CHM 401 **Intermediate Inorganic Chemistry** **Fall 2024**

Prof. Daniel N. Huh

Mon/Wed/Fri 8:00am – 8:50am

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Office Hours: Wed/Thurs 11am-12pm

(or by appointment)

Course Syllabus
Textbook: *Inorganic Chemistry* 5th or 4th Edition G. L. Miessler, P. J. Fischer and D. A. Tarr

Brightspace: This course will utilize *Brightspace* to communicate class material and to ask questions.

(course material may be subject to change during the semester)
Topics:
Section I
Chapter 2 Atomic Structure
- 2.1 Periodic Properties of Atoms

Chapter 3 Simple Bonding Theory
- 3.1 Lewis Electron-Dot Diagrams
- 3.2 Valence Shell Electron-Pair Repulsion Theory

Chapter 4 Symmetry and Group Theory
- 4.1 Symmetry Elements and Operations
- 4.2 Point Groups
- 4.3 Point Group Representations and Character Tables
- 4.4 Molecular Vibrations

Section II
Chapter 5 Molecular Orbitals
- 5.1 *s, p,* and *d* orbitals
- Homonuclear Diatomics
- Heteronuclear Diatomics
- Triatomics

Chapter 6 Acid-Base/Donor-Acceptor
- Hard-Soft Acid-Base Theory

Chapter 9 Coordination Chemistry
- Nomenclature
- Coordination Number (C.N.)

Section III
Chapter 10-11 Coordination Chemistry & Electronic Spectra
- Crystal Field Theory
- Ligand Field Theory
- Angular Overlap: σ- and π-bonding
- Electronic Spectra: absorption, spin-orbit coupling, selection rules

Chapter 12 Reactions and Mechanisms
- Dissociative, Associative, and Interchange Mechanisms
- Substitution, Oxidative Addition, Reductive Elimination

Chapter 13-15 Organometallic Chemistry
- Electron Counting and the Covalent Bonding Classification
- CO and Multiple Bonding

Presentations:
Groups will select 1 topic (TBA) and provide a 20-minute lecture. The presentation will either be presented in class or recorded and posted to the Slack channel #presentations. All chemical figures must be drawn by presenters; none can be copied and pasted into the presentation.

Time – 20-min presentation

Overview of catalyst – what does it accomplish and what is its global production/impact?

- Company/chemist who discovered it.
- What was their initial motivation to invent and/or improve this reaction?
- Which resources are used to generate the products? Are these starting materials cheap and easy to obtain?
- Who benefits from these products and what are they generally used for?

Catalyst description – C.N., CFT, LFT, electron counting/Covalent Bond Classification (CBC)

- What is the starting pre-catalyst?
- Describe the coordination number (C.N.) of each intermediate. Discuss why the catalyst hops around a particular range of coordination number.
- CFT: draw the proposed splitting diagram of **1 key intermediate** and justify it.
- Ligand field: describe the ligands that are coordinated to the metal center. Strong field, weak field? Do certain ligands dissociate more readily than others? Why?
- Electron count each intermediate.

Describe the mechanism

- Discuss each step and provide a reason how/why each reaction proceeds.

Future outlook

- Could this reaction be optimized? Have other people optimized the catalyst? Which properties would you examine to help improve TON, TOF, catalyst stability, cost, etc.

Q&A

- Everyone must ask 1 meaningful question on each presentation by the next day (will total to 8 questions in the comments for each talk).
- Presenters will have 1 day to answer the questions.

Grading:

Exam 1	100
Exam 2	100
Presentation	100
Final Exam	200
Problem Sets x2 (50 each)	100
In-Class Activities x3 (25 each)	75
TOTAL	675

Your score (%) on your Final Exam will replace your lowest Exam score only if this improves your overall grade. Late problem sets will not be accepted.

Academic Honesty
Students are expected to be honest in all academic work. A student's name on any written work, quiz or exam shall be regarded as assurance that the work is the result of the student's own independent thought and study. Work should be stated in the student's own words, properly attributed to its source. Students have an obligation to know how to quote, paraphrase, summarize, cite and reference the work of others with integrity. The following are examples of academic dishonesty.

- Using material, directly or paraphrasing, from published sources (print or electronic) without appropriate citation
- Claiming disproportionate credit for work not done independently
- Unauthorized possession or access to exams
- Unauthorized communication during exams
- Unauthorized use of another's work or preparing work for another student
- Taking an exam for another student
- Altering or attempting to alter grades
- The use of notes or electronic devices to gain an unauthorized advantage during exams
- Fabricating or falsifying facts, data or references
- Facilitating or aiding another's academic dishonesty
- Submitting the same paper for more than one course without prior approval from the instructors.

Any student with a documented disability is welcome to contact me as early in the semester as possible so that we may arrange reasonable accommodations. As part of this process, please be in touch with Disability Services for Students Office at 330 Memorial Union, 401-874-2098 (http://www.uri.edu/disability/dss/)

Tentative Schedule Fall 2024

Sept 4, Wed	Introductions/Syllabus
Sept 6, Fri	Atomic Structure
Sept 9, Mon	Periodic Trends and Lewis Electron-Dot Diagrams
Sept 11, Wed	Valence Shell Electron-Pair Repulsion Theory (VSEPR)
Sept 13, Fri	Symmetry Elements and Operations
Sept 16, Mon	
Sept 18, Wed	Point Groups (in-class activity Sept 20)
Sept 20, Fri	(Assign Problem Set 1 Sept 22)
Sept 23, Mon	
Sept 25, Wed	Point Group Representations and Character Tables
Sept 27, Fri	
Sept 30, Mon	Molecular Vibrations (Problem Set 1 Due on Oct 2)
Oct 2, Wed	
Oct 4, Fri	
Oct 7, Mon	Exam I
Oct 9, Wed	*s, p,* and *d* orbitals
Oct 11, Fri	
Oct 14, Mon	Columbus Day (*no class*)
Oct 15, Tues	Homonuclear Diatomics (in-class activity Oct 18)
Oct 16, Wed	
Oct 18, Fri	Heteronuclear Diatomics (assign Problem Set 2 on Oct 20)
Oct 21, Mon	
Oct 23, Wed	Triatomics (*mid semester*)
Oct 25, Fri	Hard-Soft Acid-Base Theory (Problem Set 2 Due on Oct 30)
Oct 28, Mon	*(deadline to select topic for presentations)*
Oct 30, Wed	Coordination Chemistry Nomenclature
Nov 1, Fri	Coordination Number (C.N.)
Nov 4, Mon	Exam II
Nov 6, Wed	Tuesday Classes Meet *(no class)*
Nov 8, Fri	Crystal Field Theory (CFT)
Nov 11, Mon	Veteran's Day (*no class*)
Nov 13, Wed	Ligand Field Theory (LFT)
Nov 15, Fri	
Nov 18, Mon	Electronic Spectra: absorption, spin-orbit coupling, selection rules
Nov 20, Wed	(in-class activity Nov 20)
Nov 22, Fri	Mechanisms: Dissociative, Associative, and Interchange, Substitution, Oxidative Addition, Reductive Elimination
Nov 25, Mon	Electron Counting and Covalent Bond Classification
Nov 27-29	Thanksgiving Recess (*no class*)
Dec 2, Mon	Electron Counting and Covalent Bond Classification
Dec 4, Wed	Catalysis
Dec 6, Fri	
Dec 9, Mon	
Dec 11, Wed	Presentations (*no class – recorded presentations – see above syllabus*)
Dec 12, Thurs	Reading Day
Dec 18, Wed	Final Exam 8am-10am