Chem 5520 Syllabus (Fall 2019)
Advanced Inorganic Chemistry

Instructors: Tianbiao Liu (Office: Maeser 361)
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Class Time: Monday 9:30 –10:20 am; Wednesday 9:30 – 10:20 pm
Substituted Class Time: Friday 9:30 – 10:30 (notified by email if needed)
Office Hours: Friday 9:30 – 10:30 by appointment through email
Class Location: WIDT 333

Required textbooks: No specific textbook is needed. However, reference books given below are encouraged to purchase. All related materials are available as printouts or via Canvas. Canvas handouts will be updated by each weekend or given in class.

Reference books:

1. Concepts and Inorganic Chemistry, 3rd ed., Bodie Douglas, Darl McDaniel, John Alexander

2. Inorganic Chemistry, 5th ed., Gary L. Miessler, Paul J Fischer and Donald A. Tarr, Pearson 2014.

3. "Advanced Inorganic Chemistry", 6th Edition, F. A. Cotton, G. Wilkinson, C. A. Murillo, M. Bochmann, Wiley, 1999.

4. "The Organometallic Chemistry of the Transition Metals", 5th Edition, R. H. Crabtree, Wiley, 2009.

Grading*:			
	10 quizzes (10 point for each)		100
	**6 problem sets (50 point for each)		300
	Midterm exam	100	
	Final exam	100	
		Overall: 600	

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*Note: Answers of problem sets must be turned in on a given class date.

**Two additional practice problem sets are also given but not graded and counted for grading.

Tentative Grading Scale:

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

Class Schedule

Date	Topic
08/26	Course Introduction
08/30	Lecture 1: Overview about Periodic Table
09/02	*Labor day (no class) (will assign a makeup course if needed)*
09/04	Lecture 1: Overview about Periodic Table (continued)
09/09	Lecture 2: Alkali Metals
09/11	Lecture 3: Alkaline earth group
09/16	Lecture 4: Triels
09/23	Lecture 5: C Group
09/25	Lecture 6: N and 17 Groups
09/30	Lecture 6: N and 17 Groups (continued)
10/02	Lecture 7: S and 18 Groups
10/07	Lecture 7: S and 18 Groups (continued)
10/09	Lecture 8: Basic concepts in Coordination Chemistry
10/14	Lecture 9: Ligand Nomenclature
10/16	Lecture 10: 18e and Stereochemistry of Coordination Complexes
10/21	Lecture 11: Properties of Coordination Complexes
10/23	Lecture 12: Group Theory I
10/28	**Mid-term exam**
10/30	Lecture 13: Group Theory II (MO)
10/04	Lecture 14: Group Theory III (IR)
11/06	Lecture 15: Physical methods (UV)
11/11	Lecture 16: Physical methods (NMR and X-ray)
11/13	Lecture 17: Physical methods (X-ray)
11/18	Lecture 18: Reactivities of Coordination Complexes
11/20	Lecture 19: Catalysis using TM I
11/25	Lecture 20: Catalysis using TM II
Thanksgiving (11/27-11/29)	
12/02	Lecture 21: MOFs and Super Molecules
12/04	Lecture 22: Rare Earth Metals and Bioinorganic Chemistry
12/09	Final course review
12/11	***Final exam***

Course Content: This course covers theoretical and practical aspects of descriptive periodic trends, chemical bonding and structure, symmetry of molecules, group theory, catalysis, and bioinorganic chemistry. A special emphasis is given to the chemistry of the transition metals and their catalytic

applications, including coordination and organometallic chemistry.

Learning objectives:
1) Describe representative examples of main group compounds and reactivity
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) Provide distinct examples of group properties of d-block metal complexes.
6) Describe metal-ligand and metal-metal multiple bonding.
7) Describe the properties and reactions of organometallic complexes involving CO, alkyl, alkene, alkyne, allyl, Cp ligands, and phosphines.
8) 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.
9) Use Tanabe-Sugano diagrams to predict the number of energy of electronic transitions for metal complexes.
10) Describe the physical properties of metal complexes and methods of measuring and interpreting UV, NMR, and X-ray
11) Propose mechanistic pathways for inorganic reactions
12) Describe principles associated with solid-state chemistry and inorganic MOFs materials
13) Describe the properties of the lanthanides and actinides and aspects of the coordination chemistry of these metals.
14) Draw and describe the chemistry of selected biological metal centers.

What is Inorganic Chemistry? If organic chemistry is defined as the chemistry of hydrocarbon compounds and their derivatives, inorganic chemistry can be described as the chemistry of "everything else". This includes all the remaining elements in the periodic table, as well as carbon, which plays a major role in many inorganic compounds. Inorganic chemistry encompasses a large variety of topics ranging from solid-state chemistry, semiconductor and superconductivity, industrial catalysts to the role of metals in biological systems. We will just skim the surface of inorganic chemistry in this course with introductions to the background necessary for deeper understanding of inorganic chemical topics.
Course objectives: The course will provide you with the necessary knowledge to understand the theoretical basis of structure and bonding as well as the physical and chemical properties of inorganic compounds, and their catalytic and others applications. In the end, I hope that you will appreciate this important and growing chemical discipline.

Withdrawal Policy and "I" Grade Policy

The administration of Chem 6500 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 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.

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 included warning or reprimand, grade adjustment, probation, suspension, withholding of transcripts, denial or revocation of degrees, and referral to psychological counseling.

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.

Students with Disabilities:

The American 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.