SJSU SAN JOSÉ STATE UNIVERSITY

College of Science · Chemistry

Inorganic Chemistry Section 01

CHEM 145

Fall 2023 3 Unit(s) 08/21/2023 to 12/06/2023 Modified 08/10/2023

Contact Information

Instructor: Madalyn R. Radlauer

Email: madalyn.radlauer@sjsu.edu
Office: ISB 254
Phone: 408-924-5482

Office Hours

Scheduled: Mondays 2:00 pm to 3:00 pm, Fridays 10:00 am to 11:00 am
ISB 254

You can also request additional office hours at any point (virtual or in person), just connect with me to schedule them.

Course Description and Requisites

Development of unifying principles to understand the chemistry of the elements. An introduction to the chemistry, bonding theories and applications of coordination compounds.

Prerequisite: CHEM 112B (with grade of "C" or better; "C-" not accepted).

Co-requisite: CHEM 113A (with grade of "C" or better; "C-" not accepted).

Letter Graded

Classroom Protocols

Safe and Respectful Community

I want our classroom to serve as an environment that will promote learning and the development of new ideas, as well as be a safe and respectful community. If anything in the classroom makes you feel uncomfortable or disrespected, especially if it is something that I say or do, please bring it to my attention. You all are students, but you are people first and foremost, and the classroom should be a place you feel welcomed and respected.

Email and Canvas Messages

I will do my best to respond to class-related emails or Canvas messages within 1 business day of receiving them.

Attendance and Illness

As a show of respect to your fellow classmates and me, please be on time to class; we will start at 9:00 am.

Please do not come to class if you do not feel well. Email me and I can set up one of two options for you.

1. If you would like to attend class virtually, we can set up a Zoom meeting as long as you email me at least 10 minutes before class starts.

2. I can get notes sent to you and arrange for you to make up any group work.

If you have COVID symptoms, a positive COVID test, or are exposed to someone who tests positive for COVID, do not come to campus. Email me and I will send you a follow up email with the appropriate protocols to follow. I will do my best to make accommodations so that your progress and grade are not negatively affected should this occur.

There may be other reasons why you may need to miss class or an assignment at some point in the semester. If this is the case, please contact me ahead of class time and with as much of a heads up as possible and we can discuss the situation. The more heads up you can give me, especially with regards to missing exams or assignment deadlines, the better. Even if you cannot give me a heads up, reach out. I will do my best to be accommodating.

Course Goals

The goal of this course is to provide an introduction to inorganic chemistry, specifically regarding periodic trends, bonding theory, molecular symmetry, atomic and molecular orbitals, and coordination compounds.

Course Learning Outcomes (CLOs)

Upon successful completion of this course, students will be able to:

CLO 1: Predict and classify the structures of various inorganic complexes.

CLO 2: Predict the properties of various inorganic complexes and use this prediction to distinguish between molecules.

CLO 3: Discuss and employ atomic structure and bonding models, including molecular orbitals, to interpret experimental and spectroscopic evidence.

CLO 4: Apply concepts and models of symmetry, structure, and bonding to other areas in chemistry such as organic and biochemistry, and to use these concepts to more deeply examine many aspects of biology, forensic science, materials science, and environmental science.

These CLOs are connected to several of the Department of Chemistry's Program Learning Objectives (PLOs), which are listed below.

Upon successful completion of this program,

PLO 1.1: Students will be able to identify, formulate, and solve a range of chemistry problems (fundamental to complex) through application of mathematical, scientific, and chemical principles.

PLO 1.2: Students will be able to recognize, relate, and/or apply chemistry terms and concepts to propose and solve interdisciplinary and multidisciplinary real world problems.

PLO 3.1: Students will be able to explore, critique, and reflect on how chemistry relates to society, culture, and issues of equity and ethics that shape their scientific beliefs and identities.

PLO 3.2: Students will be able to identify as scientists within the scientific community through constructing peer reviews, engaging in collaborations, and participating in mentorship.

Course Materials

Inorganic Chemistry (textbook)

Author: Gary L. Miessler, Paul J. Fischer, and Donald A. Tarr
Publisher: Pearson
Edition: 5th Edition
ISBN: ISBN-13: 9780137518425
Optional
Availability: Pearson website
Price: you can rent for $10.99/month, or purchase for $229.32

Because this text is expensive, I am in the process of transitioning to a free textbook option. The site is still under construction so it's not a complete text, but you can find some useful readings at the following website: https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Map%3A_Inorganic_Chemistry_(Miessler_Fischer_Tarr) (https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Map%3A_Inorganic_Chemistry_(Miessler_Fischer_Tarr)).

Model Kit (highly recommended)

A model kit can be a great help in this course, especially early on. Look for one with atoms that can bind to 1-6 other atoms or groups. I have some small kits I can loan out for the semester if you do not have one.

Library Liaison

You should have a student library account with the King Library that allows you access the library electronic databases. If you plan to access the library services from off-campus, you may need to obtain a password and/or proxy to do so. Check the Library website for information. The reference Librarian for Chemistry is Anne Marie Engelsen and her email is annemarie.engelsen@sjsu.edu.

Course Requirements and Assignments

Graded work will include in-class group quizzes (14 quizzes, 15 points each, 210 points), in-class worksheets (14 worksheets, 10 points each, 140 points), take-home problems (13 THPs, 20 points each, 260 points), two midterm exams (100 points each, 200 points), and one comprehensive final exam (200 points), which all contribute to the course learning outcomes. There are also some tiny assignments in the start here module (10 points) and a course survey (10 points). In total, this comes to 1030 points, but the class will be graded out of 1000 points, which means that there are 30 extra credit points already built into the class.

Dates for the exams are in the Course Schedule below. All relevant dates are also posted to Canvas.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course related activities, including but not limited to internships, labs, and clinical practica. Other course structures will have equivalent workload expectations as described in the syllabus.

Weekly Workflow

Weekday	Activity
before Monday's class	Watch the lecture video and read the discussion prompt
Monday's class	Discussion on prompt with neighbor, lecture/discussion altogether, then start Group Quiz (last 10-15 minutes); submit Take-Home Problem (from last week) by midnight
before Wednesday's class	Look through the recommended reading, skim the worksheet, continue back-and-forth on Group Quiz
Wednesday's class	Worksheets in groups
before Friday's class	Finalize Group Quiz responses
Friday's class	Lecture/discussion to take the material to the next level

Course Modules

The course is organized into three modules on Canvas, each covering about 5 weeks of material. These modules will include the lecture videos, discussion prompts, recommended reading, worksheets, and assessments for each major course topic. Later modules will rely on the information learning earlier in the course, so numerous checkpoints are built into the course. I hope you'll ask questions early and often. The two midterms would roughly cover Module 1 and 2, respectively. The final exam is cumulative.

Group Quizzes

Each Monday during the last 10-15 minutes of class, you will do a Group Quiz, but this content will not be graded until after office hours on Friday. These quizzes will be brief and generally cover things from the pre-class video and that day's in-class discussion (though material from the previous week(s) may also be relevant). The format will typically include 1 or 2 multiple choice questions with space to explain your answers. The questions are intended to get you to think about the new material and try to apply it to a question or two. For this assignment, your group will discuss the question(s) and put down your initial ideas and then we will have back-and-forth in the comment section via Canvas before you submit your "final" answer for grading. It is expected that every student in the group will contribute to the back-and-forth. If this is not the case, then only those who contribute will benefit point-wise from the revision of the answer. Each group quiz is worth 15 points, but if you are not contributing to the back-and-forth, the maximum points you can earn is 5.

In-class Worksheets

Worksheets will be posted to the module and you are expected to skim through it before class each Wednesday. I formatted these so that you can do your work directly on the worksheets. I will have printed copies for everyone in class (though if you prefer to work on a tablet or similar, let me know and I won't waste the paper printing it). I will come around to each group to check in and offer assistance. I expect you to use this time to engage with the material and work together. These worksheets will be graded for participation. You do not need to complete the worksheet to get credit, but I recommend that you complete all of the worksheets as these are intended to help you learn the material. Keys for the worksheets will be posted on the page for that week in the Canvas module.

Take-home Problems

Instead of having large problem sets due a few times throughout the semester, we are using a model where there will be one or two questions to work through each week. They will be posted weekly (by the end of class on Wednesday at the latest) and will be due by midnight on Monday. Typically, you will both have to provide solutions as well as explain how you went about getting them and why your solution makes sense to you. The Take-home Problems are intended to challenge you, so don't be surprised if they're tough. My goal is that these questions be more difficult than anything you see on the midterms so that if you have a good understand of them, you'll rock the exams. You are welcome to bring questions about the Take-home problems to me at office hours, etc. or to work on them in groups as long as everyone does their own work. I will try to get you feedback within a week and I will post the key right away so that you can use them to study.

Recommended Reading

In each module, I will post recommended reading from the book. While this is not required, it offers you another way to learn the material.

Extra Practice Problems (optional)

In addition to the graded Take-home Problems, I will post ungraded little quizzes in each module. These will typically be multiple choice and will rely on the material covered in Monday's and Wednesday's class periods. They might also be right out of the week's recommended reading and they will be auto-graded by Canvas. I will also post recommended problems from the textbook. These will not be graded, but I have often gotten requests for more practice problems, so here they are! Feel free to pick and choose which exercises you attempt, I list all of the problems that I think are interesting/well-suited to how I teach the course, so they might start to feel repetitive. Solutions to exercises are at the back of the textbook (Appendix A) and solutions to the problems have been posted to Canvas. While all the solutions are provided to you up front, remember that you will learn more effectively by attempting the problems before looking at the answers. Note that I don't use multiple choice on exams and my way of writing questions is a bit different from the book, so these extra practice problems will not map perfectly to the midterms and final, though the content is directly related to what we are covering.

Missed Exams or Assignments

The difficult circumstances of the past >3 years have not gone away and I am aware that the havoc in our world has forced us to work and learn under various stressors. This may make it more difficult for you to maintain a steady schedule and you may need to miss class or an assignment at some point in the semester. If this is the case, please contact me ahead of class time and with as much of a heads up as possible and we can discuss the situation. The more heads up you can give me, especially with regards to missing exams or assignment deadlines, the better. Even if you cannot give me a heads up, reach out. I will do my best to be accommodating.

Final Examination or Evaluation

The Final Exam is comprehensive and will be have a range of question styles that will be similar to the other assignments and exams in the course.

Grading Information

Breakdown

Points will be distributed as described in Course Requirements and Assignments above. I will not curve because I believe that everyone can succeed in this course. I may, at the end of the course, linearly shift the scale. I will only shift it to benefit you. The course grade will be determined from the resulting average of the point total as follows.

Grade	Range	Notes
A plus	96 and above	
A	92 to 95.9	
A minus	88 to 91.9	
B plus	84 to 87.9	
B	80 to 83.9	
B minus	76 to 79.9	
C plus	72 to 75.9	
C	68 to 71.9	
C minus	64 to 67.9	
D plus	60 to 63.9	
D	50 to 59.9	
F	less than 50	

University Policies

Per University Policy S16-9 (PDF) (http://www.sjsu.edu/senate/docs/S16-9.pdf), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on the Syllabus Information (https://www.sjsu.edu/curriculum/courses/syllabus-info.php) web page. Make sure to visit this page to review and be aware of these university policies and resources.

Course Schedule

The tentative course calendar below includes weekly course content, exam dates, and the date for the final exam. Dates may be subject to change, but prior to this, fair notice will be given during class and through Canvas. The recommended reading and problems from our primary textbook, Inorganic Chemistry by Miessler, Fischer, and Tarr will be listed on the Canvas site along with each module. The related modules are indicated in bold as M1, M2, and M3.

When	Topic	Notes

When	Topic	Notes
Class 1, Week 1 M 8/21/23	First day of classes	Introduction to the course
Class 2, Week 1 W 8/23/23	Module 1	Drawing structures and finding symmetry elements
Class 3, Week 1 F 8/25/23	Module 1	Symmetry elements worksheet
Class 4, Week 2 M 8/28/23	Module 1	Point groups
Class 5, Week 2 W 8/30/23	Module 1	Point groups worksheet
Class 6, Week 2 F 9/1/23	Module 1	Character tables
no class M 9/4/23	Labor Day	
Class 7, Week 3 W 9/6/23	Module 1	Character tables worksheet
Class 8, Week 3 F 9/8/23	Module 1	How to use character tables
Class 9, Week 4 M 9/11/23	Module 1	How to use character tables
Class 10, Week 4 W 9/13/23	Module 1	Reducing reducible representations worksheet
Class 11, Week 4 F 9/15/23	Module 1	Applications in vibrational spectroscopy
Class 12, Week 5 M 9/18/23	Module 1	Applications in vibrational spectroscopy
Class 13, Week 5 W 9/20/23	Module 1	Vibrational spectroscopy worksheet
Class 14, Week 5 F 9/22/23	Module 2	Diatomic MO diagrams

When	Topic	Notes
Class 15, Week 6 M 9/25/23	Module 2	Moving to larger molecules
Class 16, Week 6 W 9/27/23	Module 2	Diatomic MO diagrams worksheet
Class 17, Week 6 F 9/29/23	Module 1	**Midterm Exam 1**
Class 18, Week 7 M 10/2/23	Module 2	SALCs
Class 19, Week 7 W 10/4/23	Module 2	SALC The Game
Class 20, Week 7 F 10/6/23	Module 2	Using SALCs for MO diagrams
Class 21, Week 8 M 10/9/23	Module 2	MO diagrams of more complex molecules
Class 22, Week 8 W 10/11/23	Module 2	MO theory worksheet
Class 23, Week 8 F 10/13/23	Module 2	Understanding the reactivity of molecules that do not contain transition metals by looking at their MO diagrams
Class 24, Week 9 M 10/16/23	Module 2	How peripheral groups (aka ligands) contribute to an MO diagram and classifying ligands as sigma donors, pi donors, and pi acceptors – starting MO diagrams of octahedral complexes
Class 25, Week 9 W 10/18/23	Module 2	MOs of octahedral complexes worksheet
Class 26, Week 9 F 10/20/23	Module 2	MOs of octahedral complexes and delta octahedral (aka d-d splitting)
Class 27, Week 10 M 10/23/23	Module 2	Putting the right number of electrons into the MOs: electron counting and d count
Class 28, Week 10 W 10/25/23	Module 2	Electron counting and ligand type worksheet
Class 29, Week 10 F 10/27/23	Module 2	MOs of complexes with other geometries

When	Topic	Notes
Class 30, Week 11 M 10/30/23	Module 3	Trends in d-d splitting
Class 31, Week 11 W 11/1/23	Module 2	Module 2 review worksheet
Class 32, Week 11 F 11/3/23	Module 2	**Midterm Exam 2**
Class 33, Week 12 M 11/6/23	Module 3	Spectrochemical series and high and low spin complexes and distortions of the ligand field
Class 34, Week 12 W 11/8/23	Module 3	Predicting high spin or low spin worksheet
no class F 11/10/23	Veterans Day	
Class 35, Week 13 M 11/13/23	Module 3	How MO diagrams relate to electronic spectra and types of charge transfer
Class 36, Week 13 W 11/15/23	Module 3	TS Diagrams worksheet and some online tools
Class 37, Week 13 F 11/17/23	Module 3	How MO diagrams related to magnetism and ways to measure magnetism
Class 38, Week 14 M 11/20/23	Module 3	Charge transfer and magnetism, 2-part worksheet
no class W 11/22/23	Thanksgiving break	
no class F 11/24/23	Thanksgiving break	
Class 39, Week 15 M 11/27/23	Module 3	Reactivity of transition metal complexes: Ligand exchange
Class 40, Week 15 W 11/29/23	Module 3	Ligand substitution worksheet
Class 41, Week 15 F 12/1/23	Module 3	Organometallic catalysis
Class 42, Week 16 M 12/4/23	Module 3	Bioinorganic chemistry

When	Topic	Notes
Class 43, Week 16 W 12/6/23	Last day of classes	Review and course wrap-up
W 12/13/23	Cumulative	**Final Exam** at 7:15 - 9:30 am in our usual classroom (sorry it's so early; I have no control over this!)