

Chemistry 340/441

Fall 2024

Course Name: Advanced Inorganic Chemistry

Description: CHEM 340/441 will provide the students with a detailed examination of several topics pertaining to modern inorganic chemistry. These topics include structure and bonding theories, symmetry and group theory, solid state chemistry, acid-base chemistry, coordination chemistry and organometallic chemistry.

Learning Outcomes: This course is set to provide both undergraduates and graduate students with the knowledge and the skillset to navigate the topics pertaining to modern inorganic chemistry as outlined in detail at the end of this document. Undergraduate students enrolled in 341 are expected to participate in weekly discussion sections to boost their understanding of the topics as taught during the lectures. Graduate students enrolled in 441 are expected to participate in one presentation session to demonstrate their in-depth understanding on a topic related to the course contents. The problem sets, exams and the final exam are similar for both 340 and 441.

Lecture: Tuesdays and Thursdays 1:00 - 2:15 pm Cuneo 218 (lecture)
Wednesday, 11:30 am - 12:15 pm (discussion) Crown 142

Office hours: Thursdays 3:0-4:30 pm, 445 Stem Center located in St Joseph's Hall room 102.

Instructor: Prof. Progna Banerjee
pbanerjee@luc.edu

Text book: Inorganic Chemistry – 5th Edition. by C. E. Housecroft and A. G. Sharpe

Grading: You have two other avenues of learning besides lecture, which will prepare you for the exams. The first is discussion, where students, via small group interactions, will discuss ideas and come to consensus about answers to questions. Ideas are further developed in questions that force application of the agreed upon concepts. This format is designed based on the idea that learning cannot be directly transmitted from one person to another. Please review lectures before attending discussion sections. The grade is based on participation; a total of 14 discussions (10 pts each) is collected, though the points for this category (120 pts) maxes out at 12 sessions. Thus, you may miss two discussions without impacting your grade. The second is problem sets which each set consists of 5 problems and are graded on a 0, 1, 2, 3 scale for each problem for a total of 15 points per set. 0 points indicates the problem was not done. 1 and 2 points indicate no/incorrect work or an incorrect answer. 3 points is for correct work or a correct answer. A typical exam will be slightly more difficult than the discussions and problem sets. There are three exams, each worth 100 points, and a final (150 pts) which is cumulative. Exams should not be missed, but in the case of hardship or debilitating illness can be made up. Under such circumstances, evidence of hardship should be presented, and you and I can arrange makeup. This must be scheduled within one week of the original exam date.

Grading Scale (CHEM 340):

Problem sets (9%)	4 × 15 pts	60
Discussion (19%)	14 × 10 pts	120 (two can be missed)
Exams (48%)	3 × 100 pts	300
Final (24%)	150 pts	<u>150</u>
Total		630

Letter Grade:

A: 100-90%, A-: 90-86%, B+: 86-82%, B: 82-78%, B-: 78-74%, C+: 74-70%, C: 70-66%, C-: 66-62%, D: 62-54%, F < 54%

Grading Scale (CHEM 441):

Problem sets (10%)	4 × 15 pts	60
Presentation (16%)	100 pts	100
Exams (49%)	3 × 100 pts	300
Final (25%)	150 pts	<u>150</u>
Total		610

Final exam: The University sets the schedule for all final exams. The final will be held on: TBA. You will have exactly 2 hours to complete the exam. Additional time will not be granted, even if you arrive late. There will be no make-up final exams given under any circumstance, and the exam will not be given early, either. Instructors may not reschedule final exams for a class for another day and/or time during the final exam period. There can be no divergence from the posted schedule of dates for final exams. Individual students who have four (4) final examinations scheduled for the same date may request to have one of those exams rescheduled. If a student reports having four final examinations scheduled for the same date, students should be directed to e-mail a petition to Assistant Dean for Student Academic Affairs, CAS Dean's Office.

Course Evaluation: Towards the end of the course, you will receive an email from the Office of Institutional Effectiveness to provide feedback on the course. You will receive consistent reminders throughout the period when the evaluation is open, and the reminders will stop once you have completed the evaluation. The evaluation is completely anonymous. When the results are released, instructors and departments will not be able to tell which student provided the individual feedback. Because it is anonymous and the results are not released to faculty or departments until after grades have been submitted, the feedback will not impact your grade. The feedback is important so that the instructor can gain insight into how to improve teaching and the department can learn how best to shape the curriculum.

Course Repeat Rule: Effective with the Fall 2017 semester, students are allowed only THREE attempts to pass Chemistry courses with a C- or better grade. The three attempts include withdrawals (W). After the second attempt, the student must secure approval for a third attempt. Students must come to the Chemistry Department, fill out a permission to register form or print it from the Department of Chemistry & Biochemistry website: <http://www.luc.edu/chemistry/forms/> and obtain a signature from the Undergraduate Program Director, Assistant Chairperson, or Chairperson in Chemistry. A copy of this form is then taken to your Academic Advisor in Sullivan to secure final permission for the attempt.

Pass/Fail Conversion Deadlines and Audit Policy: A student may request to convert a course into or out of the "Pass/No-Pass" or "Audit" status only within the first two weeks of the semester. For the Fall 2024 semester, students are able to convert a class to "Pass/No-Pass" or "Audit" through September 9th. Students must submit a request for Pass/No-Pass or Audit to their Academic Advisor.

Student Accommodations: The Student Accessibility Center at the Sullivan Center <http://www.luc.edu/sac>, has the mission "to serve students with documented disabilities by creating and fostering an accessible learning environment," including "support[ing] faculty, staff, and administrators on matters such as ADA and Section 504 compliance, as it relates to individuals with disabilities." Please direct all questions concerning accommodations of disabilities to the Student Accessibility Center. Academic accommodations afforded to students require documentation and review. The Student Accessibility Center will issue accommodation

letters for registered students to present to their instructors: accommodations are not active until students present these letters to their instructors. If students' accommodations involve attendance or deadlines, instructors and students will jointly complete and execute an Agreement Form articulating their terms. See <https://www.luc.edu/sac/faculty/facilitatingaccommodations/> for guidance about implementing various kinds of accommodations in a way that is appropriate to your class. The Student Accessibility Center stands ready to work with you.

Loyola University Absence Policy for Students in Co-Curricular Activities (including ROTC): Students missing classes while representing Loyola University Chicago in an official capacity (e.g. intercollegiate athletics, debate team, model government organization) shall be allowed by the faculty member of record to make up any assignments and to receive notes or other written information distributed in the missed classes. Students should discuss with faculty the potential consequences of missing lectures and the ways in which they can be remedied. Students must provide their instructors with proper documentation (develop standard form on web) describing the reason for and date of the absence. This documentation must be signed by an appropriate faculty or staff member, and it must be provided as far in advance of the absence as possible. It is the responsibility of the student to make up any assignments. If the student misses an examination, the instructor is required to give the student the opportunity to take the examination at another time. (<https://www.luc.edu/athleteadvising/attendance.shtml>)

Accommodations for Religious Reasons: If you have observances of religious holidays that will cause you to miss class or otherwise effect your performance in the class you must alert the instructor within 10 calendar days of the first-class meeting of the semester to request special accommodations, which will be handled on a case-by-case basis.

Academic Integrity: All students in this course are expected to have read and to abide by the demanding standard of personal honesty, drafted by the College of Arts & Sciences, which can be viewed at: <http://www.luc.edu/cas/advising/academicintegritystatement/> A basic mission of a university is to search for and to communicate the truth as it is honestly perceived. A genuine learning community cannot exist unless this demanding standard is a fundamental tenet of the intellectual life of the community. Students of Loyola University Chicago are expected to know, to respect, and to practice this standard of personal honesty. Academic dishonesty can take several forms, including, but not limited to cheating, plagiarism, copying another student's work, and submitting false documents. The problem sets must be completed individually; it is not a group work. Copying others' work and presenting that work as one's own is an example of academic dishonesty. Any instance of dishonesty will be reported to The Chair of The Department of Chemistry & Biochemistry who will decide what the next steps may be. With a zero-tolerance policy, punishment for cheating may range from receiving an F grade for the assignment to receiving an F for the course and possibly suspension and/or expulsion from the University.

Privacy Statement: Assuring privacy among faculty and students engaged in online or face-to-face instructional activities helps promote open and robust conversations and mitigates concerns that comments made within the context of the class will be shared beyond the classroom. As such, recordings of instructional activities occurring in online or face-to-face classes may be used solely for internal class purposes by the faculty member and students registered for the course, and only during the period in which the course is offered. Students will be informed of such recordings by a statement in the syllabus for the course in which they will be recorded. Instructors who wish to make subsequent use of recordings that include student activity may do so only with informed written consent of the students involved or if all student activity is removed from the recording. Recordings including student activity that have been initiated by the instructor may be retained by the instructor only for individual use.

Schedule and Approximate Syllabus:

1. Atomic Orbitals and the Periodic Table (Chapter 1)

- Quantum numbers and the hydrogen atom
- Multi-electron atoms
- The periodic table
- The aufbau principle
- 2. Symmetry and Group Theory (Chapter 3)
 - Symmetry elements
 - Point groups and molecular symmetry
 - Character tables
- 3. Valence Bond and Molecular Orbital Theory (Chapters 5, 2.3, 2.7, 2.8)
 - The covalent bond
 - Valence bond theory
 - Hybridization
 - Molecular orbital theory
 - VSEPR
- 4. Ionic Solids (Chapter 6, page 1040 and 1045)
 - The ionic bond
 - Lattice energies
 - Band theory
 - Conductivity
 - Applications
- 5. Acid-Base Chemistry (Chapters 7.1–7.9 and 9)
- 6. Coordination Chemistry – Structure, Bonding, Spectra and Magnetism (Chapters 2.9, 7.11, 7.12, 7.13, 20.1–20.11 and 19.7, 19.8)
 - Structure and bonding
 - Ligands
 - Coordination numbers
 - Valence bond theory
 - Crystal field theory
 - Molecular orbital theory
 - Spectroscopy and magnetism
 - Electronic spectra
 - Tanabe-Sugano diagrams
 - Magnetic properties
 - Chelate and macrocycle effects
- 7. Coordination Chemistry – Reactions, Kinetics and Mechanisms (Chapter 26)
 - Substitution kinetics
 - Electron transfer kinetics
 - Reactions of coordinated ligands
- 8. Organometallic Chemistry (Chapters 24 and 25.1–25.6)
 - The 18-electron rule
 - Metal carbonyl complexes
 - Nitrosyl complexes
 - Metal alkyls, carbenes, carbynes and carbides
 - Nonaromatic alkene and alkyne complexes
 - Metallocenes
 - Reactions of organometallic complexes
 - Catalysis