

Advanced Inorganic Chemistry

Chem 5520

Fall 2017

M/W 9:30 – 10:20 am

W333

Professor Lisa M. Berreau

Office: ESLC 245J

Office Hours: By appointment

Phone: 797-3509

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This course is an in-depth course that builds upon your prior training in general, inorganic, organic, and physical chemistry. The goals of in-depth coursework are both to integrate topics introduced in the foundation courses and to investigate these topics more thoroughly. It is an advanced treatment of the structure/bonding/reactivity relationships across the periodic table.

Required Text: "Inorganic Chemistry", 6th Edition, Shriver, Weller, Overton, Rourke, Armstrong (5th Edition, Shriver and Atkins will also suffice)

Reference Textbooks (sections available on Canvas):

- 1) "Inorganic Chemistry: Principles of Structure and Reactivity", 4th Edition, James E. Huheey, Ellen A. Keiter, R. L. Keiter, HarperCollins, 1993.
- 2) "Inorganic Chemistry", 4th Edition, Gary L. Miessler and Donald A. Tarr, Prentice Hall, 2011.

Prerequisites: Chem 3070, 3510

Grading: A total of 700 points is possible in Chem 5520 (with 10 possible extra credit points for taking the Gain Score Assessment Tests). Points are distributed as follows:

Exam #1 (9/25-9/26, 2017)	100 pts
Exam #2 (10/23-10/24, 2017)	100 pts
Exam #3 (11/20-11/21, 2017)	100 pts
Comprehensive Final Exam (12/15-12/16, 2017)	100 pts
Literature presentation	100 pts
Total points	500 pts
*Gain Score Assessment Tests (Extra credit)	10 pts

Tentative Grading Scale

(brackets could be lowered- they **will not** be raised):

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

Canvas:

I will be utilizing a Canvas management system for Chem 5520 to make available a variety of resources for the class. **I recommend that you download the appropriate notes or Powerpoint (or pdf) files before lecture for use in class.**

Problem Sets:

Ten practice problem sets will be posted on canvas during the semester. These are to have you work through examples relevant to the areas covered in class and to exam questions.

Exams:

Exams will be given in the USU Testing Center. You will have a two-day window to take the exam. You will be given 75 minutes to complete each exam. An example of an exam will be available on the course Canvas page.

Literature Presentation:

To facilitate your familiarity with the field of inorganic chemistry, each student is required to make a formal ~15 minute presentation on a current literature article. This article will be chosen from a collection available on the course Canvas site. The presentations will take place in the last three class periods (Nov. 29, Dec. 4 and Dec. 6, 2017). A set of presentation guidelines and grading criteria will be made available on Canvas several weeks before the presentations. Students are required to meet with the instructor to review their slides prior to the presentation.

“Gain-Score” Assessment Tests:

Two short tests (~10 min) will be given – one at the beginning of the semester and one at the end. These short tests are given to assess your ability to apply, analyze, and synthesize information that is delivered throughout the course. These questions are not designed to test your specific knowledge of the subject, but rather how to apply this knowledge. You will receive 5 extra credit points for simply taking each “gain-score” assessment test, regardless of performance.

Missed Exam Policy:

If a student misses, or will miss an exam, due to illness or family emergency, the student should speak to Dr. Berreau as soon as possible. A make-up exam will be offered if the absence is supported by appropriate documentation (e.g. note from physician or parent).

Withdrawal Policy and "I" Grade Policy:

The administration of Chem 5520 will adhere strictly to the academic regulations stipulated in the most recent USU General Catalog. Withdrawal from the course will follow official USU procedures. Students are required to complete all courses for which they are registered by the end of the semester. In some cases, a student may be unable to complete all of the coursework because of extenuating circumstances, but not due to poor performance or to retain financial aid. The term 'extenuating' circumstances includes: (1) incapacitating illness which prevents a student from attending classes for a minimum period of two weeks, (2) a death in the immediate family, (3) financial responsibilities requiring a student to alter a work schedule to secure employment, (4) change in work schedule as required by an employer, or (5) other emergencies deemed appropriate by the instructor.

University Standards of Academic Integrity – “The Honor System”:

Each student has the right and duty to pursue his or her academic experience free of dishonesty. The Honor System is designed to establish the higher level of conduct expected

and required of all Utah State University students.

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." A student who lives by the Honor Pledge is a student who does more than not cheat, falsify, or plagiarize. A student who lives by the Honor Pledge:

- Espouses academic integrity as an underlying and essential principle of the Utah State University community;
- Understands that each act of academic dishonesty devalues every degree that is awarded by this institution; and
- Is a welcomed and valued member of Utah State University.

Grievance Process (Student Code):

Students who feel they have been unfairly treated [in matters other than (i) discipline or (ii) 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](#)

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 used 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.

Sexual Harassment:

Sexual harassment is defined by the Affirmative Action/Equal Employment Opportunity Commission as any "unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature." If you feel you are a victim of sexual harassment, you may talk to or file a complaint with the Affirmative Action/Equal Employment Opportunity Office located in Old Main, Room 161, or call the AA/EEO Office at 797-1266.

Students with Disabilities:

The *Americans with Disabilities Act* states: "Reasonable accommodation will be provided for all persons with disabilities in order to ensure equal participation within the program." If a student has a disability that will likely require some accommodation by the instructor, the student must contact the instructor and document the disability through the Disability Resource Center (797-2444), preferably during the first week of the course. Any request for special consideration relating to attendance, pedagogy, taking of examinations, etc., must be discussed with and approved by the instructor. In cooperation with the Disability Resource Center, course materials can be provided in alternative format, large print, audio, diskette, or Braille.

Topics to be covered:

Topic #1: Molecular symmetry; bonding and spectroscopy

Topic #2: Coordination chemistry: *d*-block metal complexes

Topic #3: Organometallic chemistry of *d*-block elements

Topic #4: Lanthanide and actinide chemistry

Topic #5: Inorganic reaction mechanisms; catalysis

Topic #6: Selected topics in bioinorganic chemistry

Topic #7: Solid-state and materials chemistry; nanomaterials

Topic #8: Main group chemistry

Monday	Tuesday	Wednesday
8/28 9:30 – 10:20		8/30 9:30–10:20 Problem Set #1
9/4 No Class		9/6 9:30-10:20
9/11 9:30 – 10:20		9/13 9:30-10:20 Problem Set #2
9/18 9:30 – 10:20		9/25 9:30-10:20 Problem Set #3
9/25 9:30-10:20	(Exam #1) 9/25-9/26	9/27 9:30-10:20
10/2 9:30-10:20		10/4 9:30-10:20 Problem Set #4
10/9 9:30-10:20		10/11 9:30-10:20 Problem Set #5
10/16 9:30-10:20		10/18 9:30-10:20 Problem Set #6
10/23 9:30-10:20	(Exam #2) 10/23-10/24	10/25 9:30-10:20
10/30 9:30-10:20		11/1 9:30-10:20 Problem Set #7
11/6 9:30-10:20		11/8 9:30-10:20 Problem Set #8
11/13 9:30-10:20		11/15 9:30-10:20 Problem Set #9
11/20 9:30-10:20	(Exam #3) 11/20-11/21	11/22 No Class
11/27 9:30-10:20 Problem Set #10		11/29 9:30-10:20 (Presentations)

12/4 (Presentations) 9:30-10:20		12/6 (Presentations) 9:30-10:20

Learning Objectives

Students emerging from Chem 5520 should be able to:

- 1) Use group theory to a) generate and factor reducible representations for molecular vibrations, rotations, and translations; and b) describe molecular orbitals for small molecules and for coordination complexes.
- 2) Draw and interpret molecular orbital diagrams for small molecules.
- 3) Use crystal field theory and MO theory to describe the bonding in metal complexes.
- 4) Apply concepts of electronic term symbols to identify the ground states of transition metal complexes.
- 5) Use Tanabe-Sugano diagrams to predict the number of energy of electronic transitions for metal complexes.
- 6) Describe the magnetic properties of metal complexes and methods of measuring and interpreting magnetic data.
- 7) Provide distinct examples of group properties of *d*-block metal complexes.
- 8) Describe metal-ligand and metal-metal multiple bonding.
- 9) Describe the properties and reactions of organometallic complexes involving CO, alkyl, alkene, alkyne, allyl, and Cp ligands.
- 10) Describe the properties of the lanthanides and actinides and aspects of the coordination chemistry of these metals.
- 11) Propose mechanistic pathways for inorganic reactions based on experimental data.
- 12) Draw and describe the chemistry of selected biological metal centers.
- 13) Describe principles associated with solid-state chemistry and inorganic nanomaterials
- 14) Describe examples of main group compounds and reactivity