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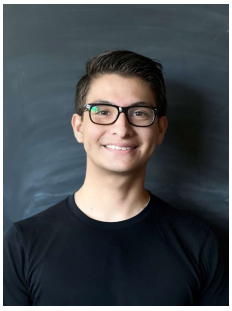
CHM 236H: INTRODUCTORY INORGANIC CHEMISTRY I

Fall Semester Course Syllabus

I TEACHING TEAM

Prof. Robert H. Morris
robert.morris@utoronto.ca
Office: Davenport Labs, room 344, 80 Saint George St.
Student hours: 4-5 pm Mondays or by appointment

Research: The Morris Group | University of Toronto (utoronto.ca)



Tutor

Name: Pedro Mendez Ocampo
Email: pedro.mendez@mail.utoronto.ca
Office: Davenport Labs, room 342, 80 Saint George St.
Student hours:

Research: The Song Research Group (utoronto.ca)

II COURSE OVERVIEW

COURSE DESCRIPTION:

Inorganic chemistry is the chemistry of all of the elements of the periodic table and includes the synthesis of the largest volume chemicals on the earth, coordination geometries found in enzymes and oxygen carriers, the key energy-generating and pollution scrubbing reactions and catalysts needed for a green planet, and compounds with the magnetic and electronic properties that are exploited in modern electronic and photonic devices. This is the first part (followed by CHM237H and then CHM338H) of a two-year sequence in Inorganic Chemistry, designed to illustrate and systematize the rich variety of structures, physical properties, and reactions of compounds of the elements across and down the Periodic Table. It describes the origins of elements and isotopes, the structure of the multielectron atom, the periodic trends of element structure and properties, theories of bonding, acid-base and redox reactions of molecular compounds and transition metal complexes and applications of this chemistry in the world, ionic, metallic, semiconducting, and molecular solids, inorganic solid-state materials, and solid-state chemistry with applications in advanced technologies. This course is recommended for students interested in learning more broadly about the chemistry across the periodic table.

STUDENT LEARNING OUTCOMES:

Upon successful completion of this course, students will be able to:

- Identify elements and isotopes account for their abundance.
- Identify and draw orbitals from the quantum numbers
- . Calculating effective nuclear charges and relating these to the periodic properties of multielectron atoms
- .. Explain the bonding of diatomics using molecular orbital theory.
- Explain the bonding of polyatomic atoms using simple bonding models. Contrast the valence bond and molecular orbital approaches to bonding.
- Identify from their molecular structure the type of acid or base and its relative strength
- Identify oxidants and reductants and list factors that determine their reduction potentials
- Construct thermodynamic cycles that quantify the strength of acids and the lattice energies of ionic solids
- Identify common acids and bases, oxidants and reductants in industry, in the home and in research.
- Know and draw the structure of simple ligands and their transition metal complexes.
- Identify hard and soft acids and bases.
- Identify and draw types of isomers of square planar and octahedral complexes.
- Appreciate and make simple drawings of the structures and energetics of molecular, semiconducting, and ionic solids.
- Know how the functionality of solids enables practical applications
- Research a topic and present it in class or as a recording

PREREQUISITE COURSE(S):

This course assumes you have a fundamental understanding of content covered in CHM 151Y/(CHM 135H, CHM 136H1) with a minimum grade of 63% in those courses. More specifically, this includes the following:

- A knowledge of components of matter – atoms and ions, simple molecules and polyatomic ions and their masses, chemical formulas.
- The nature of light, atomic spectra, the quantum-mechanical model of atoms. An introduction to the build-up of the period table and the electron configuration of the elements.
- A knowledge of the basic theories of bonding.
- Shapes of molecules using Lewis structures, valence bond and VSEPR theory.
- Molecular orbital theory of at least dihydrogen and preferably of the 2nd row element diatomics.
- Writing and balancing chemical equations involving simple acids and bases and oxidation and reduction reactions in water.
- Introductory equilibria, thermodynamics, kinetics and electrochemistry
- An introduction to the structural features of solids..

This course is a prerequisite for CHM 237H (Introductory Inorganic Chemistry II).

READINGS:

Required:

- *Inorganic Chemistry*, 5th Edition, C. Housecroft, Pearson, New York (2018). Selected topics and questions from chapters 1-20; 28 (Materials) and 29 (Trace metals of life); also available as ebook from e.g. https://uoftbookstore.vitalsource.com/products/inorganic-chemistry-catherine-housecroft-v9781292134161?term=9781292134161
- Course Notes (available on Quercus only)

Supplementary:

- *Chemistry: The Molecular Nature of Matter and Change*, Silberberg. INTERCHAPTER.
- *Inorganic Chemistry*. By Weller, Overton, Rourke and Armstrong. 7th Edition. Oxford U. Press. 2018.

III COURSE ORGANIZATION

This course is organized by:

- two classes each week (M and W at 3:10 pm LM162) starting on September 12, 2022 (CHM 236H LEC0101) given by RHM
- one tutorial for each of two sections (TUT0101 Thurs. 1-2 pm to be announced; TUT0201 Fri. 11-12) given by the tutor. Problem assigned in tutorial will be marked. Some students will opt to do their presentation assignment in the tutorial. Please attend your assigned tutorial!
- The list of topics of lectures in the Course Schedule below is subject to change due to unforeseen circumstances

FALL DATES	WEEK	TOPICS
Sept. 12 Sept. 14 Sept. 15, 16	1	Introduction Origin, nature and stability of elements and isotopes. First tutorial. Assignment of presentation topics and times. Use of the library resources (Sept 15)
Sept. 19, 21 Sept. 22, 23	2	Orbitals and energies of the multielectron atom Tutorial 2. Use of library resources (Sept. 23).
Sept. 26, 28 Sept. 29, 30	3	Build up of the periodic table. Effective nuclear charge, periodic trends in ionization energies, electron affinity energies and electronegativity. Tutorial 3. In tutorial problem.
Oct 3 Oct. 3, 5 Oct. 6, 7	4	**QUIZ 1 at Quercus due on Oct 3** Trends in structures and properties of the elements. Structures of molecules and simple bonding models. Structure determination. Tutorial 4. Student presentations.
Oct 10		Thanksgiving holiday
Oct 12 Oct. 13, 14	5	Molecular orbital theory and MO diagrams. Tutorial 5. In tutorial problem.
Oct. 17 Oct. 19 Oct. 20, 21	6	**MIDTERM TEST, Oct 17, 5:10-7:00 pm.** Molecular orbital theory and bonding Tutorial 6. Student presentations.

Oct 24, 26 Oct. 27, 28	7	Reactions: Acids and bases Tutorial 7. Student presentations.
Oct. 31 Oct. 31, Nov. 2 Nov. 3, 4	8	**QUIZ 2 at Quercus due on Oct. 31** Transition metals and coordination chemistry. Tutorial 8. In tutorial problem.
Nov. 7-11		Fall reading week
Nov. 14, 16 Nov. 17, 18	9	Redox reactions and electrochemistry. Tutorial 9. Student presentations.
Nov. 21-25 Nov. 21 Nov. 23 Nov. 24, 25	10	**Online student presentations due before Nov. 21 and online participation due by Nov. 25.** Transition metals in biology, green technology Solids. Ionic, metallic, semiconducting, molecular. Tutorial 10. Research in our Department.
Nov. 28, 30 Dec. 1, 2	11	Lattices. Structure determination. Tutorial 11. Exam preparation
Dec. 5 Dec. 5, 7	12	**QUIZ 3 at Quercus due on Dec. 5** Solids and materials. Solids that changed the world.
Dec. 10-20		**Final exam TBA**

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TUTORIAL OBJECTIVES:
Tutor takes up questions assigned by RHM and provides study help. All students answer a problem posed by the tutor that will be marked. Students will choose a presentation assignment topic and either opt to present it in person in the tutorial or record it and send a link of their recorded presentation before Nov. 21 to the tutor to set up a Discussion on Quercus to be help the week of Nov 21-25

IV EVALUATION/GRADING SCHEME

OVERVIEW:
Booking your presentation topic: 2%
Quizzes at Quercus website (best 2 of 3): 10%
In tutorial problems: 15%
Midterm test: 20%
Presentation: 20%
Participation: 3%
Final exam 30%

ASSESSMENT DATES & MARK BREAKDOWN:
Booking your presentation topic: 2%. Choose your topic and presentation mode (oral or recorded) at Quercus before Sept. 20.
5 MIN PRESENTATION (5 POWERPOINT SLIDES) (FIRST COME, FIRST SERVED, ONLY TWO PEOPLE MAY CHOOSE THE SAME TOPIC).
2. Quizzes: 5%* each (*best 2 of 3), Monday Oct. 3, Oct. 31, Dec. 5: 1 h; 5 multiple choice questions to be answered anytime within a 24-hour window between 12 a.m. – 11:59 p.m. ET
3. In tutorial problem: 5% each. During tutorial times as indicated above.

4. Midterm Test: 20%, Monday October 17: 60 minutes, to be written at an exam location TBA.
5. Presentation: 20%. Students will opt to make a 5 minute, 5 PowerPoint slide presentation in a tutorial (dates indicated above) or record this presentation for a question and answer session on Quercus. Recorded presentations should be uploaded to Mymedia.library.utoronto.ca and the link to this recording sent to the tutor before Nov 21 so that the Discussions section of the Quercus Website can be created. Quercus Discussion on-line during the week of Nov 22-25.
6. Student participation in asking and answering questions during the presentations online: 3% due before Nov. 25.
7. Final exam. 30%. 3h exam during the exam period Dec. 10-20. Time and place TBA.

Accommodations will be made for students who miss tests for valid reasons.

IMPORTANT: if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the quizzes/term tests.

V COURSE POLICIES

- Each member of this course is expected to maintain a:

(i) professional and respectful attitude during all course activities, including classes, tutorials, and online activity.
(ii) personal calendar/schedule/organizer to ensure that all course activities are completed, and due dates are met.
(iii) collection of notes recorded independently based on concepts covered in course activities (students registered with Accessibility Services requiring a class note-taker will have access to this accommodation)
(iv) familiarity with the university policy on Academic Integrity (overleaf)

- The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. As a Course Instructor, I will neither condone nor tolerate behaviour that undermines the dignity or self-esteem of any individual in this course and wish to be alerted to any attempt to create an intimidating or hostile environment. It is our collective responsibility to create a space that is inclusive and welcomes discussion. Discrimination, harassment and hate speech will not be tolerated. If you have any questions, comments, or concerns, we encourage you to reach out to the staff in our Equity Offices.

- Communication with instructor (e.g., I will respond to email within 24 hrs. on weekdays).

- Privacy language and appropriate use of course materials: https://teaching.utoronto.ca/ed-tech/audio-video/sample-statements/

- Policy for late assignment submissions:10% will be deducted daily

- Policy for reweighting due to missed pieces of academic work (for valid reason). The average of marks for the other assignments of the course will be used to determine the mark for the missed work. Contact Prof. Morris by email immediately if you miss assigned work.

- Submission methods: Tutorial problem answers on paper will be handed to the tutor at the end of the tutorial.

- Process for requesting re-grading of course work. Provide it to the tutor at the next tutorial after the one where you received back the graded work.

VI TECHNOLOGY REQUIREMENTS

- Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here: https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/

- Advice for students more broadly regarding online learning is available here: https://onlinelearning.utoronto.ca/getting-ready-for-online/
- This course requires the use of computers, and technical issues are possible. When working on a piece of academic work, students are responsible for scheduling enough time to allow for reasonable delays due to technical difficulties to be overcome, so such issues will not be acceptable grounds for deadline extension. Particularly, maintaining an up-to-date independent backup copy of your work is strongly recommended to guard against hard-drive failures, corrupted files, lost computers, etc.

VII INSTITUTIONAL POLICIES & SUPPORT

ACADEMIC INTEGRITY
Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In presentations and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any report. **Please note that the use of websites (such as Chegg.com or the course discussion board) to post virtual laboratory report material/questions or to post/access answers to questions is an academic offence under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Science Student Academic Integrity office.**

On quizzes and term tests:

1. Using or possessing unauthorized aids. **Please note that the use of websites (such as Chegg.com or the course discussion board) to post quiz/term test questions or to post/access answers to questions is an academic offence under the University of Toronto's Code of Behaviour on Academic Matters. Alleged instances of this nature are forwarded to the Faculty of Arts & Science Student Academic Integrity office.**
2. Looking at someone else's answers or collaborating/discussing answers during a quiz or term test.
3. Misrepresenting your identity.

In general, academic work:

1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see www.academicintegrity.utoronto.ca/).

COPYRIGHT

If a student wishes to copy or reproduce class presentations, course notes or other similar materials provided by instructors, he or she must obtain the instructor's written consent beforehand. Otherwise, all such reproduction is an infringement of copyright and is absolutely prohibited. More information regarding this is available here: https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/

ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations

for a disability, or have any other accessibility concerns about the course, please contact Accessibility Services as soon as possible.

ACCOMMODATIONS FOR RELIGIOUS OBSERVANCES
Following the University's policies, reasonable accommodations will be made for students who observe religious holy days that coincide with the due date/time of an assignment, tutorial, class or laboratory session. Students must inform the instructor **before** the session/assignment date to arrange accommodations.

ADDITIONAL SERVICES & SUPPORT
The following are some important links to help you with academic and/or technical service and support:

- General student services and resources at Student Life
- Full library service through University of Toronto Libraries
- Resources on conducting online research through University Libraries Research
- Resources on academic support from the Academic Success Centre
- Learner support at the Writing Centre
- Information for Technical Support/Quercus Support

ACKNOWLEDGEMENT OF TRADITIONAL LANDS
We wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.