University of Windsor
Chemistry and Biochemistry
Chemistry 59-250, Fall Term 2018

Lectures: Tues. and Thurs. 11:30-12:50 in ***ERIE HALL 2123***
Tutorials: Friday 8:30-9:50 am in the Toldo Health Education Centre room 102 (not every week, first meeting on Sept 21st)
Instructor: Dr John Hayward (office: 255 Essex Hall)
Office hours: ***Tuesdays after lectures (1pm – 3pm)***
Teaching Assistant: Ala Swidan (office: 260 Essex Hall)

Course Outline

Primary Goal: Introduction to Chemical Structure and Bonding
We will review some of the fundamental aspects of atomic structure and properties (and periodic trends) before proceeding with the examination of theories of bonding in molecules and the use of symmetry.

Topics:

1. Atomic Structure I: The Hydrogen Atom
2. Atomic Structure II: Multi-electron atoms
3. Atomic Structure III: Periodic Trends
4. Bonding I: Ionic bonding and ionic solids
5. Bonding II: Molecular Structures – Lewis Structures and VSEPR theory
6. Bonding III: Valence Bond Theory and hybridisation
7. Bonding IV: MO Theory 1 – Homonuclear Diatomic Molecules
8. Bonding V: MO Theory 2 – Heteronuclear Diatomics
9. Symmetry I: NMR and Symmetry Operations
10. Symmetry II: Point Groups
11. Symmetry III: Character Tables
12. Symmetry IV: Symmetry, Bonding & Photoelectron Spectra
13. Symmetry V: Symmetry-Adapted Linear Combinations of atomic orbitals
14. Symmetry & Bonding I: Period 2 Hydrides.
15. Symmetry & Bonding II: π-bonding and Hypervalent Molecules
16. Symmetry VI: Vibrational spectroscopy
17. Symmetry & Bonding III: Extended conjugation and band theory of solids.

Text:
Inorganic Chemistry, 4th edition by Catherine Housecroft and Alan Sharpe (**H & S**)
This is a detailed introductory textbook for Inorganic Chemistry (also including Main Group, Transition Metal and Organometallic compounds) that will also be useful for students that will continue to study Chemistry. The textbook is **not mandatory**, however I may assign material to read from these books and I will be posting suggested practice problems from the text.
I've conferred with Dr Rawson (who is instructing 59-251 next semester) and he will ALSO have H&S as his recommended text. So if you're taking both courses it should be a worthwhile investment!
If you have the **3rd edition**: It has a good index and the topics covered are generally the same. The order of presentation has changed slightly, but the course does not rigidly follow the text.

Dr Johnson has previously used chapters 4 and 5 from Inorganic Chemistry, 3rd edition by Gary L. Miessler and Donald A. Tarr as a supplement *The selected chapters cover symmetry and molecular orbital theory in a similar manner to the way we will use them.*
These subjects will be presented in a modified order, but are covered in the first few chapters in the textbook:

Atomic structure and atomic properties - H & S **Chapter 1**
- Atomic orbitals
- Aufbau principle
- Periodic trends

Molecular structure and bonding - H & S **Chapter 2**
- Hybridisation and the valence bond model
- **Molecular orbital theory (diatomics)**
- VSEPR model

Molecular shape and symmetry - H & S **Chapter 3**
- Symmetry operations and elements
- Character tables & Point Groups
- Vibrational modes

Selected Experimental techniques - H & S **Chapter 4**
- Primarily nuclear magnetic resonance (NMR) spectroscopy
- Photoelectron spectroscopy
- Vibrational spectroscopy

Bonding in polyatomics - H & S **Chapter 5**
- MO theory of polyatomics – application of group theory and symmetry
- Symmetry-Allowed Linear Combinations (SALCs)/Ligand Group Orbitals (LGOs)
- Delocalised & multi-centre bonding

Structures of metallic and ionic solids - H & S **Chapter 6**
- Structure and prediction of ionic solids
- Band theory – metals and semiconductors.

The major goals of this course are to provide you with an understanding of:
- *trends in properties observed for the elements in the periodic table*
- *why atoms bond to each other and the models we use to describe bonding*
- *why molecules have the shapes that they do and the insights that we can gain using symmetry*

Overall, this course will provide you with the many of the basic tools you require to understand the structural features, the bonding and certain aspects regarding the reactivity of molecules.

Please note that the description of specific chemical reactivity is not the primary goal of this course as such information is available in later courses. This course is primarily intended to give you the solid foundation of fundamental understanding that is necessary for further studies in the chemical sciences. Limited specific examples of chemical reactivity will be taught.

Internet Resources
https://blackboard.uwindsor.ca/ I will post notes on the course website
http://symmetry.otterbein.edu/gallery/index.html examples of symmetry, with 3D models
http://wps.pearsoned.co.uk/ema_uk_he_housecroft_inorgchem_4/ *This is a companion web site for the book that has additional information and some practice problems.*

Grading:
The overall grade will be based on two mid-term tests (each 50 minutes long and each worth 24%) and a comprehensive final exam (3 hours long, 48%).
Test Dates: ***There will be no make-up tests or exams!***
Test 1: Tuesday October 16th – during class time
Test 2: Thursday November 8th – during class time
Spot tests: there will be 4 spot tests throughout the semester, mostly relating to the periodic table. Each worth 1%!
Final Exam: Saturday, Dec. 8, 8:30 am

Please note: If you are unable to write a midterm, you must provide me with an acceptable excuse within 12 hours (before or after, by phone message or e-mail) of the prescribed time or you will receive a grade of 0% on that test. If you do not write the final exam, you will receive a grade of 0% for the exam; your grade may only be changed through a formal application for an Aegrotat assessment. Students caught cheating will receive an automatic grade of 0% on that work, will be reported to the Department and are subject to disciplinary action as described in Senate By-Law 31.
Last date for voluntary withdrawal from course: November 14th
Student evaluation of this class will be conducted during the last two weeks of the term as per the Senate regulations. Please participate!

Department of Chemistry and Biochemistry at the University of Windsor
Guidelines for Examinations, Assignments and Laboratory Reports
Cheating and Plagiarism

1. During an examination, students must not have in their possession any unauthorized books, notes, or extraneous material, unless permitted by the instructor.
2. All incidents of cheating and plagiarism will be reported by the instructor directly and immediately to the Departmental Head for consideration of disciplinary action as delineated in Senate By-law 31.

Calculators

1. Students may only use calculators approved by the Faculty of Science and/or their instructors. Programmable calculators and calculators with infra-red transmission capability are not permitted.

Absence

1. Attendance of laboratories and mid-term examinations is MANDATORY.
2. Students who miss a mid-term examination or laboratory must provide written documentation to justify an absence. Unexcused absences or incomplete laboratory reports will result in a grade of incomplete, which in turn will result in a grade of incomplete for the course.
3. Such a student should call the departmental office 253-3000 ext3521 to report his/her name and the examination missed within 24 hours of the exam.
4. Written documentation justifying the absence must be presented within 48 hours of the examination or as soon as possible.
5. Excuses will not be accepted after a student has taken an examination.

Midterm examination

1. Only examinations written in non-erasable ink will be considered for a grade appeal.
2. All grade appeals must be accompanied with a written rationale for the grade appeal.

Requests such as "see question xx" contain insufficient information and will not be considered for a grade appeal.

3. All grade appeals must be made either within five working days after the examination is returned to the class, or by a date designated by the professor.