**Course Description:**

CHEM 4310 is an in-depth review of modern inorganic chemistry. Topics will include symmetry, acids and bases, reduction-oxidation reactions, periodic trends, coordination chemistry, organometallic chemistry, bioinorganic chemistry, and material chemistry. The course will meet for three hours of lecture and three hours of laboratory per week. This class may make use of the testing center and/or may give exams outside of regularly schedule class hours.

**Instructor:**

Dr. Jaime Murphy Office: Sci 127; Phone = 279-5836

 Lecture: MWF: 2:00 pm SCI

 Lab: R: 2:00-4:50 pm SCI 143

Office hours: MW: 3:00-5:00 pm

 T: 1:00-4:00 pm

 R: 10:00 am-12:00 pm

 F: 8:00-8:50 am

 Or by appointment

 Email: jmurphy3@harding.edu

**Required Materials:**

1. Textbook: *Inorganic Chemistry,* 7th edition, by Weller, Overton, Rourke, and Armstrong by Oxford (Previous editions are acceptable)
2. It is strongly recommended that students purchase the Solutions Manual to accompany the text, but not required.
3. Scientific Calculator: Should have at least scientific notation, square, square root, log and ln functions. The instructor reserves the right to inspect or erase the memories of programmable calculators before tests.
4. Chemical Splash Safety Goggles and Lab Coat: can be purchase in bookstore, and must completely seal the eye area (no safety glasses).

**University Learning Outcomes:**

Students will examine issues, ideas, artifacts, and/or events in order to formulate or assess an opinion or conclusion.

Students will identify and apply the principles and processes of scientific reasoning.

Students will demonstrate a broad perspective on the context of the past and the development of ideas that enables them to understand and evaluate current issues.

**Program Level Objectives:**

Students will understand the harmony between science and Christianity and be able to defend evidences for God as the creator.

Students will analyze data and scientific arguments in order to develop explanations to new situations.

Students will be able to work productively with a team of peers.

Students will be able to operate and interpret data from instrumentation commonly used in chemical laboratories.

Students will recognize key historical moments that drove the development of science and its role in the modern world.

Students will be able to use appropriate databases and other resources to locate scientific information in the primary literature to learn new concepts and apply this knowledge to further their scientific understanding.

**Student Learning Objectives for CHEM 4310:**

By the end of this course, students will be able to:

* Apply the general principles, laws, and theories of chemistry and place these in their proper historical context.
* Predict the bonding patterns, chemical properties and reactivity of an element based on its electronic structure.
* Predict and explain the molecular structures, shapes, and symmetry of molecules.
* Given appropriate constants and/or other relevant information, calculate and interpret the energetics, kinetics, equilibria, and electrochemistry of chemical reactions.
* Identify uses of coordination chemistry in the fields of material science, green chemistry, and bioinorganic chemistry.
* Design and conduct an experiment to achieve a predetermined goal.
* Perform laboratory experiments demonstrating safe and proper use of standard chemistry glassware, equipment, and chemicals.
* Record, graph, chart and conceptually and mathematically interpret data obtained from experimentation.
* Use critical thinking and logic in the solution of new problems.
* Develop an appreciation of the value of chemistry by identifying ways in which chemistry impacts our daily lives.
* Demonstrate an understanding for the intricate design contained in matter, citing examples from chemistry that could be used to indicate the hand of God in the design of matter.

**Lecture Attendance:**

Attendance is mandatory and will be recorded on a daily basis. Students are allotted three excused absences through the semester. Excused absences must be communicated prior to class time. Three percentage points per absence over three absences will be deducted for the student’s FINAL grade. Only students with excused absences will be allowed to redeem the points associated with in-class assignments and unannounced quizzes, but it is the responsibility of the student to follow up with the professor immediately upon his/her return to class. Once graded quizzes are returned to the class, then no make-ups will be allowed after that point. Unexcused absences are not allowed to make up the work.

Please notify the instructor via email any time that there is a potential conflict with class or lab. All students are expected to abide by the Student Handbook. A student may be asked to leave class or other activities if they are not in keeping with these instructions.

**Lab Activities and Attendance:**

The laboratory is a required part of the course and 25% of your course grade will be from lab. The Inorganic Lab will be project-based, and the students of the class will be expected to work together to plan and complete the assigned projects prior to the end of the semester. Attendance is required, but the instructor acknowledges that the time spent in the laboratory may be flexible and outside of the scheduled lab class. Students will be expected to keep a lab notebook and must document the work done by the group each week. Expectations for the notebook will be posted on Canvas. The notebook will be checked at the beginning of lab each week.

**Lecture Exams:**

Three exams will be interspersed throughout the semester, and a final, comprehensive exam will be given during exam week (Tuesday, May 3 at 1:00 pm). Exams will be administered outside of lecture time. Due to the small size of the class, we will come to an agreement about time as the exam approaches. The Final Exam will be the ACS Inorganic Chemistry Exam and will be administered by the instructor.

**Policy on Make-up Exams or Quizzes:**

If you do have a valid emergency which will cause you to miss an exam, contact your professor **before** the exam. Unless **prior** arrangements are made with your professor, the student will receive a grade of “0” on the exam. **Remember**, it is your responsibility to contact your professor as soon as you know there is a conflict.

**Credit Hour Calculator:**

For every course credit hour, the typical student should expect to spend at least three clock hours per week of concentrated attention on course-related work, including but not limited to time attending class, as well as out-of-class time spent reading, problem solving, reviewing, organizing notes, preparing for upcoming quizzes/exams, developing and completing projects, and other activities that enhance learning. Thus, for a three-hour course, a typical student should expect to spend at least nine hours per week dedicated to the course. The lab time contributes an additional three hours per week for laboratory technique and instruction.

**Students with Disabilities:**

It is the policy for Harding University to accommodate students with disabilities, pursuant to federal and state law. Therefore, any student with a *documented disability* condition (e.g. physical, learning, or psychological) who needs to arrange reasonable accommodations must contact the instructor and the Disabilities Office at the *beginning* of each semester. (If the diagnosis of the disability occurs during the academic year, the student must self--‐identify with the Disabilities Office *as soon as possible* in order to get academic accommodations in place for the remainder of the semester.) The Disabilities Office is located in Room 205 in the Student Center, telephone, (501) 279-4019.

**Dress Code:**

All members of the Harding community are expected to maintain standards of modesty and decency in dress appropriate to the Christian lifestyle and consistent with professional employment expectations. For these reasons, students are expected to adhere to an established dress code.

For lab, you should be covered from the waist down and wear close-toed shoes. You may only wear leggings if your shirt/dress covers to your knees. You must also wear chemical splash-proof safety goggles while in the laboratory.

**Academic Integrity:**

Honesty and integrity are characteristics that should describe each one of us as servants of Jesus Christ. As your instructor, I pledge that I will strive for honesty and integrity in how I handle the content of this course and in how I interact with each of you. I ask that you join me in pledging to do the same.

Academic dishonesty will result in penalties up to and including dismissal from the class with a failing grade and will be reported to the Associate Provost. All instances of dishonesty will be handled according to the procedures delineated in the Harding University catalog. All material for this course, whether in lecture or lab, must be your, and only your, work. **If you are caught cheating or engaged in plagiarism, you will receive an F for the course.** If you have a question as to what behavior is proper, including what constitutes plagiarism, please do not hesitate to ask. It is your responsibility to know how to avoid academic dishonesty. Please also remember that discussing exam questions with another student before or after you take an exam is an academic integrity violation.

Copying the work of fellow students and turning it in for credit is unethical and contributes nothing to a person’s professional development. It is also wrong to encourage this type of activity by allowing others to use (and sometimes improve upon) your original work. Therefore, any assignments turned in that contain substantial duplication of another student’s work will not be tolerated. If duplication is found, a grade of zero for the assignment will be assigned to all parties having duplicate work.

For exams, no supplemental materials may be utilized unless provided by the professor or the testing lab. This description includes, but is not limited to: equation sheets, periodic tables, index cards, programmed calculators, phones, or computers. Everything needed for the exams will be provided by the instructor.

**Assessment**: Harding University, since its charter in 1924, has been strongly committed to providing the best resources and environment for the teaching--‐learning process. The board, administration, faculty, and staff are wholeheartedly committed to full compliance with all criteria of the Higher Learning Commission. The university values continuous, rigorous assessment at every level for its potential to improve student learning and achievement and for its centrality in fulfilling the stated mission of Harding. Thus, a comprehensive assessment program has been developed that includes both the Academic units and the Administrative and Educational Support (AES) units. Specifically, all academic units will be assessed in reference to the following Expanded Statement of Institutional Purpose: **The University provides programs that enable students to acquire essential knowledge, skills, and dispositions in their academic disciplines for successful careers, advanced studies, and servant leadership.**

**Cell Phones:**

Nothing communicates disrespect for your professor or any other public speaker like looking at your cell phone during a lecture. You will not be called out for utilizing a cell phone in class, but you should know that it is observed and may be detrimental to you in circumstances for which you are seeking mercy.

**Evaluation:**

 3 Unit Exams 30%

 Final Exam 20%

 Laboratory 25%

 Quizzes and Reviews 10%

 Special Project Presentation 5%

 Problem Sets 10%

 Total possible 100%

**Grading Policy:**

The final course grade is based on your total number of points from your exams, quizzes, homework, and your lab performance. Final grades will be based on the following scale.

 89.5 and above = A (Outstanding)

 79.5 and above = B (Above Average)

 69.5 and above = C (Average)

 59.5 and above = D (Below Average)

 59.4 and below = F (Failure)

**Problem Sets:**

Students will be assigned one problem set per unit, which will be due the week before the exam for that unit. Students are expected to use the problem set to prepare themselves for the topics covered in that unit. It is expected that students will attempt all problem sets on their own but may discuss and work through the problems with their classmates. Answers to discussion-type questions should never be exactly the same as their classmates.

**Quizzes and Reviews:**

Quizzes will be administered periodically, usually at the conclusion of each chapter. It is recommended that students use the questions at the end of each chapter of the text to prepare for these quizzes. Every third week (not on the same week as a problem set or exam), a paper will be assigned for review. Instructions for reading, review, and discussion can be found on Canvas.

**Special Project Presentation:**

Students will choose a special topic to present on regarding Inorganic Principles in Current Chemical Research. Students will be expected to give a 20 minute presentation on the topic. Details and rubrics will be provided on Canvas.

**Lab Grades:**

The advanced inorganic chemistry lab will challenge the students to incorporate lab skills learned throughout their undergraduate careers. Six projects will be completed throughout the semester, with focus on synthesis and characterization techniques used in inorganic laboratories. Each student will be expected to choose one of six projects to write up as a formal lab report. In addition, the final project will be completed and written as a group in ACS format for publication. Grading will be broken down as follows: 50% Lab Notebook for all projects, 25% Individual Lab Report, 25% ACS Publication.

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| --- | --- | --- | --- | --- | --- | --- |
| **Wk** | **Day** | **Date** | **Tentative Lecture Topic** | **Chap** | **Wk** | **EXAMS** |
| 1 | M | 10-Jan | Atomic Structure | 1 | 1 |  |
|  | W | 12-Jan | Molecular Structure and Bonding | 2 |  | Nomenclature Ch. 7 |
|  | F | 14-Jan | Ch.1 and 2 Quiz | 2 |  |  |
| 2 | M | 17-Jan | Martin Luther King, Jr Day |  | 2 |  |
|  | W | 19-Jan | Reteaching for 1 and 2 | 1,2 |  |  |
|  | F | 21-Jan | Molecular Structure Theory Literature Discussion |  |  |  |
| 3 | M | 24-Jan | Symmetry | 3 | 3 | Exam 1 |
|  | W | 26-Jan | Symmetry | 3 |  |  |
|  | F | 28-Jan | Symmetry | 3 |  |  |
| 4 | M | 31-Jan | Symmetry | 3 | 4 |  |
|  | W | 2-Feb | Symmetry | 3 |  |  |
|  | F | 4-Feb | Solid State | 4 |  |  |
| 5 | M | 7-Feb | Solid State | 4 | 5 |  |
|  | W | 9-Feb | Solid State | 4 |  |  |
|  | F | 11-Feb | Solid State | 4 |  |  |
| 6 | M | 14-Feb | Acids and Bases | 5 | 6 |  |
|  | W | 16-Feb | Acids and Bases | 5 |  | Exam 2  |
|  | F | 18-Feb | Acids and Bases | 5 |  |  |
| 7 | M | 21-Feb | Oxidation and Reduction | 6 | 7 |  |
|  | W | 23-Feb | Oxidation and Reduction | 6 |  |  |
|  | F | 25-Feb | Oxidation and Reduction | 6 |  |  |
| 8 | M | 28-Feb | Physical Techniques | 8 | 8 |  |
|  | W | 2-Mar | Physical Techniques | 8 |  |  |
|  | F | 4-Mar | Physical Techniques | 8 |  |  |
| 9 | M | 14-Mar | Electronic Structure and Properties | 20 | 9 |  |
|  | W | 16-Mar | Electronic Structure and Properties | 20 |  |  |
|  | F | 18-Mar | Electronic Structure and Properties | 20 |  |  |
| 10 | M | 21-Mar | Reaction Mechanisms | 21 | 10 |  |
|  | W | 23-Mar | Reaction Mechanisms | 21 |  |  |
|  | F | 25-Mar | Reaction Mechanisms | 21 |  |  |
| 11 | M | 28-Mar | TBA | Proj | 11 | Exam 3 |
|  | W | 30-Mar | TBA | Proj |  |  |
|  | F | 1-Apr | TBA | Proj |  |  |
| 12 | M | 4-Apr | Organometallic Chemistry | 22 | 12 |  |
|  | W | 6-Apr | Organometallic Chemistry | 22 |  |  |
|  | F | 8-Apr | Organometallic Chemistry | 22 |  |  |
| 13 | M | 11-Apr | F-block Chemistry | 23 | 13 |  |
|  | W | 13-Apr | F-block Chemistry | 23 |  |  |
|  | F | 15-Apr | F-block Chemistry | 23 |  |  |
| 14 | M | 18-Apr | Materials and Nanomaterials | 24 | 14 |  |
|  | W | 20-Apr | Materials and Nanomaterials | 24 |  |  |
|  | F | 22-Apr | BioInorganic | 26 |  |  |
| 15 | M |  25-Apr | BioInorganic | 26 | 15 |  |
|  | W | 27-Apr | Medicinal Applications | 27 |  |  |
|  | F | 29-Apr | Medicinal Applications | 27 |  |  |
|  Exam 4 – Tuesday, May 3, 1:00 PM |

Laboratory Resources Used:

[Synthesis and Characterization of M(acac)2 Complexes](https://www.ionicviper.org/lab-experiment/metal-acac-complexes-covid-19-version), Woolins/adapted by A. Johnson

[Nanoparticle Synthesis,](https://www.ionicviper.org/lab-experiment/preparation-and-characterization-nanoparticles) K. Grice/adapted

Coordination Complexes as Catalysts from,

Charleton, K.D.M, Prokopchuk, E.M. *J. Chem. Educ.* **2011**, 88, 1155-1157

Problem Sets or Learning Activities Used or Adapted:

[Atomic Orbital Review](https://www.ionicviper.org/class-activity/first-day-review-atomic-orbitals), M. Geselbracht