Instructor: Professor Gary J. Schrobilgen
Office: ABB-266B/213
Ext.: 23306

Teaching Assistant: Mr. John R. Debackere (Ph.D. Student)

Course Subject: The basic theories and models of bonding and structure that explain the combination of elements across the periodic table with primary emphasis on the main-group elements and their descriptive chemistry.

Prerequisite: CHEM 1AA3. Note: This course is designed for students who are pursuing an Honours B. Sc. degree in chemistry. It requires a reasonable understanding of basic concepts of physics (such as mechanics, electric fields and waves) and mathematics (including vectors, trigonometry, algebra and calculus).


Other recommended references:

Contents:

**PART I. Bonding and Symmetry:**

1. Electronic structure and properties of atoms
   (a) *atomic structure and chemical periodicity
   (b) *many electron atoms
   (c) introduction to wave mechanics
   (d) radial distribution functions, the angular part of a wavefunction and the shapes of atomic orbitals
   (e) *the periodic table
   (f) *properties of the elements:
      - ionization potential, electron affinity, atomic and other radii,
      - electronegativity, coordination number, valency and oxidation state

2. Covalent molecules: Diatomics
   (a) bond formation and orbitals
   (b) the combination of s-orbitals
   (c) the combination of p-orbitals
   (d) energy levels in diatomic molecules
   (e) bond orders and properties of diatomic molecules

3. Polyatomic Covalent Molecules
(a) valence bond model and Lewis structures
(b) review of the VSEPR rules (and Lewis structures) and further elaboration on the VSEPR model of molecular geometry
(c) the shapes of molecules and ions containing σ-bonds only
(d) the shapes of species containing π-bonds
(e) bonding in polyatomics: the two-center bond approach
(f) two-centered orbitals: hybridization
(g) delocalized (multi-centered) σ-orbitals
(h) π-bonding in polyatomic molecules

4. Introduction to Symmetry

(a) symmetry elements and the assignment of point groups
(b) the use of character tables to verify point group assignments

5. The Ionic Solids; an Introduction to the Solid State

(a) simple crystal lattices
(b) lattice energies; the Born treatment and Madelung constants
(c) the Kapustinskii equation
(d) the application of lattice energies; Born-Haber cycles

PART II. Descriptive Chemistry of the p-Block Elements:

6. Hydrogen and Its Compounds

(a) classification and structure of compounds
(b) reactivity of hydrogen compounds
(c) simple electron-deficient hydrides of the boron group
(d) electron-rich compounds of Groups 15/V to 17/VII

7. Group 1 and Group 2 Metals

8. The Boron and Carbon Groups

(a) the boron group
(b) boron cluster compounds and carboranes; Wade’s rules
(d) the carbon group

9. The Nitrogen and Oxygen Groups

(a) the nitrogen group
(b) the oxygen group with emphasis on the chemistry of sulphur
(c) p-block ring and cluster compounds

10. The Halogens and the Noble Gases

(a) polyhalogen compounds
(b) compounds of halogens and oxygen
(c) the noble gases
Evaluation

- Class tests (total, 40%)
- 1 Final Exam (40%)
- Seminar (20%)
- Tutorials STRONGLY RECOMMENDED

CHEM 2H3 Course Notes for 2017

Course Changes. The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

Missed Academic Work: The McMaster Student Absence Form (MSAF. https://pinjap01.mcmaster.ca/msaf) may NOT be used to report missed work for this course. Absences resulting in missed work for any reasons must be reported to your Faculty/Program office, with documentation, and relief from term work may not necessarily be granted. If your absence is approved by your Faculty/Program office then contact the Instructor immediately (normally within 2 working days) in person in ABB 213 or ABB 266B to learn what relief may be granted for the work you have missed."

Copyright. In this course you will have access to material that is subject to copyright laws. This includes (but is not limited to) the textbook and all resources developed by the instructor. You are not allowed under any circumstance to share or redistribute these materials in any printed or electronic form without the explicit written consent of the copyright holder (publisher, instructor, etc.). This includes posting any course material on Internet bulletin boards, course repositories, social networks, etc.

Handouts and Reference Materials. The lectures will cover the minimum background for which you are responsible. The course will be based on the recommended textbook. It is strongly recommended that you review the topic of each lecture and read the corresponding notes and chapter in the textbook. Use of the recommended textbook is not mandatory; you can use an earlier edition of the same title or another textbook of inorganic chemistry. Lecture slides will be posted on Avenue to Learn after each lecture. Because of copyright restrictions, some slides may not be posted but the illustrations and/or relevant information would be available in the textbook.

Course format. Sections 1-5 will be presented in a lecture format along with portions of 6 and 8. Subsequent sections will be presented in a seminar format. The latter is the Inquiry component of the course in which you will select a topic of Main-Group descriptive chemistry to prepare and deliver a short (<10 min) presentation during the regular class hours of the course. Topics will be released by mid-February. Detailed instructions will be provided on the same date.

Tutorials. Each tutorial session will provide students with opportunities to ask questions pertaining to recent course material and solve representative problems taken mainly from your textbook. Tutorial questions will be comparable to what you will encounter in the midterm tests and the final exam. Attendance at the tutorial sessions is not mandatory but strongly recommended. There is no penalty for skipping any session.

Class Tests. Class tests are mandatory. There will normally be two which will be held mid-February and end of March. These dates are tentative and are subject to confirmation at least two weeks in advance of the test.

Test and Exam Marking. All components of the course evaluation will be marked by the teaching assistant following the marking schemes set by the instructor. The instructor reserves the right to review, approve and modify grades as appropriate.

Office Hours. The instructor has allocated each Friday from 1:30 to 2:30 pm an office hour for this course. You may also direct questions to your tutorial leader during the tutorial period and to your instructor after class.
Academic Dishonesty

“Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: “Grade of F assigned for academic dishonesty”), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:
1. Plagiarism, e.g. the submission of work that is not one’s own or for which other credit has been obtained. Transcribing passages from other sources in assignments is an example.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., Google search, etc.).

Approved by McMaster University Senate: May 12, 2003
Revisions approved by McMaster University Senate: April 13, 2005

I hereby acknowledge that I have read McMaster’s policy on Academic dishonesty.

Name:______________________________ Signature: ____________ Date:_________

Please make copy of this page, sign and submit before or during the tutorial session of January 13th.