CHEM3014: INORGANIC CHEMISTRY

Effective Term
Semester A 2024/25

Part I Course Overview

Course Title
Inorganic Chemistry

Subject Code
CHEM - Chemistry
Course Number
3014

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
CHEM2006 Principles of Inorganic Chemistry

Equivalent Courses
Nil

Exclusive Courses
Nil

Part II Course Details

Abstract

This course is designed to equip students with a comprehensive understanding of inorganic chemistry principles, along with hands-on experience in synthesizing, analyzing, and characterizing inorganic compounds.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Identify the symmetry elements, symmetry operations, and point group of a molecule and accurately predict the infrared and Raman active vibrational modes of that molecule, demonstrating proficiency in molecular symmetry analysis.	15	x	x	
2	Explain the bonding and properties of a molecule using molecular orbital theory, showcasing a clear understanding of how molecular orbitals influence the characteristics of the molecule.	10	x	x	
3	Apply ligand field theory to effectively elucidate the spectroscopic and magnetic properties of transition metal complexes, demonstrating a comprehensive understanding of their behavior.	10	x	x	
4	Demonstrate a comprehensive understanding of the bonding, structures, properties, and reactivity of a wide range of main group and transition metal complexes, showcasing a thorough comprehension of their distinctive features and their reactions.	35	x	x	
5	Design, execute, and meticulously analyze the synthesis, purification, and characterization of inorganic compounds in a laboratory setting, displaying proficient skills in experimental techniques and data interpretation.	30		x	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 and tutorials	Students will engage in collaborative group activities that focus on exploring and discussing the principles and applications of group theory. Students will participate in hands-on small group activities involving the construction of molecular models to analyze and understand the symmetry of different molecules, fostering interactive learning experiences.	1	0.5
2	Lectures and tutorials	Students will participate in group activities to delve into the fundamental concepts of molecular orbital theory. Students will engage in discussions and explorations that enhance understanding and comprehension of molecular orbital theory and its practical applications.	2	1
3	Lectures and tutorials	Students will provide rationale for various properties exhibited by transition metal complexes utilizing ligand field theory. These activities will encourage analytical thinking and deepen knowledge of transition metal complex properties.	3	0.5

4	Lectures and tutorials	Students will take part in group sessions focused on examining and discussing the properties of diverse main group and transition metal compounds. Through interactive discussions, students will explore the distinctive characteristics and reactivity of these compounds, fostering a comprehensive understanding of their chemistry.	4	1
5	Experiments and written reports	Students will collaborate with a team of two to three students to design and participate in laboratory work, acquiring essential skills in the synthesis, purification, and characterization of inorganic compounds. Students will collect and analyze data, and present findings through comprehensive written reports and engaging oral discussions, promoting a practical and interactive approach to learning.	5	2 (for CHEM3014 only)

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Quizzes & Assignments	1, 2, 3, 4	20	
2	Laboratory Reports	4, 5	10	

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

3

Additional Information for ATs

Written Examination: 50% (duration: 3 hours) Practical Examination: 20% (duration: 3 hours) Examination Total: 70%

Minimum passing requirement for CHEM3014: A minimum of 40% in continuous assessment, written examination, and practical examination components.

Assessment Rubrics (AR)

Assessment Task
Short Quizzes

Criterion
ABILITY to develop an understanding of the basic principles of inorganic chemistry

Excellent (A+, A, A-)
Able to demonstrate excellent understanding of the principles and practice of various topics of inorganic chemistry.

Good (B+, B, B-)
Able to describe and explain the principles of various topics of inorganic chemistry.

Fair (C+, C, C-)
Able to describe and explain some key principles of selected topics of inorganic chemistry.

Marginal (D)
Able to briefly describe isolated principles of selected topics of inorganic chemistry.

Failure (F)
Fail to accurately describe and explain relevant principles of any topics of inorganic chemistry.

Assessment Task
Tutorial Assignments

Criterion
ABILITY to describe, explain and apply concepts of inorganic chemistry and to solve problems

Excellent (A+, A, A-)
Able to demonstrate excellent understanding of the principles and practice of the selected topics of inorganic chemistry.

Good (B+, B, B-)
Able to describe and explain the principles of various topics of inorganic chemistry.

Fair (C+, C, C-)
Able to describe and explain some key principles of selected topics of inorganic chemistry.

Marginal (D)
Able to briefly describe isolated principles of selected topics of inorganic chemistry.

Failure (F)
Fail to accurately describe and explain relevant principles of any topics of inorganic chemistry.

Assessment Task
Laboratory Reports
(For CHEM3014 only)

Criterion
ABILITY to conduct inorganic chemistry experiments and to present results and discussions in written reports

Excellent (A+, A, A-)

Able to demonstrate excellent skills of various topics of inorganic synthesis.

Good (B+, B, B-)
Able to demonstrate the principles of various skills of inorganic synthesis.

Fair (C+, C, C-)
Able to demonstrate some key skills of selected topics of inorganic synthesis

Marginal (D)
Able to briefly demonstrate isolated skills of selected topics of inorganic chemistry.

Failure (F)
Fail to accurately demonstrate relevant skills of any topics of inorganic synthesis.

Assessment Task
Examination

Criterion
ABILITY to describe, explain and apply concepts of inorganic chemistry and to solve problems

Excellent (A+, A, A-)
Able to demonstrate excellent understanding of the principles and practice of various topics of inorganic chemistry.

Good (B+, B, B-)
Able to describe and explain the principles of various topics of inorganic chemistry.

Fair (C+, C, C-)
Able to describe and explain some key principles of selected topics of inorganic chemistry.

Marginal (D)
Able to briefly describe isolated principles of selected topics of inorganic chemistry.

Failure (F)
Fail to accurately describe and explain relevant principles of any topics of inorganic chemistry.

Part III Other Information

Keyword Syllabus

Symmetry and Group Theory
Symmetry elements and symmetry operations. Point groups. Character tables. Irreducible and reducible representations.

Application of group theory to Infrared and Raman Spectroscopy
Normal modes of vibrations. Symmetry of vibrational modes. Infrared and Raman active vibrational modes.

Molecular Orbital Theory
Linear combination of atomic orbitals. Wavefunctions and energies of molecular orbitals. Group Theory approach to molecular orbital theory. Bonding in diatomic molecules. Bonding in polyatomic molecules.

Bonding in Transition Metal Complexes
Ligand-field theory. Ligand–field stabilization energy. Spectrochemical series. Spectroscopic and magnetic Properties. Distorted octahedral complexes. Square planar and tetrahedral complexes. Selection rules for electronic transitions.

Inorganic Mechanisms
Dissociative, associative, concerted, inner sphere and outer sphere reaction mechanism. Trans effect and trans influence.

Main Group Chemistry

Synthetically important lithiated and Grignard reagents. Inert pair effect. Wade’ s rules.

Organometallic Chemistry
Survey of ligands. 18-electron rule. Carbonyl complexes: bonding, synthesis and reactivity. Alkene and alkyne complexes. Complexes containing delocalized carbocyclic ligands. Alkyl complexes.

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Inorganic Chemistry, Shriver and Atkins, 5th Edition, Oxford University Press, Oxford.
2	Chemical Applications of Group Theory, F. Albert Cotton, 3rd Edition, Wiley, New York.
3	Inorganic Chemistry, Housecroft and Sharpe, 5th Edition, Pearson, Essex.