City University of Hong Kong
Course Syllabus

offered by School of Energy and Environment
with effect from Semester A 2024/25

Part I Course Overview

Course Title:	**Hydrogen Production and Storage**
Course Code:	**SEE6126**
Course Duration:	**One semester**
Credit Units:	**3 credits**
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)*	**Nil**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

Hydrogen stands at the forefront of alternative energy solutions, offering a pathway to reduce carbon emissions and transition towards a sustainable energy future. Recent advancements in hydrogen production and storage technologies have elevated its potential as a versatile and clean energy carrier. Against this backdrop, this course is designed to provide a comprehensive understanding of this field, covering hydrogen production from both non-renewable and renewable sources including some of the niche hydrogen production techniques, emphasizing the importance of hydrogen in the future energy landscape. Key topics include various production methods, safe handling practices, and the complexities of storage and transportation, ranging from high-pressure and cryogenic tanks to metal and chemical hydrides. Additionally, the course also includes the basic science and technology behind fuel cells, highlighting their role in the hydrogen economy. Through case studies and project work, students will gain insights into hydrogen's role in contemporary/emerging energy systems, its environmental impact, and its economic feasibility, equipping them to contribute meaningfully to the field of sustainable energy.

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 and apply the relevant principles of physics, chemistry, and engineering in the context of hydrogen production and storage technologies.	20%	√	√	
2	Evaluate various hydrogen production methods (including renewable and non-renewable sources) for their efficiency, environmental impact, and technological viability.	20%	√	√	√
3	Compare technologies for hydrogen storage, distribution, and utilization (including fuel cell technologies)	20%	√	√	√
4	Critically appraise the niche areas of hydrogen research evaluating their prospects, limitations, and challenges.	20%	√	√	√
5	Understand hydrogen adoption in a broader context, considering factors such as technological readiness, economic feasibility, safety, environmental impact, infrastructure, social acceptance, as well as regulatory and policy considerations.	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 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.

3. Learning and Teaching Activities (LTAs)

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

LTA	Brief Description	CILO No.					Hours/week (if applicable)
		1	2	3	4	5	
Lectures	Lectures provide the foundational scientific and engineering knowledge required for understanding hydrogen technologies (both mature and niche areas). Guest lectures from academia and industry may be included when possible to offer additional perspectives.	√	√	√			
In-class exercises	Interactive in-class activities will be conducted to reinforce understanding of the concepts introduced in lectures. These exercises are designed to immediately solidify comprehension and allow for real-time assessment of students' grasp of the material.	√	√	√			
Reading exercises	Students will be assigned a range of reading materials, including reference books, scholarly journal articles, and relevant online resources, to support self-guided learning and deepen their understanding of course content.	√	√	√	√	√	
Topical Workgroups	Students will form workgroups to actively discuss and reflect on contemporary challenges in selected areas of hydrogen technology. Through brainstorming ideas and solutions, they will connect classroom learning with real-world applications. This collaborative approach aims to facilitate in-depth understanding and encourage inquiry-based learning in areas of specific interest.	√	√	√	√	√	
Project Report and Presentation	Students will be tasked with preparing a project report and delivering a presentation on their research findings. This exercise aims to not only share knowledge with peers but also to cultivate skills in both written and oral communication, essential for articulating complex technical concepts effectively.	√	√	√	√	√	

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: 100%							
In-class exercises and Reading exercises	√	√	√	√	√	10 %	
Assignments	√	√	√	√	√	20%	
Quizzes	√	√	√	√	√	30%	
Project	√	√	√	√	√	40%	
Examination: 0% (duration: , if applicable)							
						100%	

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.

5. Assessment Rubrics

(Grading of student achievements is based on student performance in assessment tasks/activities with the following 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. In-class/Reading Exercises	Ability to apply concepts and theories to practical and real-world applications pertinent to hydrogen production and storage	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignments	Proficiency in analyzing and resolving technical problems pertaining to hydrogen technologies	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Quizzes	Ability to analyse and solve questions/problems related to hydrogen production and storage	High	Significant	Moderate	Basic	Not even reaching marginal levels
4. Project	Ability to analyze the current status and recent trends, discuss/propose possible solutions to contemporary issues, and communicate the research findings in a convincing and systematic manner (both orally and in a written report)	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. In-class/Reading Exercises	Ability to apply concepts and theories to practical and real-world applications pertinent to hydrogen production and	High	Significant	Moderate	Low

	storage				
2. Assignments	Proficiency in analyzing and resolving technical problems pertaining to hydrogen technologies	High	Significant	Moderate	Low
3. Quizzes	Ability to analyse and solve questions/problems related to hydrogen production and storage	High	Significant	Moderate	Low
4. Project	Ability to analyze the current status and recent trends, discuss/propose possible solutions to contemporary issues, and communicate the research findings in a convincing and systematic manner (both orally and in a written report)	High	Significant	Moderate	Low

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.)

Hydrogen properties and characteristics; role of hydrogen in global energy transition; hydrogen economy; hydrogen colour spectrum; electrolysis; green hydrogen technologies; technologies for hydrogen storage, distribution, and utilization; fuel cells; hydrogen for mobility; economic and environmental implications of hydrogen technologies

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.	Michael Ball, Martin Wietschel, The hydrogen economy: opportunities and challenges. (2009).
2.	Macro Alvera, The Hydrogen Revolution: a blueprint for the future of clean energy (2021)
3.	Detlef Stolten, Bernd Emonts, Hydrogen Science and Engineering (2016)

2.2 Additional Readings

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

1.	S.A. Sherif, D. Yogi Goswami, E.K. (Lee) Stefanakos, Aldo Steinfeld 2014. Handbook of Hydrogen Energy. 1st Edition.
2.	International Energy Agency (IEA) Reports on Hydrogen
3.	U.S. Department of Energy (DOE) – Hydrogen and Fuel Cells Program Reports
4.	European Hydrogen Roadmap, HyLaw
5.	“Hydrogen: The Essential Element" by John S. Rigden