# CHEM4035A: ENVIRONMENTAL MEASUREMENTS

**Effective Term**
Semester A 2022/23

## Part I Course Overview

**Course Title**
Environmental Measurements

**Subject Code**
CHEM - Chemistry
**Course Number**
4035A

**Academic Unit**
Chemistry (CHEM)

**College/School**
College of Science (SI)

**Course Duration**
One Semester

**Credit Units**
3

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

**Medium of Instruction**
English

**Medium of Assessment**
English

**Prerequisites**
Nil

**Precursors**
CHEM2004A/BCH2004A Principles of Analytical Chemistry
CHEM2005A/BCH2005A Principles of Environmental Chemistry

**Equivalent Courses**
BCH4035A Environmental Measurements

**Exclusive Courses**
Nil

**Additional Information**
Note: CHEM4035A does not contain any practical component, and has a credit unit value of three (3).

# Part II Course Details

**Abstract**

This course aims to enable students to develop and apply their knowledge of the principles and techniques in environmental sampling and environmental monitoring, and to master practical skills in environmental measurements, through activities conducted in the field and in the laboratory. (A brief description of how it fits with other courses students take is helpful e.g. that it prepares students to undertake field and laboratory research projects/studies in environmental science).

**Course Intended Learning Outcomes (CILOs)**

| | CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|---|---|---|---|---|---|
| 1 | Apply and explain the concepts and principles of general in-situ and ex-situ physicochemical and chemical measurement techniques which are used in monitoring of natural waters, sediments and the ambient air. | | x | | |
| 2 | Apply and explain the concepts and principles of chemical and instrumental analysis used in the assay of trace levels of heavy metals and organic contaminants in complex environmental matrices. | | x | | |
| 3 | Design environmental monitoring programmes which apply relevant statistical, analytical and bio-analytical principles to address specific environmental management and conservation needs. | | | x | |
| 4 | Critically evaluate the various environmental monitoring and measurement approaches to manage, protect and conserve local as well as the global ecosystem. | | | x | x |
| 5 | Collect and interpret field and laboratory data and communicate the assimilated information in a professional manner. | | | | 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.

**Teaching and Learning Activities (TLAs)**

| | TLAs | Brief Description | CILO No. | Hours/week (if applicable) |
|---|---|---|---|---|
| 1 | Case studies and laboratory practices | Students will learn primarily through case studies and laboratory practices where they will gain hands-on experience in the various state-of-the-art chemical and instrumental techniques for trace metal and organic analysis. | 1, 2 | |
| 2 | Group critical evaluation tasks | In large and small group critical evaluation tasks students will discuss the principles, limitations, relevance and applicability of the various environmental monitoring and measurement approaches to manage, protect and conserve local as well as the global ecosystem. | 1, 4 | |
| 3 | Field practices and group presentation | Through field practices and group presentation students will gain practical skills in: (a) analyzing environmental analytical parameters via the various in-situ and ex-situ techniques for the analysis of air, sediment and water, and (b) interpreting measurement data and assimilating information for communication with professionals. | 1, 3, 5 | |

**Assessment Tasks / Activities (ATs)**

| | ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|---|---|---|---|---|
| 1 | Short Quizzes | 1, 2 | 10 | |
| 2 | Tutorial Assignments | 1, 2 | 15 | |
| 3 | Group Presentations | 3, 4, 5 | 20 | |

**Continuous Assessment (%)**

45

**Examination (%)**

55

**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**

Short Quizzes

**Criterion**

Demonstration of understanding the principles and practice of various topics of environmental analytical chemistry, and apply them in real world problems.

**Excellent (A+, A, A-)**

Able to demonstrate excellent understanding of the principles and practice of various topics of environmental analytical chemistry, and apply them in real world problems.

**Good (B+, B, B-)**

Able to describe and explain the principles of various topics of environmental analytical chemistry, and apply them in real world problems.

**Fair (C+, C, C-)**

Able to describe and explain some key principles of selected topics of environmental analytical chemistry, and apply them in real world problems.

**Marginal (D)**

Able to briefly describe isolated principles of selected topics of environmental analytical chemistry, and show limited ability to apply them in real world problems.

**Failure (F)**

Fail to accurately describe and explain relevant principles of any topics of environmental analytical chemistry.

---

**Assessment Task**

Tutorial Assignments

**Criterion**

Demonstration of understanding the principles and practice of the selected topics of environmental analytical chemistry, and apply them in real world problems.

**Excellent (A+, A, A-)**

Able to demonstrate excellent understanding of the principles and practice of the selected topics of environmental analytical chemistry, and apply them in real world problems.

**Good (B+, B, B-)**

Able to describe and explain the principles of the selected topics of environmental analytical chemistry, and apply them in real world problems.

**Fair (C+, C, C-)**

Able to describe and explain some key principles of the selected topics of environmental analytical chemistry, and apply them in real world problems.

**Marginal (D)**

Able to briefly describe isolated principles of the selected topics of environmental analytical chemistry, and show limited ability to apply them in real world problems.

**Failure (F)**

Fail to accurately describe and explain relevant principles of any topics of environmental analytical chemistry.

---

**Assessment Task**

Group Presentations

**Criterion**

Demonstration of understanding the principles and practice of the selected topics of environmental analytical chemistry, and the ability to present those principles and practice in concise, orderly and professional manners.

**Excellent (A+, A, A-)**

Able to deliver fluent, well organized and well prepared presentations to demonstrate excellent understanding of the principles and practice of the selected topics of environmental analytical chemistry.

**Good (B+, B, B-)**

Able to deliver fluent presentations, with evidence of proper preparation, to describe and explain the principles of the selected topics of environmental analytical chemistry.

**Fair (C+, C, C-)**

Able to deliver presentations, with evidence of proper preparation, to describe and explain some key principles of the selected topics of environmental analytical chemistry.

**Marginal (D)**

Able to deliver comprehensible presentations to briefly describe isolated principles of the selected topics of environmental analytical chemistry.

**Failure (F)**

Fail to present relevant principles of any topics of environmental analytical chemistry in coherent and comprehensible manners.

---

**Assessment Task**

Fieldwork / Laboratory Reports

**Criterion**

Demonstration of ability to apply the principles and practice of the various environmental analytical chemistry techniques in environmental monitoring, and the ability interpret monitoring data and communicate the information in concise, orderly and professional manners.

**Excellent (A+, A, A-)**

Able to demonstrate excellent ability in applying the principles and practice of various environmental analytical chemistry techniques in environmental monitoring, and in interpreting monitoring data and communicate the information in concise, orderly and professional manners.

**Good (B+, B, B-)**

Able to apply the principles and practice of various environmental analytical chemistry techniques in environmental monitoring, and interpret monitoring data and communicate the information in concise and orderly manners.

**Fair (C+, C, C-)**

Able to apply relevant principles and practice of selected environmental analytical chemistry techniques in environmental monitoring, and interpret monitoring data and communicate the information in comprehensible manners.

**Marginal (D)**

Able to demonstrate limited ability in applying isolated principles and practice of selected environmental analytical chemistry techniques in environmental monitoring, and interpret monitoring data and communicate the information in comprehensible manners.

**Failure (F)**

Fail to accurately apply relevant principles and practice of any environmental analytical chemistry technique in environmental monitoring.

---

**Assessment Task**

Examination

**Criterion**

Demonstration of understanding the principles and practice of various topics of environmental analytical chemistry, and apply them in real world problems.

**Excellent (A+, A, A-)**

Able to demonstrate excellent understanding of the principles and practice of various topics of environmental analytical chemistry, and apply them in real world problems.

**Good (B+, B, B-)**

Able to describe and explain the principles of various topics of environmental analytical chemistry, and apply them in real world problems.

**Fair (C+, C, C-)**

Able to describe and explain some key principles of selected topics of environmental analytical chemistry, and apply them in real world problems.

**Marginal (D)**

Able to briefly describe isolated principles of selected topics of environmental analytical chemistry, and show limited ability to apply them in real world problems.

**Failure (F)**

Fail to accurately describe and explain relevant principles of any topics of environmental analytical chemistry.

---

# Part III Other Information

**Keyword Syllabus**

Strategies in Environmental Monitoring
Design of environmental monitoring and sampling programmes. Statistical analysis and interpretation of environmental data: univariate, multivariate analysis, discrimination analysis, time-trend analysis. Case studies.

Trace analysis
Working practise for the sampling and analysis of trace metals and organics in solid, liquid and air phases. Various preconcentration techniques: precipitation and co-precipitation, liquid-liquid extraction, solid-liquid extraction, ion-exchange, solid phase extraction, solid phase microextraction, super-critical fluid extraction, purge-and-trap technique and closed-loop stripping.

Water and Sediment Quality Measurement

Selection of water and sediment quality parameters, field measurements of some water quality and hydrology parameters. Working practise for water and sediment sampling and handling samples. Classical and instrumental methods of water and sediment analysis. Biological monitoring at individual, population and community levels.

Air Quality Measurement
General sampling and analysis techniques. Modern air pollution monitoring devices. Basis of methods for analysis of selected organic and inorganic pollutants. Techniques for particulate matter. Methods for chemicals in air of the workplace.

Environmental Modelling and its Applications
Modelling techniques and assumptions in water and air quality modelling. Applications of Geographic Information Systems (GIS). Case studies.

**Reading List**

**Compulsory Readings**

| | Title |
|---|---|
| 1 | Nil |

**Additional Readings**

| | Title |
|---|---|
| 1 | Basic Concepts of Environmental Chemistry, Des W. Connell, Lewis Publishers, CRC Press LLC, NY, 1997. |