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

Effective Term
Semester A 2022/23

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	10	x		
2	Design various nanomaterials as building blocks of Nanotechnology and develop basic understanding in the relevant analytical techniques	20		x	x
3	Describe the concepts of heterogeneous catalysis, and further apply in the creative designing of various nanocatalysts for fossil fuel conversions	20		x	x
4	Apply Nanotechnology and nanomaterials in the designing of different innovative energy storage technologies	10		x	
5	Apply Nanotechnology and nanomaterials in the designing of various fuel cells technologies	15		x	
6	Apply creative Nanotechnology in the development of solar cells technologies for photovoltaic conversions	15		x	x
7	Practise ethics and anticipate the outlook of Nanotechnology implementations	10	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.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lecture	Regular lectures to enrich students with the required science fundamentals for the applications of nanotechnology in energy conversion and storage	1, 2, 3, 4, 5, 6, 7	
2	Tutorial	Mathematical-based in-class exercise to consolidate the skills of students in designing energy systems based on nanotechnology	2, 3, 4, 5, 6	
3	Presentation	General presentation to share research findings with classmates	1, 2, 3, 4, 5, 6, 7	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Assignments	1, 2, 3, 4, 5, 6, 7	20	
2	Tests	1, 2, 3, 4, 5, 6, 7	20	
3	Oral presentation and report	1, 2, 3, 4, 5, 6, 7	30	

Continuous Assessment (%)

70

Examination (%)

30

Examination Duration (Hours)

2

Additional Information for ATs

Examination duration: 2 hrs
Percentage of coursework, examination, etc.: 70% by coursework; 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 coursework (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. 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. Tests

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 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; Catalysts; Ultraclean fossil fuel; Solar photovoltaic conversions; Shockley-Queisser limit, photophysics, electrochemistry, photoelectrochemistry, p-n junction solar cells; Excitonic solar cells; Polymer electrolyte membrane fuel cell (PEMFC); Direct methanol fuel cells (DMFC); Solid oxide fuel cell (SOFC); Hydrogen storage; Li-ion batteries; Supercapacitor.

Reading List

Compulsory Readings

	Title
1	Wilson, M., Kannangara, K., Raguse, B., Simmon, M. (2002) Nanotechnology: Basic Science and Emerging Technologies, Chapman and Hall/CRC
2	Garcia-Martinez, J. (2010) Nanotechnology for the Energy Challenge, Wiley-VCH
3	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.
4	Kamat, P.V. Meeting the clean energy demand. Nanostructure architectures for solar energy conversion, J. Phys. Chem. C, 2007, 111, 2834.

Additional Readings

	Title
1	Nil