

**CHEM 5400:** Advanced Inorganic Chemistry, 3.0 credits

**Fall 2022 Lecture**

MWF, 12:00 PM – 12:50 PM, Lafayette L411

**Instructor**

Prof. Matt Liptak

Innovation E336

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**Office Hours**

MW, 1:00 – 2:00 PM, Innovation E336

**Prerequisites**

Instructor permission

**Course Description**

Chem 5400 will cover the fundamentals of inorganic chemistry within the frameworks of molecular symmetry and molecular orbital theory. All areas of inorganic structure, bonding, and reactivity will be covered, with an emphasis on transition metal complexes. This course is lecture-based, there is no associated laboratory.

**Statement on Diversity and Inclusion**

I strive to create a classroom environment that supports students from a diverse set of backgrounds. Our society is composed of individual from diverse ethnic, socioeconomic, and educational backgrounds. Half of our society are women. I strongly believe that our best path forward to a stronger and more equitable society is to promote inclusiveness.

It is my expectation that every member of this class will also support diversity and inclusion. As a community, we should strive to uphold the ideals of Our Common Ground:

<https://www.uvm.edu/president/our-common-ground>

I welcome any suggestions as to how I can promote a diverse and inclusive classroom.

**Course Learning Objectives**

Upon completion of CHEM 5400, it is anticipated that you will:

1. Apply group theory to understand the relationship between symmetry and bonding.
2. Analyze the chemical properties of molecules using molecular orbital theory.
3. Distinguish the structures and properties of transition metal complexes from those of main group compounds.
4. Categorize the reaction types used in organometallic and bioinorganic catalytic cycles.
5. Critique the current inorganic chemistry literature within the context of group theory, molecular symmetry, and molecular orbital theory.

### Textbook

Miessler, G.L. and Tarr, D.A. *Inorganic Chemistry*, 5<sup>th</sup> Ed., Prentice Hall, 2013  
The 3<sup>rd</sup> and 4<sup>th</sup> edition of this textbook are acceptable alternatives.

### Web Content

Lecture notes, problem sets, problem set answer keys, and exam answer keys will be available through Blackboard (bb.uvm.edu). These materials are available for all current, UVM-affiliated, students, but they may not be shared off-campus without permission of the instructor.

### Attendance Policy

I do not take attendance in CHEM 5400, but you are responsible for all material covered in lecture. If you miss lecture for any reason, it is **your** responsibility to catch-up on missed material either through reviewing lecture notes posted to Blackboard or by meeting with another student in the course.

### Grading

Your grade will be based upon two exams (33% each) and a paper based upon a critique of primary literature (33% total). I strive to be as accurate as possible when grading exams, but will occasionally make a mistake. You may request a complete regrade of an assignment, plus a clear explanation for any lost points, at any point prior to administration of the final exam. I will retain your graded final exams for one year after completion of the course.

**Grading Scale:** Final course grades will be assigned based upon the following scale.

Numerical	Letter	Numerical	Letter
97 – 100	A+	73 – 76	C
93 – 96	A	70 – 72	C-
90 – 92	A-	0 – 69	F
87 – 89	B+		
83 – 86	B		
80 – 82	B-		
77 – 79	C+		

### Problem Sets

Problem sets will be handed out approximately once every two weeks throughout the course of the semester. These problem sets **will not be graded**, but are intended to solidify your understanding of the major course concepts and challenge you to think critically using your new-found knowledge.

### Exams

Two exams are scheduled for CHEM 5400, which will cover units 1 – 2 separately. In other words, the exams will not be cumulative. Exam #1 is scheduled for 12 PM on **October 18**. Exam #2 is scheduled for **December 11** at 10:30 AM.

### Literature Critique Paper

All students in CHEM 5400 must write a 10-page paper covering a current topic in inorganic chemistry. The topic will be chosen in consultation with me. You will be expected to provide a

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review of the current state of research in that field and critically review *at least* three journal articles published within the last two years. Your critique should incorporate the group theory, molecular symmetry, and molecular orbital theory frameworks discussed during unit #1 of the course.

### **Course Evaluations**

All students are expected to completed online course evaluations using our class meeting time on **December 8**. The evaluations will be anonymous and confidential. The information gained from these evaluations will be used to iteratively improve CHEM 5400 for future *UVM* students.

### **Tips for Success**

CHEM 5400 is a 3.0 credit course. As such, you are expected to spend 3 hours per week attending lectures and devote 6-9 additional hours per week to CHEM 5400. This breaks down to 2-3 hours per lecture.

I strongly recommend devoting one of these hours to reading the textbook section noted in the syllabus, and working through any examples or exercises in that section. The remainder of your time should be dedicated to writing your literature critique. In September, the focus should be selecting a topic in collaboration with me. In October, I suggest focusing on reading current journal articles for eventual inclusion in your paper. Finally, in November, it is time to draft, edit, and finish your paper!

### **Office Hours**

This is your time to ask me any questions you have on course material, or additional inorganic chemistry questions that go beyond the course material. For the most part this is an opportunity to discuss inorganic chemistry one on one with me, but I'm also happy to meet with small groups. I will make a concerted effort to divide up this time equitably between all students in the class, so your time may be a bit shorter on days when a large number of students visit office hours.

Ideally this time will be spent discussing course concepts, practice problems, or your literature critique.

There is no need to make an appointment for office hours. I will be available in my office for the entirety of the time blocks noted above regardless of attendance.

### **General statement regarding potential changes during the semester:**

<http://catalogue.uvm.edu/>

The University of Vermont reserves the right to make changes in the course offerings, mode of delivery, degree requirements, charges, regulations, and procedures contained herein as educational, financial, and health, safety, and welfare considerations require, or as necessary to be compliant with governmental, accreditation, or public health directives.

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**Green and Gold Promise:**

The [Green and Gold Promise](#) clearly articulates the expectations that UVM has for students, faculty, and staff to remain compliant with all COVID-19 recommendations from the federal CDC, the State of Vermont, and the City of Burlington.

The [Code of Student Conduct](#) outlines policies related to violations of the Green and Gold Promise. Sanctions for violations include fines, educational sanctions, parent notification, probation, and suspension.

**Intellectual Property Statement/Prohibition on Sharing Academic Materials:**

Students are prohibited from publicly sharing or selling academic materials that they did not author (for example: class syllabus, outlines or class presentations authored by the professor, practice questions, text from the textbook or other copyrighted class materials, etc.); and students are prohibited from sharing assessments (for example homework or a take-home examination). Violations will be handled under UVM's Intellectual Property policy and Code of Academic Integrity.

**University-wide Policies and Procedures****Student Learning Accommodations**

In keeping with University policy, any student with a documented disability interested in utilizing accommodations should contact SAS, the office of Disability Services on campus. SAS works with students and faculty in an interactive process to explore reasonable and appropriate accommodations, which are communicated to faculty in an accommodation letter. All students are strongly encouraged to meet with their faculty to discuss the accommodations they plan to use in each course. A student's accommodation letter lists those accommodations that will not be implemented until the student meets with their faculty to create a plan.

**Contact SAS:**

A170 Living/Learning Center;  
802-656-7753;  
[access@uvm.edu](mailto:access@uvm.edu)  
[www.uvm.edu/access](http://www.uvm.edu/access)

**Religious Holidays**

Students have the right to practice the religion of their choice. If you need to miss class to observe a religious holiday, please submit the dates of your absence to me in writing by the end of the second full week of classes. You will be permitted to make up work within a mutually agreed-upon time. <https://www.uvm.edu/registrar/religious-holidays>

**Academic Integrity**

The policy addresses plagiarism, fabrication, collusion, and cheating.  
<https://www.uvm.edu/policies/student/acadintegrity.pdf>

**Grade Appeals**

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If you would like to contest a grade, please follow the procedures outlined in this policy:

<https://www.uvm.edu/policies/student/gradeappeals.pdf>

### **Grading**

For information on grading and GPA calculation, go to <https://www.uvm.edu/registrar/grades>

### **Code of Student Conduct**

<http://www.uvm.edu/policies/student/studentcode.pdf>

### **FERPA Rights Disclosure**

The purpose of this policy is to communicate the rights of students regarding access to, and privacy of their student educational records as provided for in the Family Educational Rights and Privacy Act (FERPA) of 1974.

<http://catalogue.uvm.edu/undergraduate/academicinfo/ferparightsdisclosure/>

### **Promoting Health & Safety**

The University of Vermont's number one priority is to support a healthy and safe community:

#### **Center for Health and Wellbeing**

<https://www.uvm.edu/health>

#### **Counseling & Psychiatry Services (CAPS)**

Phone: (802) 656-3340

#### **C.A.R.E.**

If you are concerned about a UVM community member or are concerned about a specific event, we encourage you to contact the Dean of Students Office (802-656-3380). If you would like to remain anonymous, you can report your concerns online by visiting the Dean of Students website at <https://www.uvm.edu/studentaffairs>

### **Final Exam Policy**

The University final exam policy outlines expectations during final exams and explains timing and process of examination period. <https://www.uvm.edu/registrar/final-exams>

### **Statement on Alcohol and Cannabis in the Academic Environment**

As a faculty member, I want you to get the most you can out of this course. You play a crucial role in your education and in your readiness to learn and fully engage with the course material. It is important to note that alcohol and cannabis have no place in an academic environment. They can seriously impair your ability to learn and retain information not only in the moment you may be using, but up to 48 hours or more afterwards. In addition, alcohol and cannabis can:

- Cause issues with attention, memory and concentration

- Negatively impact the quality of how information is processed and ultimately stored

- Affect sleep patterns, which interferes with long-term memory formation

It is my expectation that you will do everything you can to optimize your learning and to fully participate in this course.

### **Course Outline**

#### ***Unit #1 – Main Group Chemistry***

- I. Molecular Symmetry
- II. Vibrational Spectroscopy
- III. Molecular Orbital Theory
- IV. Main Group Bonding
- V. Acid-Base Chemistry
- VI. Solid State Chemistry

#### ***Unit #2 – Transition Metal Chemistry***

- VII. Transition Metal Bonding
- VIII. Ligand Field Theory
- IX. Electronic Spectroscopy
- X. Coordination Chemistry
- XI. Organometallic Chemistry
- XII. Bioinorganic Chemistry

<b>Tentative Lecture Schedule</b>			
	<b>Monday</b>	<b>Wednesday</b>	<b>Friday</b>
<b>Aug. 28</b>	<i>Course Introduction</i>	Proper Rotations (4.1)	Improper Rotations (4.1)
<b>Sep. 4</b>	<b>Labor Day No Class</b>	Point Groups (4.2)	Group Theory (4.3)
<b>Sep. 11</b>	Molecular Motions (4.4)	IR and Raman Spectra (4.4)	Molecular Orbitals (5.1)
<b>Sep. 18</b>	Homonuclear Diatomics (5.2)	Heteronuclear Diatomics (5.3)	Main Group $\sigma$ Bonding (5.4)
<b>Sep. 25</b>	Main Group $\pi$ Bonding (5.4)	Delocalized Bonding (8.5)	Lewis Acid-Base (6.4) <b>Topic Selection</b>
<b>Oct. 2</b>	FLP Catalysis (6.4)	HSAB Theory (6.6)	Solid State Structure (7.1)
<b>Oct. 9</b>	Band Theory (7.3)	Solid State Devices (7.4)	<b>Fall Recess No Class</b>
<b>Oct. 16</b>	Exam #1 Review	<b>Exam #1 Main Group Chemistry</b>	Magnetism (10.1)
<b>Oct. 23</b>	Transition Metal $\sigma$ Bonding (10.3)	Transition Metal $\pi$ Bonding (10.3)	Spin States (10.3)
<b>Oct. 30</b>	Angular Overlap Model (10.4)	Jahn-Teller Effect (10.5)	UV/Vis Spectra (11.1) <b>Annotated Bibliography</b>
<b>Nov. 6</b>	Term Symbols (11.2)	Tanabe-Sugano (11.3)	Substitution Reactions (12.1-12.5)
<b>Nov. 13</b>	Trans Effect (12.6-12.7)	Redox Reactions (12.8)	Oxidative Addition (14.1)
<b>Nov. 20</b>	<b>Thanksgiving Recess No Class</b>	<b>Thanksgiving Recess No Class</b>	<b>Thanksgiving Recess No Class</b>
<b>Nov. 27</b>	Insertion Reactions (14.2)	Homogeneous Catalysis (14.3)	Metal Tetrapyrroles (16.1)
<b>Dec. 4</b>	Metalloproteins (16.2-16.3)	Iron-Sulfur Clusters (16.4)	Exam #2 Review <b>Literature Critique</b>
<b>Dec. 11</b>	<b>Exam #2 Transition Metals</b>		

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