

Department of Chemistry and Biochemistry, CEFNS
CHM 350: Inorganic Chemistry I

Fall 2022

Instructor: Dr. Tony Hascall

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Lectures: Monday, Wednesday and Friday, 11:30 a.m. – 12:20 p.m., Building 36,
Room 212. Holidays: 9/5, 11/11, 11/25

Final exam: Wednesday December 14th, 10:00 am-12:00 noon.

Office Hours:

Tuesdays 11:00 a.m. – 12:00 noon, Thursdays 2:00 – 3:00 p.m. and Fridays 10:00 –
11:00 a.m. (and other times by appointment)

Course Description:

This is an introductory survey course that covers some of the fundamentals necessary for the understanding of the importance and relevance of inorganic chemistry in the fields of chemistry, life sciences and environmental studies. This course will prepare students for the advanced inorganic chemistry course (CHM 450C) as well as for graduate studies or professional school.

Course prerequisites:

First semester organic Chemistry (CHM 235 or equivalent) with a grade of C or better. Physical Chemistry (CHM 341) is a suggested corequisite

Required Course Materials (textbooks)

1. *Inorganic Chemistry*, Miessler, G. and Tarr, D. (4th Edition) Pearson, 2009
2. *Molecular Symmetry and Group Theory*, Vincent, Alan (2nd Edition) Wiley, 2001

Earlier editions of these texts will be OK, although page and figure numbers, and homework questions from earlier editions may not align with those stated in the lecture notes. The 5th edition of Miessler and Tarr is missing important sections.

It is also recommended that you have a molecular model kit, particularly one that can model the geometries typically encountered in inorganic chemistry.

Communication:

Check the class webpage often for updates. I will occasionally send announcements to the class by email, so be sure to check your NAU e-mail account regularly. Email is the best way to contact me. Please include in your messages a subject indicating that it relates to CHM 350, an appropriate salutation, grammatically acceptable text, and a closing. Messages lacking these elements may be ignored!

Reading: Sections to be read from the textbooks will be announced in class and posted on the class webpage. It is very important that you read the sections that are assigned. The lectures alone will not suffice.

The course will cover the following topics for the class (4th Edition of Miessler and Tarr):

1. Atomic structure; *d* orbitals; periodic trends (Chapter 2)
2. Introduction to main group chemistry; simple bonding; VSEPR (Chapters 3, 8)
3. Symmetry, point groups and group theory (Chapter 4 and Vincent book)
4. Structure and nomenclature of inorganic complexes (Chapter 9)
5. Bonding in inorganic complexes; crystal and ligand field theories (Chapter 10)
6. Electronic spectra of inorganic complexes (Chapter 11)
7. Reactions and mechanisms of inorganic complexes (Chapter 12)
8. Hard and soft acid and base theory (Chapter 6)
9. Organometallic chemistry and catalysis (Chapters 13-14)
10. Bioinorganic and environmental chemistry – as time permits (Chapter 16)

Student Learning Expectations/Outcomes for this Course:

The objective of the class is to introduce you to important concepts in inorganic chemistry, including the topics listed above. You should also become familiar with some of the roles of inorganic chemistry in the different fields of science including atmospheric science, biochemistry, biology and physics.

Assessment of Student Learning Outcomes:

1. **Midterm Exams:** There will be three 50-minute, in-class exams given on the dates specified on the class schedule. Exceptions to these dates will only be given for extenuating circumstances (institutional excuse, medical or family emergencies), which must be certified in writing in advance, and then adjustments may be made on a case-by-case basis. The exams will consist of mainly short-answer questions, both conceptual and calculations, and possibly some multiple choice.
2. **Quizzes:** To encourage you to keep up with the material, brief (approx. 10 mins.) quizzes will be given each week at the beginning of class, generally on Mondays, except on a Monday following an exam. Each quiz will be scaled to be worth 3 % of the class grade. **No early or make-up quizzes will be given for any reason**, but your lowest quiz score will be dropped (the ten best quiz scores will be counted) so if you must miss a quiz for any reason, then that will be your dropped score. There *may* be other opportunities to make up missed quiz scores during the semester.
3. **Final Exam:** The final exam will cover material from the entire semester, and may consist of multiple choice, short-answer and essay type questions. The exam is scheduled for Wednesday December 14th, 10:00 am-12:00 noon
4. **Homework:** Suggested problems from the textbooks will be assigned. These will be posted on the class schedule web page and announced in class. While these problems will not be collected or graded, it is strongly recommended that you work all of the assigned problems, which will likely have a positive impact on your grade.

Grading Policies

Your final grade in the class will depend on the percentage of the points that you earn. The following grade scale is guaranteed: > 90% for an A, 80-89% for a B, 65-79% for a C, 50-64% for a D. These are the *maximum* cutoffs for each letter grade; you are guaranteed at least the appropriate grade for your total points. The **cutoffs may be lowered** (but not raised) when the final grades are calculated, if appropriate.

The points in the class will be assigned as follows:

Item	% of Grade
Three midterm exams (10 % each)	30
Quizzes (3 % each)	30
Positive Class Participation	10
Final Exam	30
TOTAL	100

Note: in the event of an extraordinary circumstance, including, but not limited to, an exam being cancelled due the campus being closed, the instructor reserves the right to modify the above grading scheme to one more appropriate for the new circumstances.

Attendance: It is highly recommended that you attend all lectures. There is a strong correlation between performance in the class and attendance. A portion of the grade is for “positive class participation.” To receive the maximum grade in this category, you should attend every class, ask questions, and respond when questions are posed to the class. Attendance will be monitored by a sign-in sheet. Not attending class will result in a reduction in this part of the grade.

Electronic Devices

Please do not use your cellphone during class. Computers and tablets etc... may only be used for class-related purposes (*e.g.* taking notes).

Academic Integrity: The university’s academic integrity policy will be followed (<https://policy.nau.edu/policy/policy.aspx?num=100601>). If you are caught cheating on an assignment, you will receive 0 % for that assignment. If you are caught cheating a second time, or are caught cheating on the final exam, you will receive an “F” for the entire course. Examples of cheating include, but are not limited to, copying another student’s test, using any unauthorized material to help answer test questions or attempting to receive participation credit for a class you did not attend. All violations of academic integrity will be documented with the university. ***Having a cellphone, smart watch or any other web-enabled device within reach during a test will be considered a violation of academic integrity and will result in a score of zero for that assignment.***

Class Schedule

The proposed schedule of lecture topics, as well as dates of quizzes and exams are shown on the schedule on the next page. The schedule is also on the class webpage (<http://jan.ucc.nau.edu/~ah476/CHM350Schedule.html>), and any changes to the schedule will be posted there. Please note the important dates on the schedule.

Week #	Monday	Wednesday	Friday
1 (8/29-9/2)	Introduction The Structure of the Atom	The Bohr Model of the Hydrogen Atom and the Rydberg Equation	Quiz 1 Quantum Numbers, Electron Configurations and <i>d</i> Orbitals
2 (9/5-9)	No Class – Labor Day	Electron Configurations Thursday (9/8) is the add/drop deadline	The Slater Rules and Effective Nuclear Charge
3 (9/12-16)	Quiz 2 Trends in the Periodic Table and Simple Bonding	Main Group Chemistry; Formal Charge and Steric Geometry	Main Group Chemistry and VSEPR
4 (9/19-23)	Quiz 3 VSEPR; Intro to Symmetry	Symmetry Operations	EXAM 1
5 (9/26-30)	Symmetry: Point Groups	Symmetry: Point Groups	Symmetry: Point Groups
6 (10/3-7)	Quiz 4 Symmetry: Character Tables; Reducible and Irreducible Reps	Symmetry and Molecular Vibrations	Symmetry and Molecular Vibrations
7 (10/10-14)	Quiz 5 Introduction to Inorganic Complexes	Inorganic Complexes: Ligands	Geometries and Coordination Numbers of Inorganic Complexes
8 (10/17-21)	Quiz 6 Isomers of Inorganic Complexes	Nomenclature of Inorganic Complexes	EXAM 2
9 (10/24-28)	Crystal Field Theory	Crystal Field Theory	Crystal Field Theory Last day to withdraw from courses.
10 (10/31-11/4)	Quiz 7 Crystal Field Theory	Magnetic Properties of Inorganic Complexes	Ligand Field Theory
11 (11/7-11)	Quiz 8 Spectroscopy of Inorganic Complexes	Spectroscopy of Inorganic Complexes	No Class – Veterans’ Day
12 (11/14-18)	Quiz 9 Reactions and Mechanisms of Inorganic Complexes	Reactions and Mechanisms of Inorganic Complexes	EXAM 3
13 (11/21-25)	HSAB Theory	Catch-up Lecture	No Class – Thanksgiving
14 (11/28-12/2)	Quiz 10 Organometallic Chemistry	Organometallic Chemistry	Organometallics and the 18 Electron Rule
15 (12/5-9)	Quiz 11 Organometallic chemistry in Industry	Bioinorganic and Environmental Chemistry	Bioinorganic and Environmental Chemistry
Finals Week	Final Exam – 10:00 am – 12:00 noon – Wednesday December 14 th		

COVID-19 REQUIREMENTS AND INFORMATION

Additional information about the University's response to COVID-19 is available from the **Jacks are Back!** web page located at <https://nau.edu/jacks-are-back>.

SYLLABUS POLICY STATEMENTS

ACADEMIC INTEGRITY

NAU expects every student to firmly adhere to a strong ethical code of academic integrity in all their scholarly pursuits. The primary attributes of academic integrity are honesty, trustworthiness, fairness, and responsibility. As a student, you are expected to submit original work while giving proper credit to other people's ideas or contributions. Acting with academic integrity means completing your assignments independently while truthfully acknowledging all sources of information, or collaboration with others when appropriate. When you submit your work, you are implicitly declaring that the work is your own. Academic integrity is expected not only during formal coursework, but in all your relationships or interactions that are connected to the educational enterprise. All forms of academic deceit such as plagiarism, cheating, collusion, falsification or fabrication of results or records, permitting your work to be submitted by another, or inappropriately recycling your own work from one class to another, constitute academic misconduct that may result in serious disciplinary consequences. All students and faculty members are responsible for reporting suspected instances of academic misconduct. All students are encouraged to complete NAU's online academic integrity workshop available in the E-Learning Center and should review the full *Academic Integrity* policy available at <https://policy.nau.edu/policy/policy.aspx?num=100601>.

COPYRIGHT INFRINGEMENT

All lectures and course materials, including but not limited to exams, quizzes, study outlines, and similar materials are protected by copyright. These materials may not be shared, uploaded, distributed, reproduced, or publicly displayed without the express written permission of NAU. Sharing materials on websites such as Course Hero, Chegg, or related websites is considered copyright infringement subject to United States Copyright Law and a violation of NAU Student Code of Conduct. For additional information on ABOR policies relating to course materials, please refer to ABOR Policy 6-908 A(2)(5).

COURSE TIME COMMITMENT

Pursuant to Arizona Board of Regents guidance (ABOR Policy 2-224, *Academic Credit*), each unit of credit requires a minimum of 45 hours of work by students, including but not limited to, class time, preparation, homework, and studying. For example, for a 3-credit course a student should expect to work at least 8.5 hours each week in a 16-week session and a minimum of 33 hours per week for a 3-credit course in a 4-week session.

DISRUPTIVE BEHAVIOR

Membership in NAU's academic community entails a special obligation to maintain class environments that are conducive to learning, whether instruction is taking place in the classroom, a laboratory or clinical setting, during course-related fieldwork, or online. Students have the obligation to engage in the educational process in a manner that does not interfere with normal class activities or violate the rights of others. Instructors have the authority and responsibility to address disruptive behavior that interferes with student learning, which can include the involuntary withdrawal of a student from a course with a grade of "W". For additional information, see NAU's *Disruptive Behavior in an Instructional Setting* policy at <https://nau.edu/university-policy-library/disruptive-behavior>.

NONDISCRIMINATION AND ANTI-HARASSMENT

NAU prohibits discrimination and harassment based on sex, gender, gender identity, race, color, age, national origin, religion, sexual orientation, disability, veteran status and genetic information. Certain consensual amorous or sexual relationships between faculty and students are also prohibited as set forth in the *Consensual Romantic and Sexual*

Relationships policy. The Equity and Access Office (EAO) responds to complaints regarding discrimination and harassment that fall under NAU's *Nondiscrimination and Anti-Harassment* policy. EAO also assists with religious accommodations. For additional information about nondiscrimination or anti-harassment or to file a complaint, contact EAO located in Old Main (building 10), Room 113, PO Box 4083, Flagstaff, AZ 86011, or by phone at 928-523-3312 (TTY: 928-523-1006), fax at 928-523-9977, email at equityandaccess@nau.edu, or visit the EAO website at <https://nau.edu/equity-and-access>.

TITLE IX

Title IX of the Education Amendments of 1972, as amended, protects individuals from discrimination based on sex in any educational program or activity operated by recipients of federal financial assistance. In accordance with Title IX, Northern Arizona University prohibits discrimination based on sex or gender in all its programs or activities. Sex discrimination includes sexual harassment, sexual assault, relationship violence, and stalking. NAU does not discriminate on the basis of sex in the education programs or activities that it operates, including in admission and employment. NAU is committed to providing an environment free from discrimination based on sex or gender and provides a number of supportive measures that assist students, faculty, and staff.

One may direct inquiries concerning the application of Title IX to either or both the Title IX Coordinator or the U.S. Department of Education, Assistant Secretary, Office of Civil Rights. You may contact the Title IX Coordinator in the Office for the Resolution of Sexual Misconduct by phone at 928-523-5434, by fax at 928-523-0640, or by email at titleix@nau.edu. In furtherance of its Title IX obligations, NAU promptly will investigate or equitably resolve all reports of sex or gender-based discrimination, harassment, or sexual misconduct and will eliminate any hostile environment as defined by law. The Office for the Resolution of Sexual Misconduct (ORSM): Title IX Institutional Compliance, Prevention & Response addresses matters that fall under the university's Sexual Misconduct policy. Additional important information and related resources, including how to request immediate help or confidential support following an act of sexual violence, is available at <https://in.nau.edu/title-ix>.

ACCESSIBILITY

Professional disability specialists are available at Disability Resources to facilitate a range of academic support services and accommodations for students with disabilities. If you have a documented disability, you can request assistance by contacting Disability Resources at 928-523-8773 (voice), 928-523-8747 (fax), or dr@nau.edu (e-mail). Once eligibility has been determined, students register with Disability Resources every semester to activate their approved accommodations. Although a student may request an accommodation at any time, it is best to initiate the application process at least four weeks before a student wishes to receive an accommodation. Students may begin the accommodation process by submitting a self-identification form online at <https://nau.edu/disability-resources/student-eligibility-process> or by contacting Disability Resources. The Director of Disability Resources, Jamie Axelrod, serves as NAU's Americans with Disabilities Act Coordinator and Section 504 Compliance Officer. He can be reached at jamie.axelrod@nau.edu.

RESPONSIBLE CONDUCT OF RESEARCH

Students who engage in research at NAU must receive appropriate Responsible Conduct of Research (RCR) training. This instruction is designed to help ensure proper awareness and application of well-established professional norms and ethical principles related to the performance of all scientific research activities. More information regarding RCR training is available at <https://nau.edu/research/compliance/research-integrity>.

MISCONDUCT IN RESEARCH

As noted, NAU expects every student to firmly adhere to a strong code of academic integrity in all their scholarly pursuits. This includes avoiding fabrication, falsification, or plagiarism when conducting research or reporting research results. Engaging in research misconduct may result in serious disciplinary consequences. Students must also report any suspected or actual instances of research misconduct of which they become aware. Allegations of research misconduct should be reported to your instructor or the University's Research Integrity Officer, Dr. David Faguy, who can be reached at david.faguy@nau.edu or 928-523-6117. More information about misconduct in research is available at <https://nau.edu/university-policy-library/misconduct-in-research>.

SENSITIVE COURSE MATERIALS

University education aims to expand student understanding and awareness. Thus, it necessarily involves engagement with a wide range of information, ideas, and creative representations. In their college studies, students can expect to encounter and to critically appraise materials that may differ from and perhaps challenge familiar understandings, ideas, and beliefs. Students are encouraged to discuss these matters with faculty.

Last revised August 4, 2022