

CHEM8130: ADVANCED INORGANIC CHEMISTRY

Effective Term

Semester A 2025/26

Part I Course Overview

Course Title

Advanced Inorganic Chemistry

Subject Code

CHEM - Chemistry

Course Number

8130

Academic Unit

Chemistry (CHEM)

College/School

College of Science (SI)

Course Duration

One Semester

Credit Units

4

Level

R8 - Research Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

Nil

Equivalent Courses

BCH8130 Advanced Inorganic Chemistry

Exclusive Courses

Nil

Part II Course Details

Abstract

This course is a postgraduate taught course tailored for postgraduate research students only.

The aim of this course is to help students to develop an understanding of the principles and concepts of modern inorganic chemistry with an emphasis on the role of transition metals in inorganic redox reaction mechanisms, metalloproteins, and inorganic photophysics and photochemistry.

Course Intended Learning Outcomes (CILOs)

CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Analyse the principles for the extraction of various elements from their ores based on redox potentials and Ellingham diagrams. Evaluate the redox stability of inorganic species in water and the products of inorganic redox reactions using Latimer diagrams, Frost diagrams and Pourbaix diagrams	x	x	
2	Analyse the rate of mechanism of an inorganic electron transfer reactions using Marcus Theory.		x	x
3	Evaluate the roles of transition metal centres and amino acid residues on the structural and functional properties of metalloproteins.	x	x	
4	Analyse the photophysical and photochemical properties of inorganic and organometallic transition metal complexes.	x	x	
5	Discover examples encountered in our daily lives that involve the applications of transition metal systems.			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	Group activities	Students will learn the principles of extraction of various elements and the basic concepts of Latimer diagrams, Frost diagrams, and Pourbaix diagrams in large and small group activities.	1

2	Group critical evaluation tasks	In large and small group critical evaluation tasks students will discuss and rationalise the various factors affecting the rate of electron transfer reactions.	2	
3	Group activities	Teaching and learning will be in the form of large and small group activities; students will develop an understanding on the structural and functional properties of metalloproteins.	3	
4	Group activities	In large and small group activities, students will discuss and examine the photophysical and photochemical properties of inorganic and organometallic transition metal complexes.	4	
5	Literature search and presentation	Students, in small groups, will take part in the literature search on identification of their daily life encounters related inorganic chemistry. They will then present, evaluate and discuss their findings in the light of modern day living in the form of written reports and oral presentations.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Short Quizzes and Tutorial Questions	1, 2, 3, 4	5	-	Yes
2	Assignments	1, 2, 3, 4	10	-	Yes
3	Tests	1, 2, 3, 4	10	-	Yes
4	Written Reports and Group Presentations	5	5	-	Yes

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Minimum Continuous Assessment Passing Requirement (%)

40

Minimum Examination Passing Requirement (%)

40

Assessment Rubrics (AR)

Assessment Task

Short Quizzes and Tutorial Questions (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to develop an understanding on the concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to develop an understanding on the aforementioned concepts

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Tests (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to describe and explain the aforementioned concepts to solve problems

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Written Reports and Group Presentations (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to conduct literature search and give written and oral presentations on different topics on inorganic chemistry at the advanced level

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Examination (for students admitted before Semester A 2022/23 and in Semester A 2024/25 & thereafter)

Criterion

ABILITY to describe, explain, and integrate the aforementioned concepts and apply them to solve problems

Excellent

(A+, A, A-) High

Good

(B+, B, B-) Significant

Fair

(C+, C, C-) Moderate

Marginal

(D) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Short Quizzes and Tutorial Questions (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

ABILITY to develop an understanding on the concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

Excellent

(A+, A, A-) High

Good

(B+, B) Significant

Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Assessment Task

Assignments (for students admitted from Semester A 2022/23 to Summer Term 2024)

Criterion

ABILITY to develop an understanding on the aforementioned concepts

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(A+, A, A-) High

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Tests (for students admitted from Semester A 2022/23 to Summer Term 2024)

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Marginal

(B-, C+, C) Basic

Failure

(F) Not even reaching marginal levels

Part III Other Information**Keyword Syllabus**

Oxidation and Reduction:

Extraction of the elements. Ellingham diagrams. Redox potentials. Redox stability in water. Latimer diagrams, Frost diagrams and Pourbaix diagrams.

Inorganic Reaction Mechanisms:

Inner-sphere and outer-sphere electron transfer reactions. Marcus theory. Factors affecting rates of reactions.

Metalloproteins:

Role of transition metal centres and amino acid residues. Structures and functions of selected metalloproteins.

Inorganic Photochemistry:

Absorption and emission properties of luminescent transition metal complexes. Excited-state nature. Energy- and electron-transfer. Potential applications.

Reading List**Compulsory Readings**

Title	
1	Nil

Additional Readings

Title	
1	Inorganic Chemistry Shriver and Atkins, 3rd Edition, Oxford University Press, Oxford 1999.
2	Basic Inorganic Chemistry Cotton, Wilkinson and Gaus, 3rd Edition, J. Wiley, 1995.
3	Advanced Inorganic Chemistry Cotton and Wilkinson, 5th Edition, Wiley, 1988.
4	Principles of Bioinorganic Chemistry Lippard and Berg, University Science Books, 1994.
5	Photochemistry of Polypyridine and Porphyrin Complexes, Kalyanasundaram, Academic Press, 1992.