City University of Hong Kong
Course Syllabus

offered by Department of Chemistry
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	Materials Chemistry for Energy Technologies
Course Code:	CHEM8015
Course Duration:	1 semester
Credit Units:	3 credits
Level:	R8
Medium of Instruction:	English
Medium of Assessment:	English
Prerequisites: *(Course Code and Title)*	Nil
Precursors: *(Course Code and Title)*	Nil
Equivalent Courses: *(Course Code and Title)*	BCH8015 Materials Chemistry for Energy Technologies
Exclusive Courses: *(Course Code and Title)*	Nil

Part II Course Details

1. Abstract

This course aims to develop an understanding of chemistry concepts to design and synthesis functional materials for energy harvesting and storage technologies. Conventional and emerging chemical synthesis and material processing technologies will be introduced. The core and fundamental elements of physics, chemistry and materials science will be recognized through study of the cutting-edge high-performance energy technologies.

The lecture content will provide the chemistry of materials for energy conversion, including basics concepts and fundamentals of functional materials, chemical synthesis and materials preparation, and their materials properties. The lecture topics will be discussed in the following subjects: Photovoltaic materials and technologies including c-Si solar cells, thin film solar cell (CdTe, CIGS, amorphous Si), organic solar cells, dye-sensitized solar cells, quantum dot solar cells, perovskite solar cells; Energy storage materials technologies, battery and super capacitor; Thermoelectric solar cells; fuel cells; water splitting.

2. Course Intended Learning Outcomes (CILOs)

No.	CILOs[#]	Weighting (if applicable)	Discovery-enriched curriculum related learning outcomes		
			A1	*A2*	*A3*
1.	Understand the chemistry used to prepare the materials and their properties and application for energy conversion and storage	20%	✓	✓	
2.	Recognize the conventional and emerging chemical synthesis and material processing technologies for energy technologies;	20%	✓	✓	
3.	Apply chemistry concepts and principle to analyse the formulation, composition and chemical structure of functional materials;	20%	✓	✓	✓
4.	Assess the current stage of existing high-performance energy technologies and conduct the analysis of their future potentials;	20%	✓	✓	✓
5.	Be able to define materials properties with the key structure-property relationship and good communication in teamwork	20%	✓	✓	✓
		100%			

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 self-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.

3. Learning and Teaching Activities (LTAs)

LTA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lecture	Students will describe the basic concepts and fundamentals of functional materials, chemical synthesis and materials preparation techniques, and assess the application of functional materials in energy systems.	✓	✓	✓	✓	✓	26 hours in total
Small group presentation, Proposal report	Students will prepare group presentations and proposal reports for a selected topic		✓	✓	✓		10 hours in total
Laboratory Exercise	Students will visit the Lab for the fabrication and tests of some energy conversion or storage devices			✓	✓	✓	6 hours in total

4. Assessment Tasks/Activities (ATs)

Assessment Tasks/Activities	CILO No.						Weighting	Remarks
	1	2	3	4	5			
Continuous Assessment: 60%								
Class discussion/Quiz	✓	✓	✓	✓	✓		15%	
Group presentation		✓	✓	✓			25%	
Proposal report		✓	✓	✓	✓		20%	
Examination: 40% (duration: 150 min)								
Examination	✓	✓	✓	✓	✓		40%	
							100%	

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for courses offered by CHEM:
"A minimum of 40% in both coursework and examination components."

5. Assessment Rubrics

Applicable to students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Class quiz and discussion	Understand the concepts and fundamentals of functional materials, chemical synthesis and materials preparation, and their application	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Group presentation	Apply and assess the current stage of existing high-performance energy technologies through using chemistry concepts and principles	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Proposal report	Be able to predict and analysis development and potential of energy application	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Examination	Define and analysis the chemical synthesis and material processing technologies for energy technologies	High	Significant	Moderate	Basic	Not even reaching marginal levels

Applicable to students admitted from Semester A 2022/23 to Summer Term 2024

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-, C+, C)	Failure (F)
1. Class quiz and discussion	Understand the concepts and fundamentals of functional materials, chemical synthesis and materials preparation, and their application	High	Significant	Basic	Not even reaching marginal levels
2. Group presentation	Apply and assess the current stage of existing	High	Significant	Basic	Not even reaching marginal levels

	high-performance energy technologies through using chemistry concepts and principles				
3. Proposal report	Be able to predict and analysis development and potential of energy application	High	Significant	Basic	Not even reaching marginal levels
4. Examination	Define and analysis the chemical synthesis and material processing technologies for energy technologies	High	Significant	Basic	Not even reaching marginal levels

Part III Other Information

1. Keyword Syllabus

Basics concepts and fundamentals of functional materials, chemical synthesis and materials preparation, and their materials properties; Photovoltaic materials and technologies including c-Si solar cells, thin film solar cell (CdTe, CIGS, amorphous Si), organic solar cells, dye-sensitized solar cells, quantum dot solar cells, perovskite solar cells; Energy storage materials technologies, battery and super capacitor; Thermoelectric solar cells; fuel cells; water splitting.

2. Reading List

2.1 Compulsory Readings

1.	Selected research reviews
2.	
3.	
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2.2 Additional Readings

1.	Duncan W. Bruce, Dermot O'Hare, Richard I. Walton Energy Materials, 1st ed.; Wiley: Hoboken, 2011
2.	Harry R. Allcock Introduction to Materials Chemistry, 1st ed.; Wiley: Hoboken, 2008
3.	Rolando R.-M, The Physical Chemistry of Materials: Energy and Environmental Applications, 1st ed. CRC Press, Florida, 2009