Intermediate Inorganic Chemistry
Chem 3510
Spring 2008
Section 001
Tues/Thurs 12:00-12:50 pm
Widtsoe 007

Professor Lisa M. Berreau
Office: ESLC 245J (primary), Widtsoe 339 (secondary)
Office Hours: R/F 1:30-2:20 pm and by appointment (preferable)
(Check in W316 (797-0365) if I'm not in either of my offices)
Phone: 797-3509 (primary office), 797-1625 (secondary office)
Email: lisa.berreau@usu.edu (best way to contact me)

Text: "Inorganic Chemistry", 2nd Edition, Catherine E. Housecroft and Alan G. Sharpe, Prentice Hall, 2005.

Prerequisites: Chem 1220 or equivalent; Chem 2310, Chem 2330

Grading: A total of 500 points is possible in Chem 3510 (with 10 possible extra credit points for taking the Gain Score Assessment Tests). Points are distributed as follows:

Quizzes	100 pts
Exam #1 (2/14/08, 12:00-1:20 pm, Widtsoe 007)	100 pts
Exam #2 (3/27/08, 12:00-1:20 pm, Widtsoe 007)	100 pts
Comprehensive Final Exam (4/29/08, 9:30 am – 11:20 pm, Widtsoe 007)	200 pts
*Gain Score Assessment Tests (Extra credit)	10 pts
Total points	500 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%

Course Objectives/ Goals:

Chemistry 3510 is designed to take students from the introductory principles of chemistry to a broader and deeper level of understanding of the chemistry across the periodic table. The subject of chemical bonding is paramount throughout the course. Especially important is the practical development of molecular orbital (delocalized) bonding models. Leading from a basis of chemical bonding, the subject of reactivity is addressed in considerable detail. Especially important are issues of coordination complexes of transition metals, organometallics, and bioinorganic chemistry. Qualitative aspects of spectroscopy will be addressed as applications arise. The Chem 3510 course is organized in concert with the Chem 3520 laboratory course (offered concurrently).

Blackboard:

I will be utilizing a Blackboard Vista management system for Chem 3510. All registered students will have access to Blackboard using the following process:

1) Using a web browser from any location go to bb.usu.edu
2) Log on using your Blackboard identity. This is your Banner ID/Pin (Access).

Details of Blackboard use will be introduced as we proceed into the term as needed.

** Materials for the class (e.g. powerpoint files, notes, overheads, practice problems, recommended/practice problem solutions, sample exams, demonstrations, and other materials) will be available through Blackboard. **I recommend that you download and print the appropriate powerpoint (or pdf) files before lecture and use them to take notes in class.**

Quizzes: Quizzes will be given on selected dates and will consist of 3-4 short questions that are relevant to the topics discussed in lectures going back to the previous quiz or exam. The question(s) may be related to the suggested problems outlined for each lecture in the syllabus. There will be a total of 5 quizzes during the semester, each worth 20 points. The lowest quiz score will be dropped at the end of the semester and the scores of the remaining 4 quizzes will be weighted appropriately to calculate the final quiz score. Each quiz will given promptly at the start of class (12:00-12:15 pm) and you will be given ~15 minutes to answer the question(s). There will be no make-up quizzes.

"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.

Important Dates:

Jan. 11, 2008:	Last day to add course without instructor signature
Jan. 28, 2008:	Last day to add course
	Last day to drop course without notation on transcript
Feb. 19, 2008:	Attend Monday classes
March 7, 2008:	Last day to change to P/D+/D/F option
March 10-14, 2008:	Spring Break – No classes
April 24, 2008:	Last day of class

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 3510 will adhere strictly to the academic regulations stipulated in the most recent Schedule of Classes and the 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 lived 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:
http://www.usu.edu/studentservices/pdf/StudentCode.pdf#Article7
(Article VII. Grievances, pp. 25-30)

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 that 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 required 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.

Class Schedule Spring Semester 2008

Day	Date	Lecture	Topic	Chapter Sections	Text Problems
T	1/8	1	Introduction, atomic structure, isotopes, Quantum theory, Schrödinger wave equation, Atomic orbitals, nodes; quantum numbers; many electron atoms	1.1-1.7	1.1-1.11
R	1/10	2	Electron configurations; penetration and shielding; Effective nuclear charge; Aufbau; valence and core electrons; ionization energy and electron affinities; size of ions	1.7-1.10	1.12-1.18
T	1/15	3	Bonding; Lewis structures; valence bond model; MO theory; homonuclear diatomics; octet rule	1.11-1.14	1.19-1.26
R	1/17	4	Electronegativity; dipole moments; MO heteronuclear diatomics; Isoelectronic molecules; VSEPR and molecular shape	1.15-1.20; **Quiz #1**	1.27-1.38
T	1/22	5	Applications of isotopes	2.9-2.12	2.13-2.27
R	1/24	6-7	**EXTENDED LECTURE (12:00 – 1:20 pm)** Molecular symmetry; symmetry elements and operations; point groups; character tables, vibrations	3.1-3.5	3.1-3.25
T	1/29		NO CLASS: Professor Berreau at professional meeting		
R	1/31		NO CLASS: Professor Berreau at professional meeting		
T	2/5	8	Introduction to coordination complexes; stability constants; *d*-Block chemistry: complex formation; coordination numbers; isomers;	6.11-6.13; 19.1-19.8	6.25-6.32; 19.1-19.23
R	2/7	9-10	**EXTENDED LECTURE (12:00 – 1:20 pm)** Crystal field theory; Jahn-Teller; octahedral, tetrahedral, square planar fields	20.1-20.3; **Quiz #2**	20.1-20.9; 20.11
T	2/12	11	Catch-up; Exam review		
R	**2/14**	**Exam #1 12:00 pm**	**Material covered in lectures 1-11**	**Exam #1**	
T	2/19	**<No Class>**	Attend Monday Classes	-	
R	2/21	12	MO Theory; Electronic spectra; term symbols	20.4-20.6	20.13-20.14
T	2/26	13	Nephelauxetic effect; EPR; magnetic properties; ligand field stabilization energy	20.7-20.9	20.10; 20.15-20.19; 20.22-20.25
R	2/28	14	Organometallic chemistry; ligand types (CO, H, phosphines), π-organic type ligands	23.1-23.2 **Quiz #3**	23.1-23.5
T	3/4	15-16	**EXTENDED LECTURE (12:00 – 1:20 pm)** 18-electron rule; M-CO, M-NO complexes; Reactions of organometallic complexes	23.3-23.4	23.7-23.10
R	3/6		NO CLASS: Professor Berreau at NIH		
T	3/11	**Spring Break**			
R	3/13	**Spring Break**			
T	3/18	17	Wade's rules; clusters	12.11; 23.5-23.6	12.18; 23.11-23.13

R	3/20	18	*d*-block reaction mechanisms	25.1-25.4; **Quiz #4**	25.1-25.3; 25.6-25.7
T	3/25	19	Electron transfer reactions; Homogeneous catalysis	25.5; 26.1-26.4	25.19; 26.1-26.3
R	3/27	**Exam #2 12:00 pm**	Materials covered in lectures 12-19	**Exam #2**	
T	4/1	20	Metal ion transport and storage in biology	28.1-28.2	28.1-28.4
R	4/3	21-22	**EXTENDED LECTURE (12:00 – 1:20 pm)** Oxygen transport/activation proteins; Zinc proteins; electron transfer proteins	28.3-28.5;	28.5-28.16; 28.18; 28.20
T	4/8		**NO CLASS**: Professor Berreau at professional meeting		
R	4/10		**NO CLASS**: Professor Berreau at professional meeting		
T	4/15	23	Biomimetic/bioinspired metal complexes	**Quiz #5**	
R	4/17	24-25	**EXTENDED LECTURE (12:00 – 1:20 pm)** Lattice types and energy Metallic and Ionic Solids; Semiconductors	5.1-5.16	5.1-5.3; 5.6-5.7; 5.9 5.11-5.12; 5.14-5.16
T	4/22	26	Acid/Base chemistry	6.1-6.4; 8.4	6.1-6.13
R	4/24	27	Chemistry of Hydrogen	9.1-9.7	9.1-9.6
R	4/29	**FINAL EXAM 9:30 am-11:20 pm W007**	**50% - Lectures 20-27 and 50% - Comprehensive**		

Learning Objectives:

Students emerging from Chem 3510 should be able to:

1. Draw and describe the atomic orbitals in terms of n, l, and m_l quantum numbers and draw radial and angular nodal features.
2. Define the processes of atomic ionization and electron attachment.
3. Predict atomic properties based on periodic trends of effective nuclear charge.
4. Apply atomic trends to predict relative sizes of ions.
5. Describe small molecules and ions in terms of valence bond models.
6. Describe homonuclear small molecule bonding in terms of sigma and pi symmetry molecular orbitals.
7. Use bonding theory to predict what specifically happens when a molecule is oxidized or reduced.
8. Describe electronegativity and polarity in heteronuclear small molecules.
9. Describe the bonding in heteronuclear diatomic molecules using molecular orbital theory.
10. Define and provide examples of isoelectronic molecules.
11. Predict molecular shapes using the VSEPR model.
12. Discuss the range of transition metal complex structural types known.
13. Describe how isotopes can be used in spectroscopic and reactivity studies of metal complexes.
14. Distinguish between symmetry operations and symmetry elements.
15. Assign point groups for small molecules.
16. Define a coordination complex and factors that influence coordination equilibria and thermodynamic stability.
17. Describe characteristic properties of transition metal complexes including variable oxidation states, coordination numbers, and the range of isomers possible.
18. Use crystal field theory to predict the electronic configurations and magnetic features of simple octahedral, tetrahedral, and square planar coordination complexes and determine crystal field stabilization energies.
19. Explain the fundamental nature of the colors possible in transition metal complexes.
20. State the spin and Laporte selection rules for electronic transitions.
21. Write the ground state term symbol for a transition metal ion.
22. Describe how CO binds to a transition metal center.

23. Give examples and describe the bonding of other ligands typically found in "organometallic" complexes.
24. Determine whether an organometallic complex follows the 18-electron rule.
25. Use Wade's rules to rationalize the structures of boron and M-CO clusters.
26. Predict the products of selected organometallic reactions.
27. List kinetically labile versus inert metal complexes.
28. Describe dissociative, associative, and interchange mechanisms for transition metal ligand substitution reactions.
29. Interpret activation parameters in terms of possible mechanisms.
30. Describe the mechanism of ligand substitution in square planar metal complexes.
31. Define inner-sphere vs. outer-sphere electron transfer reactions.
32. Write mechanisms for the industrial applications of homogeneous catalysis.
33. Describe aspects of how metal ions are transported and stored in biological systems.
34. Elaborate the functions of metal centers in dioxygen transport and catalytic zinc proteins in biological systems.
35. Describe and calculate Madelung constants for simple ionic compounds.
36. Discuss how ionic bonding is affected by ion charges and Madelung factors.
37. Using a Born-Haber description, employ thermodynamic data to calculate lattice energies for ionic solids.
38. Compare/contrast acid/base definitions (Bronsted, Arrhenius, Lewis).
39. Provide a description of the chemistry of hydrogen.