SEE6123: ELECTROCHEMICAL ENERGY STORAGE

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Electrochemical Energy Storage

Subject Code
SEE - School of Energy and Environment
Course Number
6123

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

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

This course provides a comprehensive understanding of the fundamentals and applications of electrochemical systems in energy storage and conversion. It explores the mechanisms, design, and optimization of various electrochemical storage devices, including batteries, fuel cells, electrolyzers, and supercapacitors. Emphasis throughout the course is on understanding the underlying electrochemical processes, materials science, and engineering aspects crucial for the development of efficient, sustainable, and economically viable energy storage solutions. The course is designed to provide students with the essential knowledge required for advancing energy storage technologies.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Understand the fundamental principles of electrochemistry relevant to energy storage.	20	x	x	
2	Analyze the design, operation, and performance metrics of various electrochemical energy storage systems.	20	x	x	
3	Evaluate the material and component choices for different types of energy storage systems and assess their efficiency, durability, and environmental impact.	20	x	x	
4	Develop skills in interpreting and critiquing current research and trends in electrochemical energy storage.	20	x	x	x
5	Enhance problem-solving and critical thinking skills within the context of electrochemical energy storage challenges.	20	x	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	Lectures		1, 2, 3, 4, 5	
2	Tutorials		1, 4	

Assessment Tasks / Activities (ATs)

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

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Additional Information for ATs

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

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

Criterion

Understanding the basic theory and principles of electrochemistry; capable of rationalizing experimental observations using theory and simple calculations

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Falling short of even marginal levels

Assessment Task

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

Criterion

Understanding basic principles and capable of explaining experimental phenomena and material properties

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Falling short of even marginal levels

Assessment Task
Project Report (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Understanding the key problems of energy storage technologies and capable of proposing potential strategies to solve them

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Falling short of even marginal levels

Assessment Task
Final Exam (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion
Understanding basic principles and capable of explaining experimental phenomena and material properties

Excellent
(A+, A, A-) High

Good
(B+, B, B-) Significant

Fair
(C+, C, C-) Moderate

Marginal
(D) Basic

Failure
(F) Falling short of even marginal levels

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

Criterion
Understanding the basic theory and principles of electrochemistry; capable of rationalizing experimental observations using theory and simple calculations

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Falling short of even marginal levels

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

Criterion
Understanding basic principles and capable of explaining experimental phenomena and material properties

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Falling short of even marginal levels

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

Criterion
Understanding the key problems of energy storage technologies and capable of proposing potential strategies to solve them

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Falling short of even marginal levels

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

Criterion
Understanding basic principles and capable of explaining experimental phenomena and material properties

Excellent
(A+, A, A-) High

Good
(B+, B) Significant

Marginal
(B-, C+, C) Basic

Failure
(F) Falling short of even marginal levels

Part III Other Information

Keyword Syllabus

- Electrochemical systems: Fundamentals of electrochemistry, overview of energy storage and conversion.
- Electrochemical principles: electrochemical thermodynamics; kinetics and mechanisms of electrochemical reactions.
- Battery technologies: Principles and types of batteries; lithium-ion batteries; advanced and emerging battery technologies.
- Fuel Cells: Fundamentals and types of fuel cells; electrochemical and materials aspects; applications and challenges.
- Electrolyzers: Principles of electrolysis; hydrogen production and storage; efficiency and optimization.
- Supercapacitors: Basics; materials and performance characteristics; comparison with other storage technologies.
- Applications of electrochemical energy storage: Portable electronics; electric vehicles; grid storage; renewable energy integration.
- Advancements in energy storage technologies: Innovations in materials and processes; challenges and future directions; role in the energy transition.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Allen J. Bard, et al. "Electrochemical Methods: Fundamentals and Applications", 3rd Edition, Wiley 2022.
2	Allen J. Bard et al. "Electrochemical Methods: Fundamentals and Applications", 2nd Edition, Wiley 2002.

3	Cynthia G. Zoski "Handbook of Electrochemistry", Elsevier, 2007.
4	Jiujun Zhang, et al., Electrochemical Technologies for Energy Storage and Conversion, Wiley, 2012.