CHEM4030: ADVANCED INORGANIC CHEMISTRY

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Advanced Inorganic Chemistry

Subject Code
CHEM - Chemistry
Course Number
4030

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
CHEM3014/BCH3014 Inorganic Chemistry

Equivalent Courses
BCH4030 Advanced Inorganic Chemistry

Exclusive Courses
Nil

Part II Course Details

Abstract

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 inorganic photochemistry, materials chemistry, and catalysis.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Explain the photophysical and photochemical properties of luminescent transition metal complexes.	25		x	x
2	Describe the synthetic methods and functional properties of solid state materials.	25		x	x
3	Predict the catalytic applications of inorganic compounds and solid state materials.	25		x	x
4	Predict the redox stability of inorganic species in water and the products of inorganic redox reactions using Latimer diagrams, Frost diagrams and Pourbaix diagrams.	15		x	x
5	Explain the principles of basic crystallographic and NMR spectroscopic techniques for inorganic compounds and materials.	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	Group activities	In large and small group activities, students will discuss and examine the photophysical and photochemical properties of luminescent transition metal complexes.	1	
2	Group activities	Teaching and learning will be in the form of large and small group activities; students will develop an understanding on the composition, structure, synthesis, and functional properties of solid state materials.	2	

3	Group activities	In large and small group activities, students will discuss and examine general principles of catalysis, as well as the catalytic applications of inorganic compounds and solid state materials.	3	
4	Group activities	In large and small group activities, students will develop an understanding of the basic concepts of Latimer diagrams, Frost diagrams and Pourbaix diagrams.	4	
5	Group activities	Teaching and learning will be in the form of large and small group activities; students will develop an understanding in basic crystallographic and NMR spectroscopic methods for the characterization of inorganic compounds and materials.	5	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Short Quizzes and Tutorial Questions	1, 2, 3, 4, 5	10	
2	Assignments	1, 2, 3, 4, 5	10	
3	Tests	1, 2, 3, 4, 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

Short Quizzes and Tutorial Questions

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-)

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

Good (B+, B, B-)

Able to describe and explain the concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

Fair (C+, C, C-)

Able to describe and explain some key concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

Marginal (D)

Able to briefly describe isolated concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

Failure (F)

Fail to accurately describe and explain relevant concepts of element extraction; Latimer, Frost and Pourbaix diagrams; electron transfer; bioinorganic chemistry; and inorganic photochemistry

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Assessment Task

Assignments

Criterion

ABILITY to develop an understanding on the aforementioned concepts

Excellent (A+, A, A-)

Able to demonstrate an excellent understanding on the aforementioned concepts

Good (B+, B, B-)

Able to describe and explain the aforementioned concepts

Fair (C+, C, C-)

Able to describe and explain some key concepts mentioned above

Marginal (D)

Able to briefly describe isolated concepts mentioned above

Failure (F)

Fail to accurately describe and explain relevant concepts mentioned above

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Assessment Task

Tests

Criterion

ABILITY to describe and explain the aforementioned concepts to solve problems

Excellent (A+, A, A-)

Able to well describe and explain the aforementioned concepts to solve problems

Good (B+, B, B-)
Able to describe and explain the aforementioned concepts to solve problems

Fair (C+, C, C-)
Able to describe and explain some key concepts mentioned above to solve problems

Marginal (D)
Able to briefly describe isolated concepts mentioned above to solve problems

Failure (F)
Fail to accurately describe and explain relevant concepts mentioned above to solve problems

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Assessment Task
Written Reports and Group Presentations

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-)
Able to well conduct literature search and give written and oral presentations on different topics on inorganic chemistry at the advanced level

Good (B+, B, B-)
Able to conduct literature search and give written and oral presentations on different topics on inorganic chemistry at the advanced level

Fair (C+, C, C-)
Able to conduct literature search and give written and oral presentations on some key topics on inorganic chemistry at the advanced level

Marginal (D)
Able to briefly conduct literature search and give written and oral presentations on isolated topics on inorganic chemistry at the advanced level

Failure (F)
Fail to accurately conduct literature search and give written and oral presentations on relevant topics on inorganic chemistry at the advanced level

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Assessment Task
Examination

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

Excellent (A+, A, A-)
Able to well describe, explain, and integrate the aforementioned concepts and apply them to solve problems

Good (B+, B, B-)
Able to describe, explain, and integrate the aforementioned concepts and apply them to solve problems

Fair (C+, C, C-)

Able to describe, explain, and integrate some key concepts mentioned above and apply them to solve problems

Marginal (D)

Able to briefly describe, explain, and integrate isolated concepts mentioned above and apply them to solve problems

Failure (F)

Fail to accurately describe, explain, and integrate relevant concepts mentioned above and apply them to solve problems

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Part III Other Information

Keyword Syllabus

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

Materials Chemistry
Physical and chemical properties of solid state materials. Synthetic methods. Chemical composition. Functional properties. Potential applications.

Catalysis
Catalytic applications of solid state materials. General principles of catalysis. Homogeneous catalysis. Heterogeneous catalysis.

Oxidation and Reduction
Redox potentials. Redox stability in water. Latimer diagrams, Frost diagrams and Pourbaix diagrams.

Characterization of inorganic compounds and solid state materials
Basic crystallography. X-ray diffraction (indexing powder XRD spectra). Multinuclear NMR techniques: ^{31}P, ^{19}F, ^{195}Pt, $^{117/119}Sn$, etc.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Photochemistry of Polypyridine and Porphyrin Complexes, Kalyanasundaram, Academic Press, 1992.
2	Inorganic Chemistry, Shriver and Atkins, 3rd Edition, Oxford University Press, Oxford 1999.
3	Advanced Inorganic Chemistry, Cotton and Wilkinson, 5th Edition, Wiley, 1988.
4	Introduction to Modern Inorganic Chemistry, K.M. Mackay, R.A. Mackay and W. Henderson, 6th Edition, Cheltenham: Nelson Thornes Ltd., 2002.
5	Online Resources: N.A.