Chemistry 336 INORGANIC CHEMISTRY Spring 2023

INSTRUCTOR: Dr. Ben Lovaasen – SCI 326 – Ext.7444

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Office Hours: MWRF 9:00—10:30a

COURSE MATERIALS: *Inorganic Chemistry,* Housecroft and Sharpe, 5th ed. (2018)

A Google Drive folder

Schoology

symotter.org

TIME/PLACE: MWF 11:35—12:45 p.m.; SCI 302

**Course Outcomes:**

Students who complete this course will be able to:

1) Explain atomic properties and periodic trends by using electronic structure arguments.

2) Construct MO diagrams for diatomic and simple polyatomic molecules.

3) Assign a symmetry point group to molecules, and use symmetry to interpret vibrational spectra.

4) Demonstrate Identify a unit cell for a solid-state structure.

5) Explain the physical properties of solid-state materials using an appropriate lattice model.

6) Classify solid-state materials by their conductivity and electronic structure.

7) Describe coordination complexes and organometallic complexes in terms of ligands, oxidation state, and stability.

8) Classify organometallic reactions.

9) Relate the period properties of the elements to fundamental electronic structure of atoms and molecules.

10) Perform inorganic syntheses and characterize inorganic molecules, including using air-sensitive techniques and magnetic characterization.

11) Communicate the results of an Inorganic synthesis and analysis using the conventions of chemical communication.

This course aligns well with Chemistry Department learning outcomes 1, 2, and 3:

1) Chemistry Knowledge – students will know and be able to apply fundamental knowledge in five core areas of chemistry (organic, inorganic, analytical, physical, biochemical)

2) Laboratory Skills – students will have mastered essential laboratory techniques and procedures

3) Scientific Communication – students will have developed the ability to clearly communicate scientific ideas in both written and oral formats

**Course Description:**

Inorganic chemistry involves the study of all compounds that do not include C–H bonds, which are the domain of organic chemistry. This leads to an incredible diversity that ranges from the chemistry of gemstones and ores, to dyes and catalysts, to simple table salt. Some inorganic compounds are stable on a geologic time scale and others are short-lived and decompose readily; some inorganic compounds are largely unreactive and some are highly reactive in the presence of O2, water, light, heat or other stimuli. Due to the tremendous breadth of Inorganic Chemistry, this course is not designed to be comprehensive, but aims to build a foundation and provide the student with tools that will enable her or him to explore the aspects of creation that she or he finds most intriguing.

To tackle such a large topic, we will divide this course up into three sections: the fundamentals of chemistry, inorganic distinctives, and building upon this foundation.

The fundamentals of chemistry include: atomic structure, molecular structure and bonding, molecular symmetry, and group theory in chemistry.

Inorganic distinctives include: solid state structures, coordination chemistry, organometallic chemistry.

We will build upon the established foundation primarily in the main group descriptive chemistry unit.

**Course Policies:**

**Accommodations**

Accommodations will be made for students with learning disabilities. Please alert the instructor in advance of any exams if special accommodations are necessary.

Wheaton College is committed to providing access and inclusion for all persons with disabilities, inside and outside the classroom. Students are encouraged to discuss with their professors if they foresee any disability-related barriers in a course. Students who need accommodations in order to fully access this course’s content or any part of the learning experience should connect with Learning and Accessibility Services (LAS) as soon as possible to request accommodations  [http://wheaton.edu/las](http://www.wheaton.edu/las) (Student Services Building - Suite 209, las@wheaton.edu, phone 630.752.5615). The accommodations process is dynamic, interactive, and completely free and confidential. Do not hesitate to reach out or ask any questions.

**Academic Honesty**

The Wheaton College Community Covenant, which all members of our academic community affirm, states that, “According to the Scriptures, followers of Jesus Christ will…be people of integrity whose word can be fully trusted (Psalm 15:4; Matt. 5:33-37).” It is expected that Wheaton College students, faculty and staff understand and subscribe to the ideal of academic integrity and take full personal responsibility and accountability for their work. Wheaton College considers violations of academic integrity a serious offense against the basic meaning of an academic community and against the standards of excellence, integrity, and behavior expected of members of our academic community. Violations of academic integrity break the trust that exists among members of the learning community at Wheaton and degrade the College’s educational and research mission.

***All work that you hand in is expected to be an accurate representation of a student’s own effort and level of understanding***. If it is suspected that this does not describe any work submitted by a student then the policies and procedures outlined in the Student Handbook will be followed. The likely result will be that any work that was determined not to be the student’s own original work will result in a zero for the assignment. Any repeat offenses will result in failure of the course. Any discussion of exams or quizzes with a student who has not yet taken that exam or quiz is considered academic dishonesty.

**Attendance**

Attendance is expected, but unexpected circumstances occasionally arise. If these circumstances lead to your absence from class you will be held responsible for everything covered in class. Make-up exams will only be given for extenuating circumstances, or if a student arranges a change in exam date in advance.

**Classroom Participation**

*Classroom participation is enthusiastically welcomed!* Please feel free to get my attention at appropriate times and in appropriate ways as the situation arises. This course will be better with your participation.

**Collaboration**

Discussion with both students and faculty alike are often the best way to learn chemistry. *Therefore, it is encouraged that you study in groups or discuss particularly challenging homework problems with other students in the class.* There is a fine line between collaboration and copying. Each student is expected to come to the final answers for homework questions on his or her own.

**Course Development**

The VIPEr Fellows project is supported by a 5-year grant from the National Science Foundation’s Improving Undergraduate STEM Education (IUSE) program. A primary project goal is to develop, test, and refine a flexible, foundation-level inorganic chemistry course based on classroom observations, analysis of student work, surveys of students, and interviews with faculty. Your instructor has been chosen as a VIPEr Fellow (cohort 2) for AY21-23, and as such, there will be several surveys and recorded sessions that accompany this project. If you have any questions, please refer to the Participant Notice for Students form or ask your instructor. The research team will analyze this data to study the effects that student-centered active learning pedagogies and support from a community of practice has on student learning and instructional practice.

**Office Hours**

Office hours are available at the times posted above by appointment. Office hours appointments will be conducted in person. Sign up for office hours on my door. You may sign up for up to 2x 15 minute slots/week. If the times listed do not work with your schedule, email me to set up an appointment at a mutually available time.

**Technology**

The last thing we need in our life right now is more communications technology. Don’t bring your laptop to class; keep your phone put away during class, or better yet, keep it at home. I have been known to remove students from class for using communications technology and I am willing to do it again.

**Title IX and Mandatory Reporting**: Wheaton College instructors help create a safe learning environment on our campus. Each instructor in the college has a mandatory reporting responsibility related to their role as a faculty member. Faculty members are required to share information with the College when they learn of conduct that violates our Nondiscrimination Policy or information about a crime that may have occurred on Wheaton College’s campus. Confidential resources available to students include Confidential Advisors, the Counseling Center, Student Health Services, and the Chaplain’s Office. More information on these resources and College Policies is available [http://www.wheaton.edu/equityandtitleIX](https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Fwww.wheaton.edu%2FequityandtitleIX&data=04%7C01%7Csarah.miglio%40wheaton.edu%7C4f35ebe382a948bcad8b08d95cd45990%7Cb7098c8ac6b24e8bba4c872cf5f00a20%7C0%7C0%7C637642889360399308%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C1000&sdata=FgelKVi3Go%2FEdkXq84mcTidnr1a8aaHqGzkL2Msg51w%3D&reserved=0).

**Course Work:**

**Overview**

For academic discourse, spoken and written, the faculty expects students to use gender inclusive language for human beings.

Throughout this course, you will engage with the subject of Inorganic Chemistry through:

- Readings

- Lectures

- Problem Sets

- Laboratory

- Exams (3 section exams and a final exam)

These tools are meant to build on each other. The best way to succeed in this class is to keep up with the coursework and material *as it is being presented*. Reading will be your first exposure to material. Lectures will be used to emphasize material *you already learned during your reading*, presenting it in a new (and exciting!) way. Problem sets will allow you to apply this material to a multitude of circumstances, and the lab will give you real-world experience with chemical topics. If your grade begins to suffer it is usually due to performance on cumulative assignments (exams, etc.). However, the best way to prevent this is to focus instead on the fundamentals (readings, note-taking, asking questions in class!).

You will be given a numerical score that evaluates your performance on each element of this course. An overall score will be calculated according to the final score formula:

Laboratory 20%

Homework 15%

Section Exams 3×15%

Final Exam 20%

Again, each assignment is given a *score*, not a grade! Your final grade is assigned based on this score. While each assignment is graded on the same scale, some assignments are easier than others. The best way to monitor your performance in this class is to use the final score formula (above) to calculate your predicted final score and then compare it to the chart below. In the chart below, I have listed the low score cutoff for a certain grade. With it, I include the Wheaton College Faculty Handbook definitions of what a grade says about a student’s performance. This rubric is a guide; the instructor reserves the right to adjust each grade on this scale (not likely by more than 2%) to account for year-to-year fluctuations in exam difficulty, course structure, etc. I generally use a ‘natural break’ method to decide on final grade cutoff values.

A 90% Distinctive

A− 85% Superior

B+ 80% Superior

B 75% Superior

B− 70% Acceptable

C+ 65% Acceptable

C 60% Acceptable

C− 55% Inadequate

D 45% Inadequate

F <45% Failing

**Homework**

Homework assignments are due at *the beginning of class* on the day they are assigned. All assignments must be on *one side* of a sheet of paper, trimmed to remove any frills or fringes, and stapled. Late assignments will be accepted up to 5 calendar days late with a penalty of 10% per late day.

HMWK 1: 1.9, 12, 14, 15, 18, 22, 25, 30, 32, 33, 34a,b,d,f, 43b

HMWK 2: 2.3, 5, 9, 10, 12, 19, 22, 26, 28, 31

HMWK 3: 3.5, 8, 10, 13, 20, 23b,c,d,e, 25, 28 (for part b, find Al-Cl stretching modes by using Al–Cl bonds as basis functions), 32, 42a,b,c, 43

HMWK 4: 5.9, 10, 14, 17, 23, 27, generate a qualitative MO diagram for hypothetical SH4.

HMWK 5: 6.1, 2, 4, 6, 9, 10, 12, 14a, 17a, 22, 26, 34b,c

HMWK 6: 7.28, 29, 33a; 19.7, 8, 10, 17a,b,c, 24a, 25a; 20.2, 3, 5, 26, 36a,b

HMWK 7: 24.1a,b, 2, 3a,b,d, 10, 14, 22, 24

HMWK 8: See handout on schoology

**Reading Assignments**

Lectures will roughly follow the schedule outlined. The appropriate readings for each day are listed in the schedule below.

**Exams**

There will be three section exams that will make up the ‘exam’ grade for this course. Each exam is written to test the material covered in the previously untested sections. Each exam may draw on previously tested topics as foundational material, but care will be taken to keep each exam focused on new material. Students who expect to miss an exam should schedule a makeup date. Make up exams will be administered *before* the scheduled exam date, and should be scheduled at least 1 week prior to the exam. Students who cannot take an exam due to an emergency situation should alert the instructor as soon as possible, before the scheduled exam time. Students who miss exams for non-emergency situations without prior arrangements, may not be allowed to take the exam, or may take it for significantly reduced credit at the instructor's discretion.

**Final Exam**

Your final exam is scheduled on **Tuesday, May 2nd from 10:30 a.m.—12:30 p.m.** The final exam will be an ACS Foundations of Inorganic Chemistry exam. The final exam must be taken as scheduled unless prior permission is granted based on college-wide policy.

**Lab**

Lab experiments will be performed using the lab handouts found on Schoology. A separate lab syllabus will be distributed during the lab.

**Tentative Schedule**

| **Date** | **Topic/Chapter** |  | **Homework** |  |  | |
| --- | --- | --- | --- | --- | --- | --- |
| 1/9/22 | Introduction |  |  |  |  | |
| 1/11/22 | Basic concepts: Atoms/Ch. 1 |  |  |  |  | |
| 1/13/22 | Basic concepts: Atoms/Ch. 1 |  |  |  |  | |
| 1/16/22 | **MLK day—no class** |  |  |  |  | |
| 1/18/22 | Basic concepts: Atoms/Ch. 1 |  |  |  |  | |
| 1/20/22 | Basic concepts: Atoms/Ch. 1 |  |  |  |  | |
| 1/23/22 | Basic concepts: Molecules/Ch. 2 |  |  |  |  | |
| 1/25/22 | Basic concepts: Molecules/Ch. 2 |  | HMWK 1 due |  |  | |
| 1/27/22 | Basic concepts: Molecules/Ch. 2 |  |  |  |  | |
| 1/30/22 | Basic concepts: Molecules/Ch. 2 |  |  |  |  | |
| 2/1/22 | Intro to molecular symmetry/Ch. 3 |  | HMWK 2 due |  |  | |
| 2/3/22 | Intro to molecular symmetry/Ch. 3 |  |  |  |  | |
| 2/6/22 | Intro to molecular symmetry/Ch. 3 |  |  |  |  | |
| 2/8/22 | Intro to molecular symmetry/Ch. 3 |  |  |  |  | |
| 2/10/22 | Intro to molecular symmetry/Ch. 3 |  |  |  |  | |
| 2/13/22 | **Exam 1 (Ch. 1-3)** |  | HMWK 3 due |  |  | |
| 2/15/22 | Bonding in polyatomic mol/Ch. 5 |  |  |  |  | |
| 2/17/22 | Bonding in polyatomic mol/Ch. 5 |  |  |  |  | |
| **2/20/22** | **President’s day—no class** |  |  |  |  | |
| 2/22/22 | Structures of metals and salts/Ch. 6 |  | HMWK 4 due |  |  | |
| 2/24/22 | Structures of metals and salts/Ch. 6 |  |  |  |  | |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| 2/27/22 | Structures of metals and salts/Ch. 6 |  |  |  |  | " |
| 3/1/22 | Structures of metals and salts/Ch. 6 |  |  |  |  | |
| 3/3/22 | Coord Chemistry/Ch 7.11-13, 19, 20.1-20.5 |  | HMWK 5 due |  |  | |
| 3/6–3/10 | **Spring break. Woo.** |  |  |  |  | |
| 3/13/21 | Coord Chemistry/Ch 7.11-13, 19, 20.1-20.5 |  |  |  |  | |
| 3/15/21 | Coord Chemistry/Ch 7.11-13, 19, 20.1-20.5 |  |  |  |  | |
| 3/17/21 | Coord Chemistry/Ch 7.11-13, 19, 20.1-20.5 |  |  |  |  | |
| 3/20/21 | Organometallic Chemistry/Ch. 24 |  | HMWK 6 due (by exam) |  |  | |
| 3/22/21 | **Exam 2 (Ch. 5, 6, 7/19/20)** |  |  |  |  | |
| 3/24/21 | Organometallic Chemistry/Ch. 24 |  |  |  |  | |
| **3/27/21** | **ACS meeting—no class** |  |  |  |  | |
| **3/29/21** | **ACS meeting—no class** |  |  |  |  | |
| 3/31/21 | Organometallic Chemistry/Ch. 24 |  |  |  |  | |
| 4/3/21 | Organometallic Chemistry/Ch. 24 |  |  |  |  | |
| 4/5/21 | Organometallic Chemistry/Ch. 24 |  |  |  |  | |
| **4/7/21** | **Good Friday—no class** |  |  |  |  | |
| 4/10/21 | Organometallic Chemistry/Ch. 24 |  |  |  |  | |
| 4/12/21 | Introduction to Descriptive Chemistry |  |  |  |  | |
| 4/14/21 | Hydrogen/Chapter 10 |  | HMWK 7 due |  |  | |
| 4/17/21 | Alkali/alkaline earth metals/Ch. 11,12 |  |  |  |  | |
| 4/19/21 | Boron group/Ch. 13 |  |  |  |  | |
| 4/21/21 | Carbon group/Ch. 14 |  |  |  |  | |
| 4/24/21 | Pnictogens and Chalcogens/Ch. 15, 16 |  |  |  |  | |
| 4/26/21 | Halogens/Ch. 17 |  | HMWK 8 due (in Lab) |  |  | |
| 4/28/21 | **Exam 3 (everything else!)** |  |  |  |  | |