CHEM6600/8600 Physical Inorganic Chemistry

The University of Toledo
Department of Chemistry and Biochemistry
College of Natural Sciences and Mathematics
CRN: 54673 (6600) or 54674 (8600)

Instructor: Dr. Joseph Schmidt
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Class Location: BO 0214
Office Hours: TR 11:00 AM – 1:30 PM and by appointment
Class Day/Time: MW 2:00-3:50 PM
Office: WO 3277
Credit Hours: 4 credit hours
Phone: 419-530-1512
Term: Fall 2019

COURSE/CATALOG DESCRIPTION
Symmetry, bonding theories, magnetism, and spectroscopic characterization of inorganic compounds are described. Coverage of spectroscopic techniques such as NMR, EPR, UV/VIS, IR, and Mössbauer focuses on applications to inorganic systems.

COURSE STATEMENT
The objective of this course is to introduce students to physical inorganic chemistry in preparation for specialized courses in inorganic and organometallic chemistry, as well as research in the fields of physical chemistry, inorganic chemistry, organometallics, and materials chemistry.

STUDENT LEARNING OUTCOMES
Students who successfully complete this course will be able to:

- Describe and utilize the principles underlying molecular (point) symmetry.
- Understand the relationship between molecular symmetry, group theory, and molecular motion (translation, rotation, bond stretching, and bending modes)
- Comprehend the relationship between molecular symmetry and molecular orbitals
- Create and interpret elementary molecular orbital diagrams
- Grasp the relationship between nuclear spin and nuclear magnetic resonance
- Relate the effect of quadrupole nuclei on NMR spectra
- Demonstrate a basic understanding of other spectroscopic techniques, including electron paramagnetic spectroscopy and Mössbauer spectroscopy

PREREQUISITES AND COREQUISITES
Prerequisites: Permission of Department.
REQUIRED INSTRUCTIONAL MATERIALS (TEXTS AND ANCILLARY MATERIALS)

Recommended Materials:
Course material will be taken from numerous sources, including both textbooks and primary research literature. Particular emphasis will be placed on the material from the books listed below. These texts have been placed on reserve in Carlson Library and are available for two hours per checkout, as well as overnight. The most recent versions of these texts, with the exception of Drago (which is out of print), may be purchased from various textbook vendors.


COURSE STRUCTURE

Lecture:
- Lecture sessions are designed to demonstrate and explain the concepts covered in this course and provide examples of what is expected of you.
- Attendance is expected and you are responsible for all material and problems covered in class.
- Please be considerate of your fellow students during the lecture period. Disruptions of any kind will not be tolerated and may result in expulsion from the classroom.

Homework:
Problem sets will be distributed periodically. These will NOT be collected or graded. Failure to work the problems will likely have an adverse effect on exam scores. Answer keys will be posted on Blackboard following the due date for each set.

Blackboard:
Blackboard is a course management system provided by the University of Toledo and can be accessed at https://blackboard.utdl.edu/. Your access code is your UTAD user name and password.

You should consult the site regularly for news and announcements. Problem sets, answer keys, exam keys, and diagrams displayed in lecture will be posted to Blackboard. The system also permits you to check your grades at any time.
Examinations:
Grades will be based on two exams (100 points each) and a comprehensive final exam (200 points). For each of the two midterms, you will allowed 2.5 hours to complete them (from 2:00 P.M. until 4:30 P.M.). Please plan your schedule accordingly for these two days.

- The midterm exams will be administered on Monday, October 7th (2:00 – 4:30 PM) and Monday, November 18th (2:00 – 4:30 PM).
- The comprehensive final exam (200 points) for the course will be administered in BO 0214 on Monday, December 9th 2:45-4:45 pm, the time scheduled by the University.

Inclement Weather Policy: If classes are cancelled on the Wednesday preceding an exam week, the exam WILL PROCEED on Monday as normally scheduled. If classes are cancelled on the day of an exam, the exam will take place during the next regularly scheduled class period (for example, if a Monday exam is cancelled for weather, the exam will take place on Wednesday instead).

Exam Absence Policies
Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict with a major responsibility must provide some written documentation to verify the conflict. This situation may occur for students on official university business, including athletes. Approval must be obtained before the scheduled test date.

Students who do not take an exam due to illness, car accident, and death in the family or similar extreme circumstance should inform their instructor of their difficulties within 24 hours of the exam. These difficulties must also be documented by a physician's note, an accident report, pastor’s note, etc. Contact information for the police department, pastor, etc. must be included on the note or report. In all other circumstances, a missed exam will result in a grade of 0. Exams cannot be excused for personal reasons. Examples of missing an exam due to personal issues include, but are not limited to: oversleeping, transportation problems, vacation plans, work schedule conflicts, childcare issues, sick children, fire alarms in adjacent buildings, etc. Please plan accordingly.

Communication:
Please communicate with the instructor about any aspect of the course which concerns you or which might limit your success. The goal is for you to be successful in this course, whatever that takes.

OVERVIEW OF COURSE GRADE ASSIGNMENT

Midterm Grading
Midterm grading serves as a point in the term where the instructor of record may provide a midterm grade assessment and may identify any student who has never attended, has stopped attending, or who is not actively participating in the course. In addition, students may use midterm grade to help make a decision in regards to withdrawing from the course.

The U.S. Department of Education requires the University to document both active participation and satisfactory academic progress as part of the compliance with federal financial aid regulations. Students receiving Title IV Federal Aid funds are required to have regular attendance and satisfactory academic progress in their courses to receive federal aid.

Final Grading
Your final grades will be calculated based on a total of 400 points.
Drop, Withdrawal and Incomplete Grades:

- Course drop and withdrawal procedures have been set by the University faculty. Dropped courses do not appear on your transcript. If you are in a course after that date, there will be a grade on your transcript (A-F, W, or Incomplete). The deadline for dropping is September 9th.
- You may withdraw from the course and receive a grade of W. W’s do not affect your GPA. For both dropping the course or withdrawing you should go to the Registrar’s Office in Rocket Hall. You do not need your instructor’s permission for either process. Please note that course registration changes might change your financial aid. The deadline for withdrawal is the end of the 10th week, November 1st.
- A course grade of Incomplete is given only to those who have completed all but a small percentage of course requirements for an acceptable reason.

Academic Dishonesty:

As a student in this course and enrolled at The University of Toledo you should be familiar with the policies that govern the institution’s academic processes, for example, Academic Dishonesty, Enrollment Status, and Grades and Grading. Please consult the Graduate Academic Policies via the UT website.

Attendance/Class Participation:

On two occasions during the term, instructors are asked to report student attendance. These reports can affect your financial aid, so you will want to be sure that you are in attendance for all classes. However, you will remain enrolled in the class independent of these reports. That is, you remain registered for the class and will receive a final grade unless you take the action of dropping or withdrawing. Students are expected to attend every class meeting of courses in which they are registered. Please read the Missed Class Policy.

Special Needs:

If you have special needs with respect to your participation in this course, please make an appointment to discuss this matter with your instructor. The instructor will work with you and the Office of Accessibility to make appropriate accommodations for your needs.

UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA). The University is an equal opportunity educational institution. Please read The University’s Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.

ACADEMIC ACCOMMODATIONS

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office.
COURSE SCHEDULE

The following topics will be covered in the order listed. The specific dates assigned to each topic will depend on many factors, including overall pace of the course, weather conditions, university holidays, etc.

VSEPR: Valence Shell Electron Pair Repulsion Theory, a Review

Symmetry: Elements, Operations, Point Groups

Group Theory: Irreducible Representations, Character Tables, Mulliken Symbols, Molecular Vibrations, IR and Raman Active Modes, Applications to Molecular Orbital Theory

Crystal Field Theory: Crystal Field Stabilization Energy, High-Spin and Low-Spin Complexes, Spectrochemical Series, Jahn-Teller Distortion

Ligand Field Theory: Ligand Field Stabilization Energy, \(\pi\)-Donor and \(\pi\)-Acceptor Ligands

Magnetism: Magnetic Moments, Temperature Dependence

NMR Spectroscopy: Relaxation, Coupling, Virtual Coupling, Quadrupolar Nuclei, Nuclei of Low or Intermediate Abundance, Fluxionality

EPR Spectroscopy: Transitions, Hyperfine Splitting, Anisotropy

Mössbauer Spect.: Transitions, Isomer Shift, Quadrupole Splitting