City University of Hong Kong
Course Syllabus

offered by School of Energy and Environment
with effect from Semester A 2022 / 23

Part I Course Overview

Course Title:	**Environmental Chemistry and Physics**
Course Code:	**SEE6224**
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)*	**SEE8224**
Exclusive Courses: *(Course Code and Title)*	**Nil**

Part II Course Details

1. Abstract

This course will provide students with knowledge of fundamental chemistry and physics principles that govern different processes in the environment, and the different analytical instrumentation and techniques that can be used to study them. Topics covered can include chemical kinetics, reaction dynamics, reactions of gas-phase species, reactions in liquid solutions, environmental fluid dynamicsenvironmental reactor models, transport mechanisms, photochemistry, spectroscopy, mass spectrometry, and chromatography.

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.	Demonstrate an understanding of chemical kinetics, reaction dynamics, reactions of gas-phase species, reactions in liquid solutions, photochemical processes, transport mechanisms, and environmental fluid dynamics.	50%	√	√	
2.	Describe the principles of different analytical instrumentation and techniques, and be able to apply these analytical instrumentation and techniques to measure trace level concentrations of environmental pollutants	50%	√	√	
		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					
Lectures	Explain key concepts related to environmental chemistry and physics, and the use of different environmental analytical instrumentation and techniques.	√	√					3.0
Tutorial	Discuss contemporary topics of environmental chemistry and physics. Hands-on demonstrations of different environmental	√	√					2.0

	analytical instrumentation/techniques may be performed.							

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						
Continuous Assessment: 50%								
Mid-term	√	√					30%	
Assignment	√	√					20%	
Examination: 50% (duration: 2h , if applicable)								
** The weightings should add up to 100%.*							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 Rubric

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. Mid-term	Ability to explain key concepts and solve problems	High	Significant	Moderate to basic	Not even reaching marginal levels
2. Assignment	Ability to apply key concepts and solve problems	High	Significant	Moderate to basic	Not even reaching marginal levels
3. Final exam	Ability to explain key concepts and solve problems	High	Significant	Moderate to basic	Not even reaching marginal levels

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. Mid-term	Ability to explain key concepts and solve problems	High	Significant	Moderate	Basic	Not even reaching marginal levels
2. Assignment	Ability to apply key concepts and solve problems	High	Significant	Moderate	Basic	Not even reaching marginal levels
3. Final exam	Ability to explain key concepts and solve problems	High	Significant	Moderate	Basic	Not even reaching marginal levels

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.)

1. Gas-phase kinetics, reaction rates and mechanisms
a. Pressure, temperature and energy of an ideal gas
b. Maxwell distributions of speeds and energy
c. Molecular collisions and mean free path
d. Rate laws: First, second, pseudo-first order and higher order reactions
e. Temperature dependence of rate constants
f. Reaction mechanisms: Elementary reactions; Opposing reactions; Parallel reactions; Consecutive reactions and the steady-state approximation; Unimolecular decomposition; Free radical chain and branched reactions
g. Reaction dynamics: Collision theory; Activated complex theory

2. Reactions in liquid solutions
a. Cage effect, friction and diffusion control
b. Reactions of charged species in solution
c. Uptake and reaction of gases in liquids

3. Environmental fluid dynamics and transport mechanisms
a. Viscous and confined flows
b. Turbulence and mixing
c. Boundary-layer flows

4. Photochemistry
a. Absorption and emission of light
b. Photophysical processes

5. Spectroscopy
a. Components of optical instruments
b. UV-vis absorption spectroscopy
c. Infrared spectroscopy
d. Raman spectroscopy

6. Mass spectrometry
a. Ionization sources
b. Ionization techniques
c. Components of mass spectrometers

7. Chromatography
a. Migration rates of solutes
b. Band broadening and column efficiency
c. Optimization of column performance
d. Gas chromatography
e. Liquid chromatography
f. Ion chromatography

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.	McQuarrie and Simon, *Physical Chemistry: A Molecular Approach*, 1st Edition, University Science Books (1997)
2.	Atkins and de Paula, *Physical Chemistry*, 9th Edition, Oxford University Press (2010)

3.	Houston, *Chemical Kinetics and Reaction Dynamics*, 1st Edition, Dover Books (2006)
4.	Skoog, Holler and Crouch, *Principles of Instrumental Analysis*, 6th Edition, Thomas Brooks/Cole (2007)

2.2 Additional Readings

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

1.	Hollas, *Modern Spectroscopy*, 4th Edition, Wiley (2004)
2.	Gross, *Mass Spectrometry: A Textbook*, 1st Edition, Springer International Publishing (2004)
3.	McLafferty, *Interpretation of Mass Spectra*, 4th Edition, University Science Books (1993)
4.	Pope, *Turbulent Flows*, Cambridge University Press (2000)
5.	Pedlosky, *Geophysical Fluid Dynamics*, Springer (1987)
6.	Foken, *Micrometeorology*, Springer (2008)