

CH 8070: Chemistry of the Transition Elements

Fall 2021

- Instructor: Professor Julia Brumaghim
- Time/Location: *In-person instruction:* 470 Hunter Laboratories; please wait at least fifteen minutes if I am not present at 8:00 am
- Text: Inorganic Chemistry, 6th Ed. (2014) by Shriver, et al. (ISBN 978-0198757177)
Recommended for additional reading: Inorganic Chemistry, 4th Edition by J. E. Huheey, et al., Harper Collins, 1993
- Office hours: Mondays 3 – 4 pm at the picnic tables outside near Hunter 100 (or by Zoom in case of inclement weather), immediately after class, or by appointment (see Canvas for scheduled office hour Zoom links)
- Contact information: Office: 481 Hunter (phone 656-0481); email: brumagh@clemsun.edu
Note: Due to the COVID-19 pandemic, I will not be having in-person meetings in my office this semester, so please email me if you need to set up a virtual appointment.

COURSE DELIVERY

This course will be delivered in-person, and *masks are required for in-person instruction*. If you are not wearing a mask, you will be asked to leave the building. Course handouts will be available through Canvas, and all problem sets and exams will be assigned and turned in online. Changes to the course syllabus may be made due to 1) changing circumstances for instruction (e.g., a work-from-home order), 2) illness of the instructor, 3) other unforeseen circumstances that require modification of course delivery or content. Every attempt will be made to give students ample lead time and explanation for any syllabus changes.

Instructor pledge: It is my intent to provide as useful and interactive a course environment as possible. I realize that pandemic education is not an ideal situation, for either the instructor or the students, and I will do my best to make this a memorable and useful course despite the circumstances.

Student expectations: This is a foundational graduate course in inorganic chemistry, and it will be fast paced, especially during the initial sections of the course. It is expected that students will:

- 1) **Attend all the course meeting times** (and office hours, if desired). I know the course is early, and I do not care at all if you attend in your pajamas. As long as you are not disruptive to the rest of the class, and you are wearing a mask, I am fine with anything.
- 2) **Make a conscientious effort to participate in the course discussions and ask/answer questions.** When taking a course, there is a tendency to simply sit back and watch the instructor. This is not how I teach, and you will learn a lot less with this approach. If you do this regularly, be advised that I may call on you to answer questions (I am persistent like that when it comes to getting students to participate and learn).
- 3) **Be respectful of others' situations and viewpoints.** I try my best to make this course inclusive and treat all students with respect so that it is a safe environment to ask questions and share opinions. I expect you to do the same. Disrespectful comments toward me or others in the class will be met with long, detailed, and scientifically referenced explanations of bias and its past and present negative effects on the sciences. If I or another student in the class says or does something that you find non-inclusive or offensive, please let me know!

COURSE OBJECTIVES

This course is intended to provide sufficient background knowledge of the topics and techniques used in transition metal chemistry so that students should be able to (1) describe the important aspects of transition metal chemistry including the relevance of the topics listed on p. 2 to the field, and to (2) critically evaluate the current literature in this field. You will also be expected to understand educational aspects of critical thinking and how they apply to teaching, learning, and doing science.

COURSE SPECIFICS

Reading

Appropriate reading from the text is given in the course outline (p. 4); *it is highly recommended that the reading be completed prior to the lecture for which it is assigned.*

Problem sets

Problem sets are due *at the beginning of class* on the indicated days (p. 4), since answer keys will be provided during the same class. No late homework will be accepted without a valid excuse.

Exams

The midterm and final exam dates are listed on p. 4. The final exam will focus *primarily* on material from the second half of the course. Make-up exams will be given by appointment for excused absences only.

Review paper

A review paper in the format of an *Angewandte Chemie* research highlight is required. A recent paper from the inorganic chemistry literature should be selected as the focus of your paper and the topic and outline must be approved by 21 October. Historically, plagiarism from published works has been a particular problem in this assignment. ***Plagiarism outside this course can mean the end to a scientific career for both students and their advisors, and therefore it will not be tolerated in this course.***

Critical thinking development

This is a critical thinking course developed as part of Clemson's CT² initiative that aims to incorporate and develop critical thinking skills in addition to covering the topical course material. Thus, we will also focus on discussing the elements of critical thinking. Critical thinking is the ability to interpret and analyze a problem and to determine and evaluate possible solutions. It is a self-reflective process for learning and problem solving that must be cultivated and practiced because it can challenge current beliefs and thought processes. Critical thinking requires both cognition (thinking) and character skills (such as motivation, curiosity, perseverance, intellectual humility, and confidence). These skills are required for successful scientists, and are widely sought after by graduate schools, pre-professional schools, and employers. Assignments in this course are designed to develop these broadly applicable critical thinking skills that will be assessed using an online assessment at the beginning of this course (specific details about this assessment will be provided in class). *Completion of the critical thinking online assessment at the beginning of the course will result in four bonus points added to the midterm exam score.*

Grading

Grades will be based upon the midterm and final exams as well as the problem sets and the review paper. Final grades will be calculated using the percentages listed below and exams will be graded so that A: 100-90%, B: 89-80%, C: 79-70%, F: <70 %. No extra credit assignments will be accepted for this course.

Problem sets (8)	40 %
Midterm exam	20 %
Review paper	20 %
Final exam	20 %

It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who need them. Students are encouraged to contact Student Accessibility Services to discuss their individual needs for accommodation. Attendance in this course is required.

Academic Integrity

Official Clemson statement: "As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form."

Our class statement: Academic dishonesty is a very harmful habit both inside and outside of the university setting. It can (and has in some cases) lead to student expulsion or degree revocation and/or job loss for graduates and for faculty. It benefits everyone, including yourself, to avoid academic dishonesty, including but not limited to cheating and plagiarism. It will not be tolerated in this class and will receive no credit.

Student Accessibility Services

It is university policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students requesting course accommodations should make an appointment with Student Accessibility Services (656-6848; <https://www.clemson.edu/academics/studentaccess/student-resources.html>) in the first month of classes to discuss specific needs. Students should present a Faculty Accommodation Letter from Student Accessibility Services when they meet with instructors. New Faculty Accommodation Letters must be presented each semester, and accommodations are not retroactive.

Clemson University Title IX Statement

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information, or protected activity (e.g., opposition to prohibited discrimination or participation in any complaint process, etc.) in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. The policy is located at <https://www.clemson.edu/campus-life/campus-services/access/title-ix/>. Alesia Smith serves as Clemson's Title IX Coordinator and may be reached at alesias@clemson.edu or 656-3181.

Class Cancellation or Moving to Online Instruction

If class is canceled due to inclement weather or other unforeseen circumstances, you will be responsible for turning in work or being prepared for test or class assignments during the next class meeting period. Due to the unpredictability of the COVID-19 pandemic, instruction may switch to an entirely online format or syllabus modifications may be required.

In the Event of Physical or Mental Illness

If you become ill with COVID-19 and/or required to quarantine, please follow the university guidelines at <https://www.clemson.edu/covid-19/medical-guidance/positive-test.html> and complete the Notification of Absence form on this website to notify your instructors. If you become ill during the semester, I recognize that this may be a longer-term illness that may hinder your participation in this course. Contact me as soon as possible, and we will make a plan for you to make up any missed material or assignments. Course accommodations for students in these situations will be made on a case-by-case basis.

If I become ill during the semester, I will make every effort to notify you and continue teaching this course as I am able. If I am not able to teach this course, then Dr. Colin McMillen, the department crystallographer who has taken and taught sections of this course previously, will take over my teaching duties.

COURSE OUTLINE

<u>Date (day)</u>	<u>Topic</u>	<u>Reading</u>	<u>Assignments due</u>
19 Aug. (Th)	Introduction and atomic properties		
24 Aug. (T)	Atomic properties and ionic bonding	Chapters 1, 3	
26 Aug. (Th)	Molecular structure (VSEPR)	Chapter 2	
31 Aug. (T)	Covalent bonding: VB and MO theories	Chapter 2	Problem set 1
2 Sept. (Th)	Periodic trends and molecular forces	Chapter 9	
7 Sept. (T)	Hard-soft acid-base theory	Chapter 4	Problem set 2
9 Sept. (Th)	Symmetry elements and point groups	Chapter 6	
14 Sept. (T)	Irreducible representations		Problem set 3
16 Sept. (Th)	Basic molecular orbitals 1	Chapter 2	
21 Sept. (T)	Basic molecular orbitals 2		
23 Sept. (Th)	Structure of coordination compounds	Chapters 7, 8	
28 Sept. (T)	Geometric isomerism		Problem set 4
30 Sept. (Th)	Review		
5 Oct. (T)	MIDTERM EXAM		
7 Oct. (Th)	Coordination complexes in biology	Chapter 27	Paper assignment given
12 Oct. (T)	Fall Break		
14 Oct (Th)	Bonding in coordination compounds	Chapter 20	
19 Oct. (T)	Crystal field theory	Chapter 20	Problem set 5
21 Oct. (Th)	Molecular orbital theory and diagrams		Paper outline approved
26 Oct. (T)	Electronic spectra of complexes	Chapter 21	
28 Oct. (Th)	Reactions of coordination compounds		
2 Nov. (T)	Kinetic vs. thermodynamic stability		
4 Nov. (Th)	Redox reactions and electron transfer	Chapters 5, 21	Paper due
9 Nov. (T)	Solid state structures	Chapters 3, 24	Problem set 6
11 Nov. (Th)	Solid state chemistry		
16 Nov. (T)	Lanthanides and actinides	Chapter 23	Problem set 7
18 Nov. (Th)	Nuclear chemistry		Peer reviews due
23 Nov. (T)	Organometallics	Chapter 22	
25 Nov. (Th)	Thanksgiving		
30 Nov. (T)	Catalysis	Chapter 26	Problem set 8
2 Dec. (Th)	Review		Revised paper due
10 Dec. (F)	FINAL EXAM (7:00 – 9:30 pm)		