Chemistry
UNIVERSITY OF TORONTO

CHM 237H: INTRODUCTORY INORGANIC CHEMISTRY II

Draft of Winter Semester Course Syllabus

I TEACHING TEAM

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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 molecules and materials with electrical, optical and magnetic properties that are exploited in a range of products, processes and devices. This course is a continuation from CHM236H1 and further studies the chemistry of the elements across the periodic table. It will cover topics that include molecular symmetry, the bonding, structures and properties of main group compounds and transition metal complexes, solid-state chemistry, from synthesis and structure to property and function, and how these relate to utility in advanced materials technologies. A strong emphasis on developing laboratory techniques and communication skills is made through the practical component of the course. CHM237H1 is strongly recommended for students exploring experimental synthetic chemistry as part of their degree program.

STUDENT LEARNING OUTCOMES:

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

- Identify symmetry elements and perform symmetry operations.
- Identify point groups to which given molecules belong.
- Apply knowledge of symmetry to bonding, structure, and spectroscopic methods.
- Explain the bonding and properties of polyatomic molecules using molecular orbital diagrams provided.
- Explain the phenomenon of luminescence.
- Explain the electron configuration of transition metal complexes using crystal field/ligand field theory.
- Explain the magnetic properties of transition metal complexes using the spin-only model.
- Understand the basic chemistry concepts and principles of how to synthesize different classes of inorganic molecules and materials for use as building blocks for making purposeful solids.
- Apply a physical chemistry approach to understand and tailor the electrical and optical properties of inorganic materials.
- Explain how these materials properties enable specific functions and practical applications in the real world.
- Safely synthesize and characterize a variety of inorganic compounds using standard laboratory techniques and spectroscopic methods; as well as implement DFT calculations to obtain qualitative and quantitative information about molecules.
- Apply the fundamental principles learned in CHM236 and CHM237 lecture to explain the properties and aspects of the inorganic systems investigated.
- Work both independently and collaboratively to interpret data and clearly/concisely communicate results using proper scientific writing

through lab reports or oral presentations; recognizing the limitations, assumptions, errors, and uncertainties that may arise in experimental work
- Use the scientific literature to prepare for, understand, and evaluate experimental procedures and results.

PREREQUISITE COURSE(S):
A minimum grade of 63% in CHM 236H

READINGS:
Required:
- *Inorganic Chemistry*, 5th Edition, C. E. Housecroft and A. G. Sharpe, Pearson, New York (2018).
- 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.
- Solid-State Chemistry, An Introduction, 5th Edition, Elaine Moore and Leslie Smart.

III COURSE ORGANIZATION

This course is organized by:
- two classes each week (M and W at 3:10 pm ET) starting on January 6, 2025
- one tutorial for each of two sections (see below) given by the tutorial TA.
- one laboratory each week on assigned day (Mon.-Fri., 9 am–1 pm ET) starting the week of **Jan. 13th, 2025**. *See your Quercus CHM237H PRA webpage for scheduling and more information.*
- The list of topics and timings in the Course Schedule below is subject to change at the instructors discretion:

WINTER DATES	WEEK	TOPICS
		Song Lectures
Jan. 6, 8	1	Molecular Symmetry
Jan. 13, 15 Jan. 16, 17	2	Molecular Symmetry Tutorial 1
Jan. 20 Jan. 20, 22	3	**Online Quiz 1** Molecular Orbital Theory
Jan. 27, Jan. 29 Jan. 30, 31	4	Coordination Compounds II: Crystal field theory Tutorial 2
Feb. 3, 5 **Feb. 3**	5	Coordination Compounds II: Crystal field theory **Online Quiz 2**
Feb. 10	6	**Term Test 1**

Feb. 12 Feb. 13, 14		Coordination Compounds II: Crystal field theory Tutorial 3
Feb. 17–21		winter reading week
Ozin Lectures		
Feb. 24, 26	7	Introduction to Inorganic Materials Chemistry
Mar. 3, 5 Mar. 6, 7	8	Electronic Properties of Inorganic Materials, I Tutorial 4
Mar. 10 Mar. 10, 12	9	**Online Quiz 3** Electronic Properties of Inorganic Materials, II
Mar. 17, 19 Mar. 20, 21	10	Applications of Inorganic Materials Tutorial 5
Mar. 24 Mar. 26	11	**Term Test 2** Inorganic Molecule and Materials Synthesis I
Mar 31 Mar. 31, Apr. 2 Apr. 3, 4	12	**Online Quiz 4** Inorganic Molecule and Materials Synthesis, II Tutorial 6
Apr. 9–30	Exam Period	**Final Exam**

TUTORIAL OBJECTIVES:
Tutorial TA will discuss topics assigned by instructors, demonstrate problem solving, and provide study help.

IV EVALUATION/GRADING SCHEME

OVERVIEW:
Quizzes (best 3 of 4): 5%
Term Tests: 20% (the better one 12% + the other one 8%)
Final Exam: 30%
Labs: 45%

ASSESSMENT DATES & MARK BREAKDOWN:

1. Quizzes (5%): average of the best 3 out of 4 in Quercus, on Jan. 20, Feb. 3, and Mar. 10, Mar. 31. The lowest one will be dropped.

2. Term Tests (20%): Feb. 10 and Mar. 24 at 3:10–4:00 pm, to be written in-person, location TBA.

3. Final Exam (30%): during the final exam period.

4. Laboratory Marking Scheme (45%):
10% Each x 2 FORMAL LAB REPORT Experiments
5% Each x 5 BRIEF LAB REPORT Experiments (*one lowest dropped*)

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 the Course Instructors, we 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 me/the course coordinator/the course administrator 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.

- Students may not use artificial intelligence tools for quizzes, term tests, final exam, or lab reports.

- We will try our best to respond to emails within 24 hrs. on workdays.

- Policy for reweighting due to missed pieces of academic work (for valid reasons): there won't be make up term tests; the weight of the missed pieces will be added to your final exam. Contact Prof. Song by email immediately if you miss assigned 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, assignments, and laboratory reports:

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 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/).

Plagiarism Detection

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (https://uoft.me/pdt-faq)

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.

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 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.