# Main Group Chemistry
# CHEM 211/ENCH 211
# Fall term, 2021

Synchronous Lecture
Mondays, 11:30 – 12:20
Tuesdays, 13:30 – 14:20
Thursdays, 12:30 – 13:20
On-line *via* MS Teams

Recorded Lectures Available before Fridays 11am
Via onQ and Queen's Streaming Service
File name format: CHEMENCH_lec_xx_y, xx = week 1-12, y = lecture 1, 2 or 3

Instructor: Dr. Peng Wang
Contact Information:
Office: *via* MS Teams
Email: wang.peng@queensu.ca
Office hours: by email appointment. I will collect requests at the end of each week and arrange a time in the following week

**Laboratories**
Lab coordinator: Dr. Jason Vlahakis, Office Room 215 Chernoff Hall.
Email: vlahakis@queensu.ca
Lab info will be announced soon.
Theoretical Lab #4 Tutorial Schedule: Exact time and place will be announced on onQ in early October. Attend only one of these. Theoretical Lab TA: Leila Pujal Gomez, 19lpg@queensu.ca

**onQ site**
Students registered in the course can access the course onQ site at https://onq.queensu.ca/d2l/home. The site includes the assignments, your grades, and other materials.

**Intended Student Learning Outcomes**
Successful students will be able to:

1. Describe basic instrumentations and techniques used in the study of main group chemistry
2. Predict molecular shapes using VSEPR theory, valence bond theory, and molecular orbital theory
3. Describe molecular shapes in terms of point groups, stereochemistry, and types of isomers
4. Prepare molecular orbital diagrams and interpret them to predict bonding order and molecular reactivity
5. Explain the causes of differences in structure and reactivity of compounds of different main group elements
6. Search for and understand a published research article describing the structure, bonding or reactivity of a main group molecule.
7. Perform laboratory experiments using main group molecules given a written procedure.

**Assessment Methods**

| Assessment | Outcome #1 | Outcome #2 | Outcome #3 | Outcome #4 | Outcome #5 | Outcome #6 | Outcome #7 |
|---|---|---|---|---|---|---|---|
| Assignment 1 | ✔ | ✓ | ✓ | | | ✓ | |
| Assignment 2 | ✓ | | ✓ | ✓ | ✔ | ✓ | |
| lab | | | | | | | ✓ |
| Final Exam (in person) | | ✔ | ✔ | ✓ | ✓ | | |

**Course Outline**

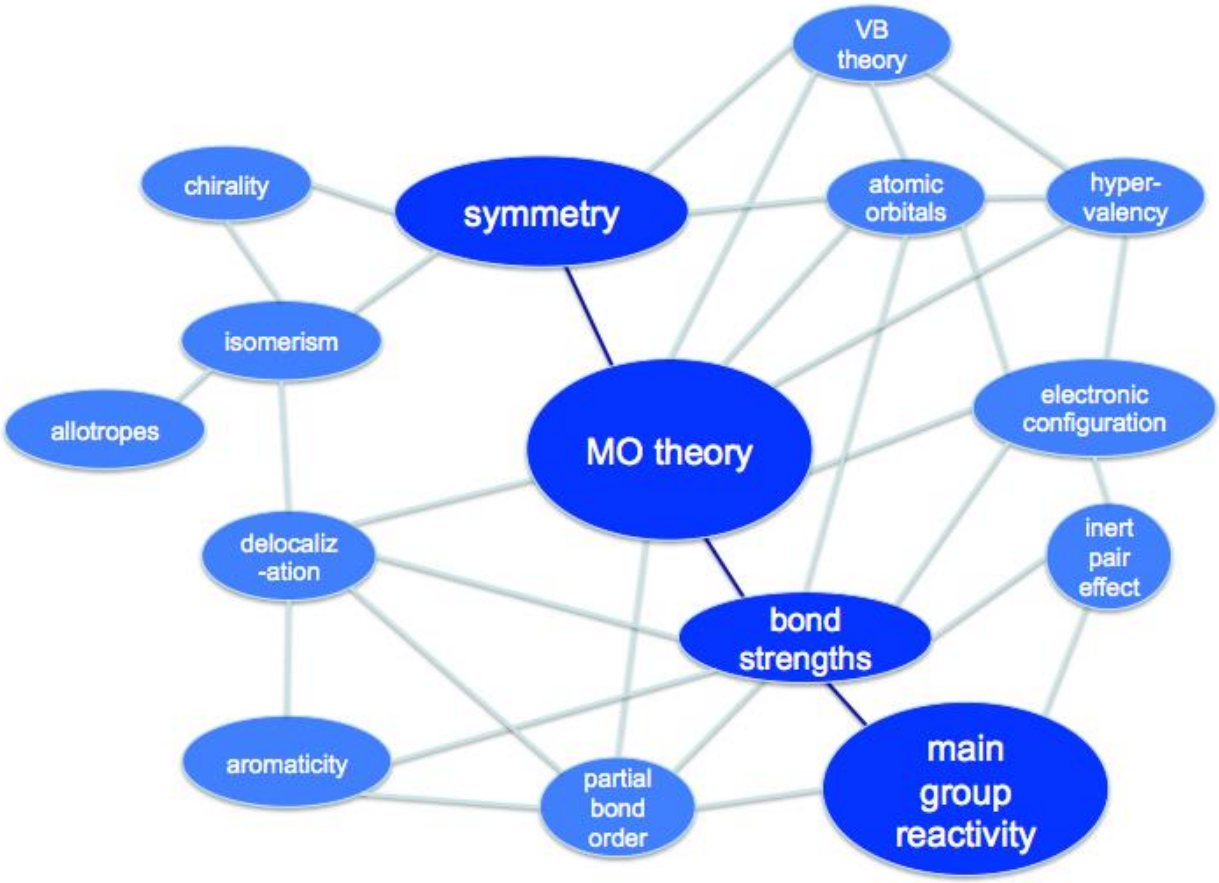
1. Introduction & Review (Atomic orbitals, nodes, electronic configuration of elements, Lewis dot structures, formal charges, oxidation state, hypervalency, VSEPR, coordination geometry, inorganic nomenclature)
2. Symmetry (operations, elements, point groups, character tables, representations)
3. Valence bond theory (hybridization, electronic configuration)
4. Molecular orbital theory Part I (XY diatomic molecules, polyatomic molecules lacking π bonding)
5. Chirality (definition, chiral centres, isomerism, projections, labels, optical rotation, asymmetric synthesis, sugars, polymers)
6. Conformational analysis (conformations, rotational barriers, cyclic compounds, polycyclic compounds)
7. Delocalization and Conjugation (alkenes, isomerization, aromaticity, polyenes, conjugation, colour)
8. Molecular orbital theory Part II (π bonding in polyatomic molecules)
9. Group 13 (boron hydrides, halides, inert pair effect, Lewis acid-base adducts, aluminium)
10. Pnictogens (bond strengths, ammonia, N halides, P, P oxides, P halides, As, Sb, Bi)
11. Chalcogens (sulfur production, elemental S, Se)
12. Oxygen (element, oxides, oxoacids, oxoanions, C oxides, Si oxides, N oxides)
13. Halides (elements, interhalogens, C halides, O halides, other element halides, Frost diagrams, chalcogen halides, nobel gas halides)
14. Review

**Approximate Schedule**

| Week | Topic | Readings from Housecroft 4th edition | Readings from Clayden 2nd edition |
|---|---|---|---|
| 1&2 | Intro & Review | 1 | 1 & 2 |
| 3 | Instruments and Methods | | |
| 4 | Symmetry | 3 except 3.8 | |
| 5 | VB theory | 2 and 5 | 4 |
| 6 | MO theory part I | 2 and 5 | 4 |
| 7 | Chirality | 3.8 and 19.8 | 14 |
| 8 | Conformational analysis | | 16 |
| 9 | Delocalization | 13.8 and 14.4 | 7 and pages 723-735 |
| 10 | Group 13 and Pnictogens | 13 and 15 | |
| 11 | Chalcogens | 16 | |

| | | | |
|---|---|---|---|
| 11 | Oxygen | 7.4-7.6, 14.9, 17.8-17.9[a] | |
| 12 | Halides & review | 14.8 and 17[a] | |

[a] plus parts of chapters 13, 15 and 16 that you've already read.




**Concept map** for the major topics in the course. The four over-riding concepts are shown in darker blue.

**Textbooks/Readings**

- Inorganic Chemistry (4th edition) by Housecroft & Sharpe
- Organic Chemistry (2nd edition) by Clayden, Greeves & Warren

**Grading Scheme**

| | | |
|---|---|---|
| Assignment 1: | 20% | Date TBA |
| Assignment 2: | 20% | Date TBA |
| 1 Final Exam (in person): | 35% | Date TBA |
| Lab | 25% | |
| Total | 100%[a] | |

NOTES: [a] Students must pass both the lecture (75% total) and the lab (25%) components to pass the course.

**Grading Method**

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

***Queen's Official Grade Conversion Scale***

| Grade | Numerical Course Average (Range) |
|---|---|
| A+ | 90-100 |
| A | 85-89 |
| A- | 80-84 |
| B+ | 77-79 |
| B | 73-76 |
| B- | 70-72 |
| C+ | 67-69 |
| C | 63-66 |
| C- | 60-62 |
| D+ | 57-59 |
| D | 53-56 |
| D- | 50-52 |
| F | 49 and below |

**Late Policy**

If you require additional time to complete an assignment, please contact me as soon as possible. See below for the Chemistry Department policy on *missed* quizzes, tests, midterms, presentations, and assignments.

**Department of Chemistry Policy on Missed Quizzes, Tests, Midterms, Presentations, and Assignments**

The Chemistry Department requires that students submit a 'declaration of extenuating circumstances' form before being considered for accommodation. The form, and related information, is available at http://www.chem.queensu.ca/undergraduate/undergraduate-resources/missed-exam-policy. Note that this departmental policy does NOT apply to final exams.

**Department of Chemistry Policy on Missed Labs**

Laboratory work is an integral part of this course. All labs must be completed to pass the course. It is the responsibility of the student to notify the lab coordinator when a lab cannot be completed at the scheduled time. In exceptional circumstances, the following considerations will be given if a scheduled lab cannot be completed at the assigned time: Whenever possible, provisions will be made for a make-up lab preferably shortly before or after the missed experiment; the lab may be completed during the following academic year and a course mark of IN will be assigned until the missing work is completed; In rare circumstances, other accommodations may be made. For further information consult the course instructor and/or the lab coordinator.

**Calculator Policy**

Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991** series calculator is permitted and is the **only approved calculator for Arts and Science students**. This calculator sells for around $25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

**Academic Integrity**

Academic Integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see http://www.queensu.ca/artsci/academics/undergraduate/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

**Copyright of Course Materials**

All materials associated with this course are copyrighted. This includes in-class handouts, emailed information, and all documents and information provided on the course OnQ site. These course materials are for the sole use of students registered in the course. These materials shall not be distributed or disseminated to anyone other than students registered in this course. Failure to abide by these conditions is a breach of copyright, and may also constitute a breach of academic integrity under the University Senate's Academic Integrity policy statement.

**Accessibility Statement**

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. Course materials are available in an accessible format or with appropriate communication supports upon request.

Please contact **Meredith Richards in the Department of Chemistry** in one of the following ways:

Email: ugadm@chem.queensu.ca
Phone: 613-533-6000 extension 75518
In person: Chernoff 200

**Accommodations for Disabilities**

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November 2016 (see https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: http://www.queensu.ca/studentwellness/accessibility-services/

**Academic Consideration for Students with Extenuating Circumstances**

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time, not to exceed three months. Students receiving academic consideration must meet all essential requirements of a course. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances was approved at Senate in April, 2017 (see http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf) Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: http://www.queensu.ca/artsci/accommodations. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:
Instructor/Coordinator Name: Peng Wang
Instructor/Coordinator email address: wang.peng@queensu.ca