

**City University of Hong Kong**  
**Course Syllabus**

**offered by School of Energy and Environment**  
**with effect from Semester A 2021/22**

---

---

**Part I Course Overview**

<b>Course Title:</b>	Chemical Sciences for Energy and Environmental Engineers
<b>Course Code:</b>	SEE2002
<b>Course Duration:</b>	One semester
<b>Credit Units:</b>	4
<b>Level:</b>	B2
<b>Proposed Area:</b> <i>(for GE courses only)</i>	<input type="checkbox"/> Arts and Humanities <input type="checkbox"/> Study of Societies, Social and Business Organisations <input type="checkbox"/> Science and Technology
<b>Medium of Instruction:</b>	English
<b>Medium of Assessment:</b>	English
<b>Prerequisites:</b> <i>(Course Code and Title)</i>	BCH1100 Chemistry OR CHEM1300 Principles of General Chemistry
<b>Precursors:</b> <i>(Course Code and Title)</i>	Nil
<b>Equivalent Courses:</b> <i>(Course Code and Title)</i>	Nil
<b>Exclusive Courses:</b> <i>(Course Code and Title)</i>	Nil

## Part II Course Details

### 1. Abstract

(A 150-word description about the course)

The course aims to equip students with the fundamentals in analytical, physical chemistry, organic chemistry and polymeric materials. The acquired knowledge shall enable students to apply the principles of chemistry in describing as well as engineering innovative solutions to the wider and increasingly complex Energy & Environment-related problems.

### 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 <sup>#</sup>	Weighting* (if applicable)	Discovery-enriched curriculum related learning outcomes (please tick where appropriate)		
			A1	A2	A3
1.	Describe the basic principles of analytical chemistry such as spectroscopy, principles of chromatography and mass spectrometry, gas and liquid chromatography, chromatographic methods and capillary electrophoresis; apply knowledge in creative energy and environment-related applications.	30	√	√	
2.	Describe the fundamentals of organic chemistry, inorganic chemistry, and electrochemistry; apply knowledge in creative energy and environment-related applications.	20		√	
3.	Describe the structures of four basic solid materials and its relevant industrial applications, including energy and environment-related applications; apply knowledge in creative applications.	20		√	
4.	Plan and execute quantitative experimental work, to record and interpret the results of such work, and to understand and communicate what has been done.	30	√	√	
		100%			

\* If weighting is assigned to CILOs, they should add up to 100%.

<sup>#</sup> Please specify the alignment of CILOs to the Gateway Education Programme Intended Learning outcomes (PILOs) in Section A of Annex.

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	
Lectures	Explain key concepts, theories and applications of chemistry topics related to energy and environmental applications, including the basic principles of analytical chemistry, and the fundamentals of organic chemistry, inorganic chemistry, electrochemistry, and material chemistry	√	√	√	√	3 hours/week
Lab-based experiment	Enable students to deepen their understanding of the key concepts and theories and apply them to practice through laboratory experiment	√	√	√	√	15 hours/semester

### 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			
Continuous Assessment: <u>60</u> %							
Homework Assignment Three assignments will be given throughout the semester. Students will complete the assignments to demonstrate their understanding of the knowledge in inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science and their ability to apply the knowledge to solve problems related to energy and environmental applications.	√	√	√			20%	
Laboratory experiments & reports Students will perform experiments in groups in three lab sessions on synthesis of alum crystals from scrap metal, determination of rates of chemical reactions, and determination of alkalinity of water by titration and write individual lab reports to analyse and their results and present their understanding of relevant chemistry knowledge.	√	√	√	√		30%	
Mid-term test	√	√	√			10%	

Students will complete a midterm test to demonstrate their ability to apply their knowledge in inorganic chemistry and analytical chemistry.									
Examination: <u>40</u> % (duration: 2 hours, if applicable) Final exam will test students' comprehensive understanding of various aspects of chemistry and their ability to apply their knowledge learned throughout the course in solving chemistry-related problems.									
* The weightings should add up to 100%.							100%		

Examination duration: 2 hrs

Percentage of coursework, examination, etc.: 60% by coursework; 40% by exam

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.)

Assessment Task	Criterion	Excellent (A+, A, A-)	Good (B+, B, B-)	Fair (C+, C, C-)	Marginal (D)	Failure (F)
1. Homework Assignment	Ability to evaluate and analyse chemistry problems related to energy and environmental applications.	Excellent analysis and problem solving skills to demonstrate in-depth understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Good analysis and problem solving skills to demonstrate good understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Acceptable analysis and problem solving skills to demonstrate adequate understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Marginally acceptable analysis and problem solving skills to demonstrate some understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Poor analysis and problem solving skills and is barely able to demonstrate an understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science
2. Laboratory experiments and reports	Ability to work in a group and to perform chemistry experiments for solving practical problems related to environmental applications.	Excellent report writing and experimental skills with in-depth understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Good report writing and experimental skills with good understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Acceptable report writing and experimental skills with adequate understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Marginally acceptable report writing and experimental skills with some understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Poor report writing and experimental skills with poor understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science
3. Mid-term test	Ability to analyse, calculate and solve chemistry problems related to environmental applications.	Excellent analysis and problem solving skills to demonstrate in-depth understanding of	Good analysis and problem solving skills to demonstrate good understanding of inorganic	Acceptable analysis and problem solving skills to demonstrate adequate understanding of	Marginally acceptable analysis and problem solving skills to demonstrate some understanding of inorganic chemistry,	Poor analysis and problem solving skills and is barely able to demonstrate an understanding of inorganic chemistry,

		inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	organic chemistry, electro chemistry, and analytical chemistry, and solid material science	organic chemistry, electro chemistry, and analytical chemistry, and solid material science
4. Exam	Ability to analyse, calculate and solve chemistry problems related to energy and environmental applications.	Excellent analysis and problem solving skills to demonstrate in-depth understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Good analysis and problem solving skills to demonstrate good understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Acceptable analysis and problem solving skills to demonstrate adequate understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Marginally acceptable analysis and problem solving skills to demonstrate some understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science	Poor analysis and problem solving skills and is barely able to demonstrate an understanding of inorganic chemistry, organic chemistry, electro chemistry, and analytical chemistry, and solid material science

### 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.)*

##### ORGANIC CHEMISTRY

- Functional groups in organic compounds
- Isomers and stereochemistry
- Organic acids and bases
- Organic reactions and mechanisms

##### ANALYTICAL CHEMISTRY

- Gravimetry
- Calibration
- Equilibrium and Titration
- Optical absorption and fluorescence
- Electrochemistry
- X-ray spectroscopy
- Atomic and mass spectrometry
- Chromatography

##### SOLID AND MODERN MATERIALS

##### ACID-BASE EQUILIBRIA

#### 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.	Brown, T.E., LeMay, H.E.H., Bursten, B.E., Murphy, C., Woodward, P., 2015. Chemistry: The Central Science, Pearson. 13th ed..
2.	McMurry, 2011. Fundamentals of Organic Chemistry. Cengage Learning, 7th Ed.
3.	Callister, W.D., Rethwisch, D.G., 2015. Materials Science and Engineering: An Introduction. John Wiley & Sons .9th Ed.
4.	Bruice, P. Y. 2016. Organic Chemistry, Pearson. 8 <sup>th</sup> Ed.

##### 2.2 Additional Readings

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

1.	Harris, D.C., 2009. Exploring Chemical Analysis. W. H. Freeman and Company.
2.	Klein, D., 2012. Organic Chemistry as a second language - First Semester Topics, 3rd ed. John Wiley & Sons, Inc., USA.
3.	Klein, D., 2012. Organic Chemistry as a second language - Second Semester Topics, 3rd ed. John Wiley & Sons, Inc., USA.
4.	Hill, J.W., McCreary, T.W., Kolb, D.K. 2010. Chemistry for Changing Times. 12th ed. Pearson Education International.