MSE6176: NANOMATERIALS DESIGN FOR ENERGY APPLICATIONS

Effective Term
Semester A 2025/26

Part I Course Overview

Course Title
Nanomaterials Design for Energy Applications

Subject Code
MSE - Materials Science and Engineering
Course Number
6176

Academic Unit
Materials Science and Engineering (MSE)

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

Energy has become a large societal issue due to the current reliance on non-renewable energy resources and their negative impact on the environment. A growing interest in clean and renewable energy resources makes researchers around the globe to discover new materials. This course aims to introduce nanomaterials design with various energy options. The materials that control the performance of various energy applications, such as energy storage devices, fuel cells, photovoltaic devices, and light-emitting diodes, are explored.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the differences between bulk and nano materials	10		x	
2	Explain the design principles for energy storage devices	25			x
3	Explain the design principles for fuel cells	25			x
4	Explain the design principles for photovoltaic devices	20		x	
5	Explain the design principles for light-emitting diodes	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	Lectures	Students will engage in formal lectures to gain knowledge about nanomaterials, energy storage devices, fuel cells, photovoltaic devices and light-emitting diodes.	1, 2, 3, 4, 5	10 weeks
2	Test/assignments	Students will engage in completing the tests/ assignments to check and consolidate their learnings	1, 2, 3, 4, 5	3 weeks

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Tests	1, 2, 3, 4, 5	40	-	No
2	Assignments	1, 2, 3, 4, 5	20	-	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Assessment Rubrics (AR)

Assessment Task

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

Criterion

Understanding and explaining fundamental problem. Ability to identify new materials to solve such problems. Ability to explain prospects to solve the problem occurred.

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not reaching marginal level

Assessment Task

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

Criterion

Able to define material design for various energy harvesting devices

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure
(F) Not reaching marginal level

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

Criterion
Understanding and explaining fundamental problem. Ability to identify new materials to solve such problems. Ability to explain prospects to solve the problem occurred.

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not reaching marginal level

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

Criterion
Able to define material design for various energy harvesting devices

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Not reaching marginal level

Part III Other Information

Keyword Syllabus
Energy storage devices
- Super capacitors
- Batteries
Fuel cells
- Proton transport materials

- Redox catalysts
Photovoltaic devices
- Photovoltaic fundamentals
- Photovoltaic materials
Light-emitting diodes
- LED fundamentals
- LED epitaxial growth, processing and packaging

Reading List

Compulsory Readings

	Title
1	Nil.

Additional Readings

	Title
1	Journal: Nature Materials, Nature Photonics, Advanced Materials, American Chemical Society Journals, American Institute of Physics Journals and Elsevier Journals.