

Chem 5520
Advanced Inorganic Chemistry
Fall 2021

Instructor: Dr. Gang Li

Office: ML359

Office Hours: By appointment (online or in-person)

Phone: 435-797-0604

Email: gang.li@usu.edu (best way to contact me)

Class Time: M/W 9:30 am -10:20 am

Deliver Method: Hybrid

In-Person: Widtsoe 330 (Mask Recommended)

Online: Zoom via Canvas, notification will be sent in advance if a lecture will be delivered online.

COVID Precautions:

USU is encouraging everyone to wear a mask in class. I will be wearing a mask during our meetings.

A COVID vaccine is the most powerful tool we currently have against infection. If you haven't yet been vaccinated, I urge you to consider getting the vaccine.

If you are sick (even mild symptoms), don't come to class. Let me know and I will make sure you get to participate.

If you think you have COVID, please get tested. USU offers free testing to all students, staff and faculties. Please refer to <https://www.usu.edu/covid-19/testing/index>.

If you stay home sick, test positive for COVID or are exposed to someone who has COVID, fill out the questionnaire on the top right of the page <https://www.usu.edu/covid-19/testing/index>. You will be sent instructions on what to do.

Course Content:

The purpose of this course is to provide a deeper understanding of inorganic chemistry based on your prior training in general, inorganic, organic, and physical chemistry. Advanced topics including coordination chemistry, reaction mechanisms of inorganic, organometallic compounds will be discussed. Selected topics on bioinorganic chemistry, solid-state materials and main group chemistry will also be introduced. Discussions of contemporary research literatures will be used to expose students in the cutting-edge research in inorganic chemistry. Recommended texts and current research literatures will be made available on Canvas.

Prerequisites: Chem 3070, Chem 3510

Required Text: None (Materials will be made available via Canvas)

Reference Textbooks:

- a) *Inorganic Chemistry*, 3rd or 4th Edition, G. L. Miessler, D. A. Tarr, Prentice Hall. (Primary reference)
- b) *Advanced Inorganic Chemistry*, 6th Edition, F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, Wiley, 1999.
- c) *Reaction Mechanisms of Inorganic and Organometallic Systems*, R. B. Jordan, Oxford, New York, NY, 1997.
- d) *Organotransition Metal Chemistry: From Bonding to Catalysis*, J. F. Hartwig, University Science Books, Sausalito, CA, 2010

Grading: A total of 700 points is possible. Points are distributed as follows:

Problem Sets (6× 50 pts)	300 pts
Midterm Exams (2 × 100 pts)	200 pts
Final Exam	150 pts
Presentations	50 pts

Tentative Grading Scale:

A/A-	B+/B/B-	C+/C/C-	D+/D
90%-100%	80%-89%	70%-79%	60%-69%

Scales could be lowered based on overall class performance but will **not** be **raised**.

Problem Sets and Exams

Six problem sets will be assigned throughout the semester. You will have a whole week to finish the problem set after it's posted. Exams will be take-home format and you will also have a whole week to finish them except the final exam. Final exams (tentatively take-home format, subject to change) will be given during on December 13th to December 17th, 2021.

Topic Outlines and Objectives

Topic 1: Molecular symmetry, bonding theories, and spectroscopy

- Basic concepts of group theory
- Use group theory to generate reducible representations; to understand molecular orbitals; and to predict spectroscopic properties of small molecules

Topic 2: Coordination chemistry

- Nomenclature, structure, and isomerism of coordination compounds.
- Use group theory to understand crystal field theory
- Bonds in coordination chemistry: covalent and dative covalent bonds.
- Ligands: σ -donors, π -donors, and π -acceptors; X-type ligand, L-type Ligand
- Introduction to electronic spectroscopy of coordination compounds.

Topic 3: Organometallic chemistry

- Electronic configuration: electron counting, valence and oxidation state, 18-electron rule.
- Survey of normal covalent and dative ligands in organometallic chemistry.
- Introductory of redox active ligands in organometallic chemistry

Topic 4: Inorganic reaction mechanisms and catalysis

- Reaction mechanisms: ligand substitution, oxidative addition, reductive elimination, migratory insertions, sigma bond metathesis, and alkene metathesis.
- Introductory of catalysis: propose reasonable mechanistic pathways based on experimental data

Topic 5: Lanthanides and Actinides

- Describe the coordination chemistry and reactivity of the lanthanides and actinides

Topic 6: Bioinorganic chemistry

- Introduction of metals in biological systems
- Case study: oxidases and halogenases

Topic 7: Solid-state and materials chemistry

- Describe principles associated with solid-state chemistry and inorganic nanomaterials

Topic 8: Main group chemistry

- Reactivities of main group elements

Course Schedule

Date	Topic	Problems and Exams
08/30	Topic 1-1	
09/01	Topic 1-2	
09/06	No class (Labor Day)	
09/08	Topic 1-3	Problem Set 1
09/13	Topic 1-4	
09/15	Topic 1-5	
09/20	Topic 1-6	Problem Set 2
09/22	Topic 2-1	
09/27	Topic 2-2	
09/29	Topic 2-3	Problem Set 3
10/04	Topic 2-4	
10/06	Topic 2-5	
10/11	Topic 2-6	Problem Set 4
10/13	No Class (Fall Break)	
10/18	Topic 3-1	
10/20	Topic 3-2	Exam 1
10/25	Topic 4-1	
10/27	Topic 4-2	
11/01	Topic 4-3	Problem Set 5
11/03	Topic 4-4	
11/08	Topic 4-5	

11/10	Topic 4-6	
11/15	Topic 5	Exam 2
11/17	Topic 6-1	
11/22	Topic 6-2	
11/24	No Class (Thanksgiving)	
11/29	Topic 7	
12/01	Topic 8	Problem Set 6
12/06	Presentation 1	
12/08	Presentation 2	Final Exam (Dec 13-17)

Academic Freedom and Professional Responsibilities

Academic freedom is the right to teach, study, discuss, investigate, discover, create, and publish freely. Academic freedom protects the rights of faculty members in teaching and of students in learning. Freedom in research is fundamental to the advancement of truth. Faculty members are entitled to full freedom in teaching, research, and creative activities, subject to the limitations imposed by professional responsibility. [USU Policy 403](#) further defines academic freedom and professional responsibilities.

Academic Integrity - "The Honor System"

The University expects that students and faculty alike maintain the highest standards of academic honesty. The Code of Policies and Procedures for Students at Utah State University ([Student Conduct](#)) addresses academic integrity and honesty and notes the following:

Academic Integrity: Students have a responsibility to promote academic integrity at the University by not participating in or facilitating others' participation in any act of academic dishonesty and by reporting all violations or suspected violations of the Academic Integrity Standard to their instructors.

The Honor Pledge: To enhance the learning environment at Utah State University and to develop student academic integrity, each student agrees to the following Honor Pledge: "I pledge, on my honor, to conduct myself with the foremost level of academic integrity". Violations of the Academic Integrity Standard (academic violations) include, but are not limited to cheating, falsification, and plagiarism

Plagiarism

Plagiarism includes knowingly "representing by paraphrase or direct quotation, the published or unpublished work of another person as one's own in any academic exercise or activity without full and clear acknowledgment. It also includes the unacknowledged use of materials prepared by another person or agency engaged in the selling of term papers or other academic materials." The penalties for plagiarism are severe. They include warning or reprimand, grade adjustment, probation, suspension, expulsion, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling.

Grievance Process

Students who feel they have been unfairly treated [in matters other than discipline, admission, residency, employment, traffic, and parking - which are addressed by procedures separate and independent from the Student Code] may file a grievance through the channels and procedures described in the Student Code: [Article VII Grievances](#)

Students with Disabilities

USU welcomes students with disabilities. If you have, or suspect you may have, a physical, mental health, or learning disability that may require accommodations in this course, please contact the Disability Resource Center (DRC) as early in the semester as possible (University Inn # 101, 435-797-2444, drc@usu.edu). All disability related accommodations must be approved by the DRC. Once approved, the DRC will coordinate with faculty to provide accommodations.

Withdrawal Policy, "I" Grade Policy and Dropping Courses

If a student does not attend a class during the first week of the term or by the second class meeting, whichever comes first, the instructor may submit a request to have the student dropped from the course. (This does not remove responsibility from the student to drop courses which they do not plan to attend.) Students who are dropped from courses will be notified by the Registrar's Office through their preferred e-mail account.

Students may drop courses without notation on the permanent record through the first 20 percent of the class. If a student drops a course following the first 20 percent of the class, a W will be permanently affixed to the student's record (check [General Catalog](#) for exact dates).

Students with extenuating circumstances should refer to the policy regarding Complete Withdrawal from the University and the Incomplete (I) Grade policy in the General Catalog.