

CHM 236H: INTRODUCTORY INORGANIC CHEMISTRY I

Fall Semester Course Syllabus

I TEACHING TEAM



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Tutor

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II COURSE OVERVIEW

COURSE DESCRIPTION:

Inorganic chemistry is the chemistry of all 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 chemistry across the periodic table.

STUDENT LEARNING OUTCOMES:

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

- Identify elements across the periodic table and interpret isotopes, accounting for their relative abundances.
- Appreciate and apply nuclear chemistry for elemental transformations and the applications thereof
- Connect the atomic structure to the periodic table and trends
- Contrast the valence bond and molecular orbital approaches to bonding.
- Draw orbitals from the quantum numbers and construct the bonding of diatomics using molecular orbital theory.
- Identify from their molecular structure the type of acid or base and its relative strength, as well as applying principles of hard/soft acids and bases.
- Categorize oxidants and reductants and evaluate 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 how they coordinate to form transition metal complexes.
- Identify and draw types of isomers of square planar and octahedral complexes.
- Make simple drawings of the structures and energetics of molecular, semiconducting, and ionic solids.
- Know how the functionality of solids enables practical applications
- Research an inorganic research topic, connecting it to topics discussed in lecture and present it 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 periodic 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.
- 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:

Recommended Text:

- *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 Texts:

- *Chemistry: The Molecular Nature of Matter and Change*, Silberberg.
- *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 (**Mon. in MP102** and **Wed. in MP202**) at **3:10 pm** starting on September 11, 2023 (CHM 236H LEC0101)
- one tutorial for each of two sections (**TUT0101 Thurs. 1:10-2 pm RW143**; **TUT0201 Fri. 11:10-12 FE230**) given by the teaching assistant (TA). In six of these tutorials, an online quiz through Quercus will be held in the last ten minutes.

The list of lecture topics in the Course Schedule below is subject to change due to unforeseen circumstances:

WEEK	LECTURE DATES	LECTURE TOPICS	TUTORIAL & ASSESSMENTS
1	Sept. 11 Sept. 13	<ul style="list-style-type: none">• Introduction• Origin, nature and stability of elements and isotopes.	
2	Sept. 18 Sept. 20	<ul style="list-style-type: none">• Atomic Structure and the Periodic Table	Tutorial 1. Use of library resources and workshop on effective presentations.
3	Sept. 25 Sept 27	<ul style="list-style-type: none">• Periodic Trends	Selection of Presentation Topics Tutorial 2. <i>with Quiz.</i>
4	Oct. 3 Oct. 4	<ul style="list-style-type: none">• Structures of molecules and simple bonding models.	Tutorial 3.
5	Oct. 9 Oct. 11	THANKSGIVING MONDAY (NO CLASS) <ul style="list-style-type: none">• Molecular orbital theory and Simple MO diagrams	Tutorial 4. <i>with Quiz.</i>

6	Oct. 16 Oct. 18	<ul style="list-style-type: none"> Molecular orbital theory and Simple MO diagrams. 	Tutorial 5. with Quiz.
7	Oct. 23 Oct. 25	<ul style="list-style-type: none"> Acids and bases - reactions and applications 	Oct. 25 EVENING 1.5h MIDTERM (5:10-6:40 PM) NO TUTORIAL
8	Oct. 30 Nov. 1	<ul style="list-style-type: none"> Introduction to transition metals and coordination chemistry. 	Tutorial 6. incl. midterm debrief
	Nov. 6 Nov. 8	READING WEEK - NO CLASS	
9	Nov. 13 Nov. 15	<ul style="list-style-type: none"> Introd'n to transition metals and coordination chemistry (cont'd) 	Tutorial 7. with Quiz.
10	Nov. 20 Nov. 22	<ul style="list-style-type: none"> Reduction/oxidation and electrochemistry. 	Online Student Presentations Due Tutorial 8. with Quiz.
11	Nov. 27 Nov. 29	<ul style="list-style-type: none"> Structure and energetics of simple solids 	Tutorial 9. with Quiz.
12	Dec. 4 Dec. 6	<ul style="list-style-type: none"> Solids: properties and utility 	Tutorial 10. Exam Preparation
13	Dec. 7 (<i>due to thanksgiving</i>)	<ul style="list-style-type: none"> TBA 	End of Classes. No Tutorial.
	Dec. 9-20	Final exam TBA	

TUTORIAL OBJECTIVES:

Tutor takes up assigned text and supplementary questions and provides study help. Select tutorials feature in-tutorial quizzes relating to lecture materials. Questions will be presented in tutorial and students will submit answers using Quercus Quiz features (student required to bring personal laptop or mobile device; please contact instructor beforehand if this is an issue to be accommodated). Midterm/exam preparation sessions and take-up will also be held for students during this time.

IV EVALUATION/GRADING SCHEME

OVERVIEW:

In-tutorial Quizzes (5 of 6, lowest dropped): **15%**

Presentation: **25%**

Midterm test: **25%**

Final exam: **35%**

OR* Midterm test: **20%**
Final exam: **40%**

* **Note:** Your midterm test and final exam marks will be calculated using both weighing schemes (25/35 or 20/40) with the higher grade being used.

ASSESSMENT DATES & MARK BREAKDOWN:

1. In-tutorial Quizzes: 3%* each (*best 5 of 6) = 15 % of Grade

- Questions will be posted during last 10 minutes of tutorial, students must submit answer **online in Quercus Quizzes during their tutorial session** to receive grade. One missed or lowest quiz will be dropped.

2. Midterm Test: 20% or 25% of Grade

- **Wednesday, October 25th**: 90 minutes, to be written at EX100 from 5:10-6:40 pm.

3. PRE-RECORDED PRESENTATION (No Slide Limit) = 25% of Grade

- **Booking your presentation topic: 1%.**
Choose your presentation topic on Quercus before Sept. 29. (FIRST COME, FIRST SERVED, ONLY TWO PEOPLE MAY CHOOSE THE SAME TOPIC).
- **Presentation: 20%.**
Students will upload to Quercus a pre-recorded video of their PowerPoint presentation, **max 3 minutes** in length but no slide limit. A more detailed marking rubric will be provided.
- **Participation & Discussions: 4%.** You are expected to watch at least ten (10) of your peers' presentations and post a question on the discussion board to them (2% of mark) within 1 week of the videos being made available. You are expected to respond and address questions posted to your video within the following weeks time (2% of mark).

4. Final exam. 35% or 40% of Grade

- 3h cumulative exam (with heavier weight on later half of course) during the exam period Dec. 10-20. Time and place TBA.

Accommodations will be made for students who miss tests for valid reasons. Please email the instructors immediately.

NOTICE: 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 assessments.

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.
 - If you are absent from your studies due to illness or other reasons and unable to complete course work (e.g., a term test or an assignment) then a piece of written documentation is required. The following four items are the recognized forms of documentation:
 1. [Absence Declaration via ACORN](#) (please note the circumstances under which an absence declaration can and cannot be submitted)
 2. [U of T Verification of Illness or Injury Form](#)
 3. College Registrar's letter
 4. Letter of Academic Accommodation from Accessibility Services

Students who complete the ACORN Absence Declaration form must additionally contact the course coordinators to discuss their situation **within five business days** of the missed piece of work. This is essential action for any consideration to be granted.

For extended absences and for absences due to non-medical reasons, make sure to contact your [College Registrar's Office](#). They can help you decide between a request for an extension or other types of academic consideration.

If you suspect or know that you have a disability that is affecting your studies, [learn about the services and supports available through Accessibility Services](#). A disability can be physical disability, sensory disability, a learning disability, mental health disorder or a short-term disability like an injury. If you are not sure whether you have a disability, you can confidentially contact [Accessibility Services](#) with your questions.

- Regarding the Use of Generative AI: Students may use artificial intelligence tools as an organizational and grammar aid, but all final submitted work must be original produced by the individual student alone. Students are ultimately accountable for the work they submit and subject to academic integrity policies.

- 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.** Quizzes cannot be retaken if missed.
- 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. De Backere or Prof. Scott Browning by email immediately if you miss assigned work.
- Submission methods: Tutorial quiz questions will be posted during tutorial and answers submitted through the Quercus Quiz feature. Presentation assessment will also be submitted as a pre-recorded video through Quercus.
- Process for requesting re-grading of course work. Contact Prof. De Backere or Prof. Scott Browning by email immediately if you wish to request regrading.

VI TECHNOLOGY REQUIREMENTS

- Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here:
<https://www.vicereprovoststudents.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.
- Personal devices are required during tutorials in order to submit quiz answers through Quercus. This may be accomplished using personal computers or smart phones.

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. If you wish to support other students taking this course, consider registering online as a Volunteer Note-Taker at: <https://clockwork.studentlife.utoronto.ca/custom/misc/home.aspx>

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.