CHEM2005: PRINCIPLES OF ENVIRONMENTAL CHEMISTRY

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Principles of Environmental Chemistry

Subject Code
CHEM - Chemistry
Course Number
2005

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
4

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
Nil

Precursors
Nil

Equivalent Courses
BCH2005 Principles of Environmental Chemistry

Exclusive Courses
Nil

Part II Course Details

Abstract

This course aims to enable students to gain basic knowledge and training in environmental chemistry. Building from fundamental knowledge in chemistry and environmental sciences, the course will cover the forms, interactions, and distribution of major components in the environment, and use relevant chemical concepts to rationalize aspects of environmental chemistry. In this course, students will develop practical experience in environmental chemistry and analysis. The skills and understanding accumulated during this course will prepare students for more advanced and specialized studies in chemistry as well as environmental sciences.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Describe the major chemical processes in the atmosphere, hydrosphere, lithosphere and biosphere, and apply relevant chemical concepts to explain aspects of environmental chemistry. Describe the changes caused by anthropogenic activities to the atmosphere, hydrosphere, lithosphere and biosphere and apply relevant chemical concepts to analyze these changes.	30	x		
2	Compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the hydrosphere, atmosphere, biosphere, and lithosphere.	20		x	
3	Based on the formula of a chemical species, hypothesize its chemical and physical properties and relate this to its environmental effects, distribution and behavior.	20			x
4	Analyze and solve mathematical problems relevant to the hydrosphere, lithosphere and atmosphere.	20		x	
5	Perform environmental analysis experiments and derive information and conclusions based on the observed data.	10		x	

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.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures, interactive questioning and tutorials, and videos	Students will recognize the basic concepts and chemical processes in the environment and give them practice in explaining these to peers through lectures, interactive questioning and tutorials, and videos.	1	
2	Lectures, interactive questioning and tutorial, and seminars from experts in relevant fields	Students will recognize the range of anthropogenic activities that have led to adverse impacts upon the environment, and to analyze the scientific evidence of these impacts through lectures, interactive questioning and tutorial, and seminars from experts in relevant fields.	1	
3	Web-based lectures, videos and tutorial teaching methods	Students will acquire knowledge regarding nature and behaviour of important chemical components in the environment through web-based lectures, videos and tutorial teaching methods, in order to draw relationships between them.	2	
4	Problem-solving activities, e.g. virtual simulation and interactive tutorials	From problem-solving activities, e.g., virtual simulation and interactive tutorials, students will gain experience in critically evaluating the composition and structure of chemical species, in order to predict the chemical-physical properties and hence environmental behavior.	3	

5	Step-by-step problem-based tutorials and assignments (with timely model answers)	From step-by-step problem-based tutorials and assignments (with timely model answers), students will gain the experience and technique to solve the mathematical problems.	4	
6	Experiments in the laboratory	Students will perform experiments in the laboratory, whereby clear relationships with the course content and ILOs will be highlighted.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Tutorials and assignments	1, 2, 3, 4	20	
2	Practicals	5	10	

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Additional Information for ATs

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."

Assessment Rubrics (AR)

Assessment Task

Tutorials and assignments

Criterion

Ability to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

Excellent (A+, A, A-)

Excellent ability to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

Good (B+, B, B-)

Good ability to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

Fair (C+, C, C-)

Some ability to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

Marginal (D)

Basic ability to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

Failure (F)
Fail to analyze and solve problems relevant to the hydrosphere, lithosphere, biosphere, and atmosphere

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Assessment Task
Practicals

Criterion
Ability to perform environmental analysis experiments and derive information and conclusions based on the observed data

Excellent (A+, A, A-)
Excellent ability to perform environmental analysis experiments and derive information and conclusions based on the observed data

Good (B+, B, B-)
Good ability to perform environmental analysis experiments and derive information and conclusions based on the observed data

Fair (C+, C, C-)
Some ability to perform environmental analysis experiments and derive information and conclusions based on the observed data

Marginal (D)
Basic ability to perform environmental analysis experiments and derive information and conclusions based on the observed data

Failure (F)
Fail to perform environmental analysis experiments and derive information and conclusions based on the observed data

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Assessment Task
Examination

Criterion
Ability to describe the major concepts and chemical processes related to environmental chemistry; ability to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and ability to hypothesize the chemical and physical properties of a chemical species

Excellent (A+, A, A-)
Excellent ability to describe the major concepts and chemical processes related to environmental chemistry; to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and to hypothesize the chemical and physical properties of a chemical species

Good (B+, B, B-)
Good ability to describe the major concepts and chemical processes related to environmental chemistry; to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and to hypothesize the chemical and physical properties of a chemical species

Fair (C+, C, C-)
Some ability to describe the major concepts and chemical processes related to environmental chemistry; to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and to hypothesize the chemical and physical properties of a chemical species

Marginal (D)

Basic ability to describe the major concepts and chemical processes related to environmental chemistry; to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and to hypothesize the chemical and physical properties of a chemical species

Failure (F)

Fail to describe the major concepts and chemical processes related to environmental chemistry; to compare and relate the nature, reactivity, speciation, and mobility of important chemical components in the environment; and to hypothesize the chemical and physical properties of a chemical species

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Part III Other Information

Keyword Syllabus

Basic Concepts
The environment. Environmental pollution. Important chemical concepts.

Natural waters (hydrosphere)
Important properties of water and their effects and significance. Water quality parameters. Gas solubility, aqueous reactions and Henry's law. Alkalinity and acidity. Ionic species in water. Speciation of metal pollutants. Humic substances, metal chelates, pesticides and organic toxins in water.

Minerals, clay, soil and sediments (lithosphere)
Formation of sediments and weathering of rocks. Nature of soil. Binding properties of clays. Mobility of ions in environment.

Biochemistry of important elements (biosphere)
Plant nutrients. Chemical processes involving nitrogen in soil. Acid rain.

Atmosphere
Structure and chemical components of the Earth's atmosphere. Impacts of anthropogenic activities upon the atmospheric environment and fates of contaminants. Modelling of atmospheric processes.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	S. E. Manahan, Environmental Chemistry, 8th Ed., CRC Press, Boca Raton, 2005.
2	D.W. Connell, Basic Concepts of Environmental Chemistry, 2nd Ed., Taylor & Francis/CRC Press, Boca Raton, 2005.