Chemistry:4270 - Advanced Inorganic Chemistry - Fall 2022
(Tuesday/Thursday 9:30 - 10:45 AM in 208 NH)

Instructor: Prof. Edward Gillan Email: edward-gillan@uiowa.edu Phone: 319-335-1308

Student Drop-In Office Hours (W325 CB and Zoom): Tues/Wed/Thurs 11-12PM and by appointment
Zoom (meeting ID: 973 6419 4238) https://uiowa.zoom.us/j/97364194238

Class textbook (ICON direct eText, can get 4th edition in print, 5th print edition is expensive):


Course Summary and General Learning Objectives: This advanced course serves several purposes for advanced undergraduate chemistry majors and new chemistry graduate students. One goal is to solidify and expand on foundational atomic property and molecular structure concepts including periodic property trends and effective nuclear charge effects, building 3D molecularly bonded structures, and using structure and symmetry to make predictions of molecular properties such as vibrational modes and molecular orbitals. This course will also detail structure, bonding, and properties of extended crystalline solid-state materials, so students gain knowledge in non-molecular systems. This course covers modern principles of atomic and molecular bonding including ligand field and molecular orbital theories, select aspects of main group and transition metal structures and reactivity, and ends with kinetics and catalysis using transition metal compounds. Lecture materials will define concepts that will aligned with homework and exam problems. Students successfully completing the tasks in this course, will have a strong inorganic structure-property skills as they relate to a wide variety molecular and non-molecular chemical systems.

ICON (http://icon.uiowa.edu): Announcements, copies of handouts, problem set/exam solutions, scores.

Grading:
1) 5 independent problem sets (20 pts each) = 100 points (10 x 2 % = 20 %)
2) 2 in-class exams (100 pts each) = 200 points (2 x 20 % = 40 %)
3) X-ray structure report (near end of semester) = 50 points (10 %)
4) Cumulative final exam = 150 points (30 %)

Total possible = 500 points

In-class exams will cover material primarily since the previous exam. In some cases, core concepts will return in multiple exams. The final will cover a range of topics covered throughout the course. The final grade distribution for this advanced undergraduate/graduate level course will be approximately A (25%), B (45%), C (25%), D/F (< 5%). Within each grade level, +/- letter grades will be given. Obtaining >80% of total points earns an A grade, >70% of total points earns a B grade, >60% of total points earns a C grade. These grade breaks may be adjusted downwards but will not be raised to higher minimum percent levels for grade breaks.

Independent work, grading, late work, and makeup exams: We will likely have a graduate student grader for homework assignments. All questions or issues with scores received for course assignments are directed to Prof. Gillan. General class assignment averages and individual scores will be periodically posted on the class ICON website and estimated midterm grades may be obtained from Prof. Gillan. General discussion with classmates on the inorganic concepts in problem set exercises is very useful and encouraged, but all problem set answers must be independently determined and in your own words! Anyone discovered using answers from a source other than their own head will be subject to severe course penalties. Late work will only be accepted with verified university approved absences. If an approved reason is not stated for late work, late work will only be accepted at the discretion of Prof. Gillan and it will have a 10%/day point penalty. Makeup exams will be provided if the exam is missed for a university approved reason.
Calendar of Course Lectures and Exams (dates of the 5 HW assignments TBD)

<table>
<thead>
<tr>
<th>Approx. dates</th>
<th>Topics covered</th>
<th>Approx. MFT book chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 23, 25, 30</td>
<td>Atomic orbitals &amp; periodic properties</td>
<td>Chp. 1, 2</td>
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<tr>
<td>Sept. 1, 6</td>
<td>Covalent bonding &amp; structures, VB theory</td>
<td>Chp. 3</td>
</tr>
<tr>
<td>Sept. 8, 13, 15</td>
<td>Symmetry, point groups, character tables</td>
<td>Chp. 4, supplements</td>
</tr>
<tr>
<td>Sept. 20, 22</td>
<td>Group theory applications to vibrations</td>
<td>Chp. 4</td>
</tr>
<tr>
<td>Sept. 27, 29, Oct. 4</td>
<td>MO theory, group theory of bonds &amp; MOs</td>
<td>Chp. 5</td>
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<tr>
<td>Oct. 6, 11</td>
<td>Solid-state structures and ionic bonding</td>
<td>Chp. 7</td>
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Thursday, October 13th: First In-Class Exam

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics covered</th>
<th>Approx. MFT book chapters</th>
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</thead>
<tbody>
<tr>
<td>Oct. 18, 20</td>
<td>Properties of solids and band theory</td>
<td>Chp. 7, supplements</td>
</tr>
<tr>
<td>Oct. 25</td>
<td>Acid/base chemistry, solvation, halides</td>
<td>Chp. 6, 8</td>
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<tr>
<td>Oct. 27</td>
<td>Molecular rings, cages, and clusters</td>
<td>Chp. 8, supplements</td>
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<tr>
<td>Nov. 1, 3</td>
<td>Intro to transition-metal (TM) complexes</td>
<td>Chp. 9</td>
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<tr>
<td>Nov. 8, 10</td>
<td>TM coordination chem., bonding, magnetism</td>
<td>Chp. 10</td>
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Thursday, November 17th: Second In-Class Exam

<table>
<thead>
<tr>
<th>Date</th>
<th>Topics covered</th>
<th>Approx. MFT book chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>November 22, 24</td>
<td>no class for Thanksgiving Recess</td>
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<tr>
<td>Nov. 15, 29</td>
<td>Spectroscopic analysis of TM complexes</td>
<td>Chp. 11</td>
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<tr>
<td>Dec. 1</td>
<td>Kinetics of ligand substitution on metals</td>
<td>Chp. 12</td>
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<tr>
<td>Dec. 6, 8</td>
<td>Organometallic reactions and catalysis</td>
<td>parts of Chps. 13, 14</td>
</tr>
<tr>
<td>Dec. 12-16</td>
<td>Cumulative Final Exam – Exam time/date to be announced later by Registrar’s Office.</td>
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College of Liberal Arts and Sciences (CLAS) and University Policies and Procedures

Administrative Home. The College of Liberal Arts and Sciences (CLAS) is the administrative home of this course, and CLAS governs the add and drop deadlines, “second-grade only” option (SGO), academic misconduct policies, and other undergraduate policies and procedures. Questions may be addressed to 120 Schaeffer Hall or see the CLAS Student Academic Handbook (www.clas.uiowa.edu/students/handbook/). Concerns with any aspect of this course that cannot be resolved by communication with Prof. Gillan can be directed to the Chemistry DEO (Prof. MacGillivray, len-macgillivray@uiowa.edu) [Room E331 CB (335-1350)] for further discussion.

Academic Honesty and Misconduct. All students in CLAS courses are expected to abide by the CLAS Code of Academic Honesty. Undergraduate academic misconduct must be reported by instructors to CLAS according to these procedures. As noted above, if students submit independent assignments with significant duplication or plagiarism, assignments will be given zero credit. Any student committing academic misconduct is reported to the College and they may be placed on disciplinary probation or suspended.

Other Expectations of Student Performance. Classroom/lecture expectations are for civil student behavior and avoiding disturbances in class, especially for those involving technology, which can distract those students sitting by the user. Students have the right to a distraction-free learning environment. Students in class are expected to help each other learn and contribute overall to a positive overall learning environment. Arriving prepared for class is expected as is not using electronic devices for work or entertainment not related to the lecture/course material.

Student Complaints. Students with a complaint about a grade or a related matter should first discuss the situation with the instructor and/or the course supervisor (if applicable), and finally with the Chair the Chemistry
Department. Undergraduate students should contact CLAS Undergraduate Programs for support when the matter is not resolved at the previous level. Graduate students should contact the CLAS Associate Dean for Graduate Education and Outreach and Engagement when additional support is needed.

Drop Deadline for this Course. You may drop an individual course before the deadline; after this deadline you will need collegiate approval. You can look up the drop deadline for this course here. When you drop a course, a “W” will appear on your transcript. The mark of “W” is a neutral mark that does not affect your GPA. Directions for adding or dropping a course and other registration changes can be found on the Registrar’s website. Undergraduate students can find policies on dropping and withdrawing here.

Date and Time of the Final Exam. The final examination date and time will be announced by the Registrar generally by the fifth week of classes and it will be announced on the course ICON site once it is known. Do not plan your end of the semester travel plans until the final exam schedule is made public. It is your responsibility to know the date, time, and place of the final exam. According to Registrar's final exam policy, students have a maximum of two weeks after the announced final exam schedule to request a change if an exam conflict exists or if a student has more than two exams in one day (see the policy here).

Electronic Email Communication. University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (uiowa.edu). Faculty and students will use this account for any communication. Instructors typically respond to student e-mails within two working days.

Attendance, Absences, and Makeup Exams: Attendance is not taken for lectures; however lecture recordings may not be available for viewing unless an absence is excused (Attendance and Absences). University regulations require that students be allowed to make up examinations which have been missed due to illness or other unavoidable circumstances (Exam Policies). Students with mandatory religious obligations or UI authorized activities must discuss their absences with me as soon as possible. Religious obligations must be communicated within the first three weeks of classes.

Accommodations for Disabilities. Any student needing academic accommodations should first register with Student Disability Services and then contact Prof. Gillan to make specific arrangements.

Reacting Safely to Severe Weather. In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over (similarly true for building fire alarms). For more information on Hawk Alert and the siren warning system, visit the Public Safety web site (https://police.uiowa.edu/emergency-preparedness/campus-emergency-plans).

Links to Other Useful University Policies
- Accommodations for Students with Disabilities
- Basic Needs and Support for Students
- Classroom Expectations
- Exam Make-up Owing to Absence
- Free Speech and Expression
- Mental Health
- Military Service Obligations
- Non-discrimination
- Religious Holy Days
- Sexual Harassment/Misconduct and Supportive Measures
- Sharing of Class Recordings
Information for optional inorganic/organometallic molecular model kit

This is an optional course item that is a useful alternative to organic model kits (greater than 4 bonds!)

Go to Orders Molecular Model Kits tab: Kit #4 ISBN 978-09648837-5-8 (price for one kit ~ $25).
MOLECULAR VISIONSTM INORGANIC-ORGANOMETALLIC - 132 pieces in a 9”x4.5”x4” corrugated box.

Atom centers incorporating the octahedral piece.

Optical isomers of a tris-ethylenediamine complex

Another molecular model kit for inorganic structures (central atoms to accommodate coordination numbers of up to six) is:  https://www.amazon.com/Duluth-Labs-Organic-Chemistry-Molecular/dp/B0781ZCPKK/