Valparaiso University Advanced Inorganic Chemistry **CHEM 421**, Fall 2021

Instructor: Dr. Paul F. Smith

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Primary text: Housecroft and Sharpe. Inorganic Chemistry, 4th edition (required).

Office hours: Walkin times Mon 9-11AM, Tues 330pm-530pm, R 3pm-4pm, F 930am-1030am; scheduled appointments outside these times are available, see Starfish

Course description:

“*If Organic chemistry is the study of carbon, Inorganic chemistry is the study of everything else*.”- Most inorganic chemists

For this reason:

*“Ask 10 organic chemists what is covered in week four of Organic Chemistry, and it is likely that you will get a similar response across a wide range of institutional types. Ask 10 inorganic chemists the analogous question about their advanced inorganic chemistry course, and it is likely that you will get 10 different responses…”* **Inorg. Chem.** 2015, 8859

**Be excited!** This class is an example of how you will learn some material which may not be widely covered at other schools. Purposefully, this comes in your final year of training for applications to jobs, graduate schools, and teaching careers. Now is the chance to further distinguish yourself!

Schedule and topics:

Week 1: Introduction and Ch. 1 PChem recap

Week 2: Ch. 2: MO theory, VSEPR

Week 3: Ch. 3: Symmetry, group theory

Week 4: Ch. 5: Advanced MO theory

Week 5: Application of MO in literature and Exam 1 on Ch 1-5

Week 6: Ch. 7 and 20, Hard-Soft Acid/Base theory and Crystal Field theory

Weeks 7-8: Ch. 19-21, CFT predictions on Ligand exchange and Isomers

Week 9: Ch. 21 Inorganic Reaction mechanisms

Week 10: Ch. 26, Electron transfer and Introduction to minireview

Week 11: Minireview presentations and Exam 2 on Ch 7,19-21,26

Weeks 12-13: Ch 24-25, Organometallic fundamentals + Industrial catalysis

Weeks 14-15 Ch. 6,28, Solid-state Chemistry, semiconductors

Grading:

Homework problems and related in-class presentations: 20%

In weeks where no exam is given, on Monday, Wednesday and Friday, homework problems will be posted on Blackboard before 5pm. At the beginning of the next class, all assignments will be collected and one student will be selected at random to briefly present some combination of problems and solution (chosen by Dr. Smith) to the rest of the class. There is no penalty for incorrect answers on homework assignments nor incorrect statements during presentations. Rather, penalty will be issued for missing an assignment, late assignments, and/or if your answers are incomplete or unjustified to the best of your ability. This is an exercise in how quickly you can learn and subsequently present material effectively- potentially with criticism- to an audience of other chemists. You’ll have to get these questions correct eventually…hence, these assignments will reflect exam questions. The point total for this component is normalized for the number of HW assignments…e.g., if 32 assignments are given:

# of assignments with penalty: Credit assigned:

1. 32/32 = 100% of 20
2. 31/32 = 97% of 20
3. 30/32 = 94% of 20
4. 29/32 = 91% of 20

Minireview article: 10%

Details for this will be provided in week 10. Briefly, you will be tasked with picking an article published in the ACS journal *Inorganic Chemistry* sometime between September-October 2021. In week 11, you’ll present (in a very nonformal way) the paper you’ve chosen to the class. With the class’s feedback, you’ll write a minireview which critically evaluates that work in the context of the field to date.

Two midsemester exams: 20% each.

Final exam: 30%

Unless announced otherwise, these exams will be written form, in-class, with no external books, notes or materials allowed.

Absence policy:

My daily-HW presentation policy is in many ways my attendance policy, and it’s done both for your benefit and my own: I can follow how you’re perceiving the material in real time and structure future classes around addressing overall weaknesses. If there are reasonable or athletics-related excuses of class absence, I will exempt you from presenting HW for that day.

Student-athletes are excused from class for university-sponsored competition but are not exempt from completing course work missed during those absences. The manner in which work will be made up is at the discretion of the instructors, and students are responsible for obtaining any class notes or other course material. Student-athletes are to provide the Class Excuse form to all faculty members for the courses in which they are enrolled during the first week of classes or as soon as schedules are set. Student-athletes may not be penalized solely for missed class time due to excused absences.

Assigned grade:

A 93-100%

A- 90-93%

B+ 86-90%

B 83-86%

B- 80-83%

C+ 76-80%

C 73-76%

C- 70-73%

D+ 66-70%

D 63-66%

D- 60-63%

F <60%

Honor Code

This course upholds the Valparaiso University Honor Code:

“I have neither given or received, nor have I tolerated others' use of unauthorized aid.”

The above phrase is to be submitted with all homeworks and exams, pending the following:

On homeworks: That the submitted work is your own words and effort. You may work with your classmates on these problems (and I encourage you to do so), and you may use your textbook, Dr. Smith, and even the internet for help on the questions (“It is known that 100% of what is on the internet is true.”- Abraham Lincoln)…. but ultimately it is you who must understand the content sufficiently well to present it, as well as remember it for exams; needless to say it would be a disservice to yourself otherwise!

On exams: That the submitted work is your own words and effort, having not used any other source for help that Dr. Smith would be unaware of.

Student Learning Objectives

The following are the SLO’s from:

The University:

1. Students will demonstrate theoretical and practical knowledge as well as the intellectual skills and creative capacities pertinent to their respective fields of study.
2. Students will solve both conceptual and applied problems by integrating broad-based knowledge, evidence-based reasoning, and information literacy.
3. Students will practice experiential, interdisciplinary, and collaborative learning in both academic and co-curricular pursuits.
4. Students will communicate effectively in oral, written, and digital forms in increasingly complex contexts.

The Chemistry Department:

1. Students will demonstrate molecular-level, atomic-level and subatomic-level understanding of each chemical discipline using the scientific method, quantitative skills, and analytic reasoning for chemical investigation and problem-solving.
2. Students will demonstrate effective communication of scientific information in both oral and written forms to audiences with a wide range of training in chemistry.
3. Students will demonstrate effective communication skills and a team-oriented approach to problem solving while working in group settings.
4. Students will live in accordance with the high ethical standards that are outlined in the American Chemical Society's official code of professional conduct.

This course:

1. Understand the fundamentals of electronic structure of atoms, specifically atomic orbitals and electron configurations, and their effects on periodic trends.
2. Be familiar with the relationships between bonding and structure in covalent and ionic compounds, and understand the limitations in using these two terms to describe interactions between atoms.
3. Be able to identify symmetry elements in the structures of chemical compounds and other objects, and classify them into point groups.
4. Have a working knowledge of molecular orbital theory in its application to simple molecular compounds.
5. Understand how crystal field theory and molecular orbital theory are used to explain bonding, magnetic properties, and spectroscopic characteristics in transition metal coordination compounds.
6. Be familiar with the nomenclature, structures, and different types of isomerism in transition metal coordination compounds.
7. Have a basic understanding of organometallic chemistry, including the different classes of ligands, electron counting methods, the common types of reactions, and their application to catalytic cycles.
8. Have an understanding of the basic crystal structures and applications of these materials in modern nanotechnology.

Emergencies

VU’s Emergency Notification System uses multiple forms of communication, including e-mail, building alarms, outdoor sirens, message boards, computer alerts, Twitter, and public address messaging. Please review the specific procedures for this class found in Blackboard. Remember: “Siren inside, GO outside; Siren outside, GO inside.” To evacuate, gather your personal belongings quickly and proceed to the nearest exit. Do not use the elevator. To shelter in place, move away from the windows and stay low to the ground; lock or barricade the door if there is a threat of violence.

University Counseling:

The University Counseling Center is located on the Northwest side of Alumni Hall. This is a wonderful resource that is available to all VU students. Students may use the counseling center to enhance their current functioning or wellbeing as well as receive help with any issues they are facing. Individual counseling is available free of charge for full-time undergraduate, graduate or law students. Intake appointments can be arranged by going in person to the Counseling Center in Alumni Hall or by calling 219-464-5002.

Access and Accommodations

The Access & Accommodations Resource Center (AARC) is the campus office that works with students to provide access and accommodations in cases of diagnosed mental or emotional health issues, attentional or learning disabilities, vision or hearing limitations, chronic diseases, or allergies. You can contact the office at aarc@valpo.edu or 219.464.5206. Students who need, or think they may need, accommodations due to a diagnosis, or who think they have a diagnosis, are invited to contact AARC to arrange a confidential discussion with the AARC office. Further, students who are registered with AARC are required to contact Dr. Smith if they wish to exercise the accommodations outlined in their letter from the AARC.

Class Cancellations

Notifications of class cancellations will be made via e-mail with as much advance notice as possible. It will be sent to your Valpo e-mail address. If you do not check your Valpo e-mail account regularly or have it set-up to be forwarded to your preferred e-mail account, you may not get the message. Please check your Valpo e-mail (or the e-mail address it was forwarded to) before coming to class.

Library Support Services:

There is a subject liaison program within the Christopher Center Library which designates a librarian for subject-specialized assistance. While all librarians are available to help, you should refer to http://library.valpo.edu/liaison.html to find your subject Librarian who will best be able to help you navigate information resources.

Title IX Statement

Valparaiso University strives to provide an environment free of discrimination, harassment, and sexual misconduct (sexual harassment, sexual violence, dating violence, domestic violence, and stalking). If you have been the victim of sexual misconduct, I encourage you to report the incident. If you report the incident to a University faculty member or instructor, she or he must notify the University’s Title IX Coordinator about the basic facts of the incident. Disclosures to University faculty or instructors of sexual misconduct incidents are not confidential under Title IX. Confidential support services available on campus include: Sexual Assault Awareness & Facilitative Education Office “SAAFE” (219-464-6789), Counseling Center (219-464-5002), University Pastors (219-464-5093), and Student Health Center (219-464-5060). For more information, visit <http://www.valpo.edu/titleix/>.

Academic Calendar & Final Exam Schedule

Final Exams are required and must be given in their assigned time slot unless an exception has been provided by the Dean’s office. Visit the Registrar’s website for the latest information. https://www.valpo.edu/registrar/calendar/