City University of Hong Kong
Course Syllabus

offered by Department of Materials Science and Engineering
with effect from Semester A 2022/23

Part I Course Overview

Course Title:	**Nanomaterials Design for Energy Applications**
Course Code:	**MSE6176**
Course Duration:	**One Semester**
Credit Units:	**3**
Level:	**P6**
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)*	**AP6176 Energy Materials Design for Current Century (From the old curriculum)**
Exclusive Courses: *(Course Code and Title)*	**AP8176 Energy Materials design for Current Century (From the old curriculum)**

Part II Course Details

1. Abstract

(A 150-word description about the course)

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 materials that revolutionize the current world with various energy options. The materials that control the performance of various energy sources such as photovoltaic devices, fuel cells, thermo-electric devices, artificial photosynthesis and energy storage are explored.

2. Course Intended Learning Outcomes (CILOs)

(CILOs state what the student is expected to be able to do at the end of the course according to a given standard of performance.)

No.	CILOs	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	*A2*	*A3*
1.	Describe the bulk and nano materials design and relate to photovoltaic device properties	20%		√	
2.	Analyse the material design and explain causes on fuel cell properties	20%			√
3.	Relate the bulk and nano materials design with thermoelectric device properties	20%		√	
4.	Generate material design and application on photosynthesis	20%		√	
5.	Identify and reflect the nanomaterial design on energy storage devices	20%			√
** If weighting is assigned to CILOs, they should add up to 100%.*		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. Teaching and Learning Activities (TLAs)

(TLAs designed to facilitate students' achievement of the CILOs.)

TLA	Brief Description	CILO No.						Hours/week (if applicable)
		1	2	3	4	5		
1	Lectures	√	√	√	√	√		11 weeks
2	Tutorials	√	√		√			2 weeks
3	Test/assignments	√		√		√		2 weeks

4. Assessment Tasks/Activities (ATs)

(ATs are designed to assess how well the students achieve the CILOs.)

Assessment Tasks/Activities	CILO No.						Weighting*	Remarks
	1	2	3	4	5			
Continuous Assessment: 30%								
Tests	√		√		√		10%	
Assignments	√	√		√			20%	
Examination (duration: 2 hours)	√	√	√	√	√		70%	
** The weightings should add up to 100%.*							100%	

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following rubrics.)

Applicable to students admitted in Semester A 2022/23 and thereafter

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B)	Marginal (B-,C+, C)	Failure (F)
1. Assignments	Understanding and explaining fundamental problem. Ability to identify new materials to solve such problems. Ability to explain prospects to solve the problem occurred.	High	Significant	Basic	Not reaching marginal level
2. Tests	Understanding the concepts of new energy materials, and their applications.	High	Significant	Basic	Not reaching marginal level
3. Examination	Able to define material design for various energy harvesting devices	High	Significant	Basic	Not reaching marginal level

Applicable to students admitted before Semester A 2022/23

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Assignments	Understanding and explaining fundamental problem. Ability to identify new materials to solve such problems. Ability to explain prospects to solve the problem occurred.	High	Significant	Moderate	Basic	Not reaching marginal level
2. Tests	Understanding the concepts of new energy materials, and their applications.	High	Significant	Moderate	Basic	Not reaching marginal level
3. Examination	Able to define material design for various energy harvesting devices	High	Significant	Moderate	Basic	Not reaching marginal level

Part III Other Information (more details can be provided separately in the teaching plan)

1. Keyword Syllabus

(An indication of the key topics of the course.)

Photovoltaic devices

- Photovoltaic materials (Bulk and NanoMaterials properties that include light absorption, charge transport properties and stability)
- Electrochemical devices that involves ionic transport and their respective nano and complex materials, e.g. dye sensitised solar cells

Fuel cells

- Basic device architecture and design on proton transport materials
- Design on Redox catalysts and co-catalysts
- Applications of fuel cells

Thermoelectric (TE) devices

- Phonon scattering, low thermal conductivity and high electrical conductivity TE materials
- TE materials design with nanostructures and Figure of merit

Photosynthesis

- Hydrogen Catalysts
- Water-oxidizing catalysts
- Photosensitizers
- Photocatalytic water splitting with nanostructures

Energy storage devices

- Super capacitors
- Batteries

2. Reading List

2.1 Compulsory Readings

(Compulsory readings can include books, book chapters, or journal/magazine articles. There are also collections of e-books, e-journals available from the CityU Library.)

1.	Next Generation Photovoltaics: High Efficiency Through Full Spectrum Utilization - by A Marti, Antonio Luque, Institute of Physics (Great Britain), 2004
2.	Organic Photovoltaics: Mechanism, Materials, and Devices by Sam-Shajing Sun, Niyazi Serdar Sariciftci Published by CRC Press, 2005
3.	The Materials Science of Semiconductors By Angus Rockett Edition: illustrated Published by Springer, 2007

2.2 Additional Readings

(Additional references for students to learn to expand their knowledge about the subject.)

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