Lahore University of Management Sciences

CHEM 721 – Selected Topics in Inorganic Chemistry

Fall 2023

Instructor	Ghayoor Abbas Chotana
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Course URL (if any)	

Course Basics				
Credit Hours	3			
Lecture(s)	Nbr of Lec(s) Per Week	2	Duration	1 hr 15 minutes
Recitation/Lab (per week)	Nbr of Lec(s) Per Week	NA	Duration	NA
Tutorial (per week)	Nbr of Lec(s) Per Week	NA	Duration	NA

Course Distribution	
Core	Chemistry Core
Elective	NA
Open for Student Category	Chemistry Graduate Students, Chemistry Seniors
Close for Student Category	NA

COURSE DESCRIPTION

The course will cover several important topics related to inorganic chemistry. Students will be introduced with the science of symmetry & group theory as well as its applications in chemical bonding, spectroscopy etc. Comprehensive coverage of advanced coordination & organometallic chemistry including structure, bonding, synthesis, reactions, and spectral properties. Applications of organo-transition metal chemistry in catalysis & organic synthesis.

COURSE PREREQUISITE(S)

- NA

COURSE OBJECTIVES

- To identify symmetry elements present in a given molecule/structure, and assign correct point group to the given molecule/structure.
- Apply the principles of symmetry & group theory to solve simple problems in chemical bonding, molecular vibrations, and electronic spectra of transition metal complexes.
- To cover the chemistry of the coordination compounds with emphasis on isomerism, bonding, electronic spectra, & reaction mechanism.
- To cover the chemistry of organo-transition metal compounds with emphasis on reaction mechanism & industrial catalysis.
- Acquaintance with the current literature in inorganic chemistry.

Learning Outcomes

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	After successful completion of this course, students should be able to • Recognize various symmetry elements (axis, plane, rotation-reflection, inversion) present in a given molecule or structure. • Based on the symmetry elements present, state the point group to which a given molecule belongs. • Understand and predict spectroscopic as well as magnetic properties of coordination compounds based upon number of unpaired electrons, type of ligands. • Understand organometallic reactions/mechanisms. • Able to read current inorganic literature.

Grading Breakup and Policy

Assignment(s): 0%; Assignments will be given and will also be checked, however these will not contribute towards the final grade.
Quiz(s): 20% (5-7 quizzes): All quizzes given will count towards this instrument of the grade.
Class Participation: All students are strongly encouraged to actively participate in class discussions.
Attendance: Students are required to attend and actively participate in all the classes. Less than 90% attendance will result in F Grade.
Midterm Examination: 35%.
Presentation: 10% All students will give one PowerPoint presentation of 15-20 minutes duration on any cutting edge topic related to inorganic/organometallic chemistry. For this you are strongly encouraged to read research papers (ACS, RSC, Willy, or Nature group) from now onwards.
Project: 0% Review Paper.
Final Examination: 35% (this will be *Comprehensive Final Exam* covering all the concepts studied throughout this semester).
I can change the grading breakup up to ±5%. In case of online teaching and exam, the midterm and final exams will have viva components.

Examination Detail	
Midterm Exam	Yes/No: Yes (Two midterm exams, will be arranged by instructor himself) Combine Separate: Duration: 3hr Preferred Date: Exam Specifications: Closed Books, Closed Notes, Calculators allowed
Final Exam	Yes/No: Yes Combine Separate: Duration: 3 hr Exam Specifications: Closed Books, Closed Notes, Calculators allowed

COURSE OVERVIEW

Week	Topics	Recommended Readings	Objectives/ Application
1 - 7	Molecular Symmetry	Alan Vincent Chapter 6 Shriver Atkins	To Identify symmetry elements and operations present in a given molecule, to assign point groups, Form non-degenerate representations to describe the effect of symmetry operations, Reduction of reducible representations, Set up matrix to perform a given transformation, Degenerate Representations, Applications of Symmetry and group theory in chemistry, Molecular Vibrations, Hybridization, splitting of orbitals/terms, Formation of molecular orbitals from atomic orbitals, Homonuclear diatomic molecules, Heteronuclear diatomic molecules, Molecular orbitals of larger molecules, Pi molecular orbitals
8 - 12	Coordination Chemistry	Chapter 7, 19, 20, 21 Shriver Atkins	History, Nomenclature & Isomerism of coordination compounds, coordination numbers, Experimental evidence for electronic structures, theories of electronic structure, Ligand field theory, Jahn-Teller effect, Quantum numbers of multi-electron atoms, electronic spectra of coordination compounds, Inert & Labile

			compounds, Substitution reactions in octahedral & square planar complexes, Trans effect, Oxidation-Reduction reactions
13 - 14	Organometallic Chemistry	Chapter 22 Shriver Atkins Chapter 13-14 Miessler & Tarr Chapter 9-12 Spessard & Miessler	Historical background, Organic ligands & Nomenclature, 18 electron rule, Spectral Analysis, Reactions involving gain or loss of ligands, reactions involving modification of ligands, Homogeneous catalysis, Structure, synthesis and reactions of Metal-Carbene & Metal-Carbyne complexes, Pi-bond metathesis, Alkyne metathesis, sigma bond metathesis, C–C bond forming reactions
Final Exam			

Textbook(s)/Supplementary Readings

Text Books

- Chemical Structure and Reactivity an Integrated Approach by James Keeler & Peter Wothers, 2nd Edition, 2014, Oxford.
- Molecular Symmetry & Group Theory by Alan Vincent, 2nd Edition, 2001, John Wiley and Sons.
- Shriver & Atkins Inorganic Chemistry by Mark Weller, Jonathan Rourke, Tina Overton, & Fraser Armstrong, 7th Edition, 2018, Oxford.
- Organometallic Chemistry by Gary O. Spessard & Gary L. Miessler, 2nd Edition, 2010, Oxford University Press.

Supplementary Readings

- Inorganic Chemistry by Catherine E. Housecroft & Alan G. Sharpe, 5th Edition, 2018, Pearson.
- Molecular Symmetry & Group Theory, by Robert L Carter, 2004, John Wiley and Sons.
- Chemical Applications of Group Theory, F. Albert Cotton, 3rd Edition, 1999, John Wiley and Sons.

Academic Honesty

The principles of truth and honesty are recognized as fundamental to a community of teachers and students. This means that all academic work will be done by the student to whom it is assigned without unauthorized aid of any kind. Plagiarism, cheating and other forms of academic dishonesty are prohibited. Any instances of academic dishonesty in this course (intentional or unintentional) will be dealt with swiftly and severely. Potential penalties include receiving a failing grade on the assignment in question or in the course overall. For further information, students should make themselves familiar with the relevant section of the LUMS student handbook.

Harassment Policy

SSE, LUMS and particularly this class, is a harassment free zone. There is absolutely zero tolerance for any behavior that is intended, or has the expected result of making anyone uncomfortable and negatively impacts the class environment, or any individual's ability to work to the best of their potential.

In case a differently-abled student requires accommodations for fully participating in the course, students are advised to contact the instructor so that they can be facilitated accordingly.

If you think that you may be a victim of harassment, or if you have observed any harassment occurring in the purview of this class, please reach out and speak to me. If you are a victim, I strongly encourage you to reach out to the Office of Accessibility and Inclusion at oai@lums.edu.pk or the sexual harassment inquiry committee at harassment@lums.edu.pk for any queries, clarifications, or advice. You may choose to file an informal or a formal complaint to put an end of offending behavior. You can find more details regarding the LUMS sexual harassment policy here. To file a complaint, please write to harassment@lums.edu.pk.

SSE Council on Equity and Belonging

In addition to LUMS resources, SSE's **Council on Belonging and Equity** is committed to devising ways to provide a safe, inclusive and respectful learning environment for students, faculty and staff. To seek counsel related to any issues, please feel free to approach either a member of the council or email at cbe.sse@lums.edu.pk

Rights and Code of Conduct for Online Teaching

A misuse of online modes of communication is unacceptable. TAs and Faculty will seek consent before the recording of live online lectures or tutorials. Please ensure if you do not wish to be recorded during a session to inform the faculty member. Please also ensure that you prioritize formal means of communication (email, lms) over informal means to communicate with course staff.