevant analytical techniques	25		x	x
3	Describe the concepts of heterogeneous catalysis, and further apply in the creative designing of various nanocatalysts for fossil fuel conversions	25		x	x
4	Apply Nanotechnology and nanomaterials in the designing of different innovative energy storage technologies	15		x	
5	Apply Nanotechnology and nanomaterials in the designing of various fuel cells 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	Students will engage in lectures to obtain required science fundamentals for the applications of nanotechnology in energy conversion and storage.	1, 2, 3, 4, 5	
2	Tutorial	Students will participate in mathematical-based in-class exercise to consolidate the skills of students in designing energy systems based on nanotechnology.	2, 3, 4, 5	
3	Presentation	Students will give a presentation to share research findings with classmates.	1, 2, 3, 4, 5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Homework Assignments There will be 2-3 assignments throughout the semester. Students will complete the assignments to demonstrate their ability to apply their knowledge in topics related to nanotechnology in energy conversion and storage.	1, 2, 3, 4, 5	25	-	Yes
2	In-class Quiz Students will take the in-class quiz to demonstrate their understandings o the topics related to nanotechnology in energy conversion and storage.	1, 2, 3, 4, 5	15	-	No

3	Oral presentation and individual report Students will deliver an oral presentation and complete an individual report to consolidate their learnings to identify, analyse, and discuss their findings on energy conversion and storage applications.	1, 2, 3, 4, 5	30	-	Yes

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

Examination duration: 2 hrs Percentage of continuous assessment, examination, etc.: 70% by continuous assessment; 30% by exam To pass a course, a student must do ALL of the following: 1) 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); 2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and 3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

1. Homework Assignments

Criterion

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

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
2. In-class Quiz

Criterion
Ability to analyse and solve problems related to energy conversion and storage by utilizing materials engineering

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
3. Oral presentation and individual report

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
4. Final examination

Criterion

Ability to explain concepts, analyze and solve problems related to nanotechnology in Energy Conversion and Storage

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

Part III Other Information

Keyword Syllabus

Materials design and synthetic strategy; Nanomaterial characterization; Ultraclean fossil fuel; Solar photovoltaic conversions; Shockley-Queisser limit, Photophysics, Electrochemistry, Photoelectrochemistry, p-n junction solar cells; Excitonic solar cells; Fuel cells; Hydrogen storage; Li-ion batteries; Supercapacitor.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Chem. Rev. 2021, 121, 10271-10366
2	Adv. Energy Mater. 2022, 12, 2100346
3	Chem. Soc. Rev., 2013, 42, 3127-3171
4	Chem. Soc. Rev., 2014, 43, 3303-3323
5	Chem. Rev. 2017, 117, 6225-6331
6	Chem. Rev. 2017, 117, 712-757