



# Chemistry

UNIVERSITY OF TORONTO

## CHM437S/CHM1263S: BIOINORGANIC CHEMISTRY

### Semester Course Syllabus

#### I Instructor

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**Prof. Robert H. Morris**

[robert.morris@utoronto.ca](mailto:robert.morris@utoronto.ca)

Office: Davenport Labs, room 344, 80 Saint George St.

In January on-line student hours 4-5 pm ET Mondays: Join Zoom Meeting

<https://utoronto.zoom.us/j/82090655057>

Meeting ID: 820 9065 5057 Passcode: 432131

In person student hours: 4-5 pm ET Mondays Feb.-Apr. or by appointment arranged by email.

Research: <https://www.chemistry.utoronto.ca/people/directories/all-faculty/robert-morris>

#### II COURSE OVERVIEW

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##### **COURSE DESCRIPTION:**

Essential elements, harmful elements, naturally occurring ligands, chelating ligands, ligands used in chelate therapy, functions of metals, principles of bioinorganic coordination chemistry, template effect, spontaneous self-assembly, properties of biological molecules, transport of metal ions, control and utilization of metal-ion concentrations, DNA binding, enzymes exploiting acid catalysis, developing artificial hydrolytic metalloenzymes, zinc fingers, electron transfer and energy sources for life, iron-sulfur proteins, Mossbauer spectroscopy, hydrogenases, nitrogenase, atom and group transfer chemistry, redox enzymes, biomineralization, metals in medicine, radiopharmaceuticals

##### **STUDENT LEARNING OUTCOMES:**

Recognize how the fundamental principles of inorganic chemistry apply to bioinorganic systems.

Appreciate how Nature acquires and places trace elements for use in life processes.

Understand the application of specialized methods used to study bioinorganic molecules.

Discuss the chemistry and biology of specific bioinorganic systems and model metal complexes.

##### **PREREQUISITE COURSE(S):**

This course assumes you have a basic understanding of transition metal coordination chemistry from a full year course in introductory inorganic chemistry such as CHM238Y and a knowledge of biochemistry. CHM238Y may not be taken concurrently with CHM437S. A biochemistry course and an advanced inorganic chemistry course such as CHM338H are strongly recommended.

Exclusion: Equivalent course in Bioinorganic Chemistry or Inorganic Biological Chemistry

### READINGS:

Required:

Course notes and materials from the QUERCUS website.

Textbook: Biological Inorganic Chemistry, 2nd ed., Robert R. Crichton, 2012 (available on-line through the UoT library: <http://go.utlib.ca/cat/8390276> ). Note that the Microsoft Edge browser may not work – install and use the Firefox or Chrome browser. Safari should work.

Supplemental: Guided Tours of Metalloproteins: [The Guided Tours of Metalloproteins \(GTM\) \(utoronto.ca\)](http://utoronto.ca)

### III COURSE ORGANIZATION

This course is organized by:

Two classes each week (Tues. and Thurs. at 4:00 pm ET) starting on January 11, 2022. The classes in January will be held on-line at

Join Zoom Meeting

<https://utoronto.zoom.us/j/89837132546>

Meeting ID: 898 3713 2546

Passcode: 600810

Starting Feb. 8 they will be held in person in room LM155.

**COURSE SCHEDULE & RELEVANT SESSIONAL DATES:**

WINTER DATES	WEEK	TOPICS
Jan. 11-27	1,2,3	Introduction, essential elements, biocoordination chemistry, metal ion transport
Feb. 1 Feb. 1 – Feb. 17	4,5,6	<b>Quiz 1 due on Feb. 1</b> O <sub>2</sub> transport, non-redox proteins, electron carriers, Iron sulfur proteins, cytochromes.
Feb. 21-25		Winter reading week
Mar. 1 Mar. 1,3	7	<b>Midterm Assignment due Mar. 1, 4:10 pm.</b> Copper blue proteins
Mar. 8-19 Mar. 15	8,9	Nitrogenase, respiration <b>Abstract of presentation due Mar 15, 4:10 pm.</b>
Mar. 22-31 Mar. 29	10,11	Photosynthesis, metals in medicine. <b>Quiz 2 due on Mar. 29</b>
Week of Apr. 4-8	12	<b>Student video presentations and Discussion</b>
Apr. 8		Classes end
Apr. 11-29		<b>Final assessment period.</b>

## IV EVALUATION/GRADING SCHEME

## OVERVIEW:

QUIZZES (two in total, best mark of the two) worth 10%

**MIDTERM ASSIGNMENT** (due Feb. 25) worth 20%

PRESENTATION ABSTRACT (due Mar. 16) worth 5%

STUDENT PRESENTATION (recorded video presentation) due Apr. 4-8 worth 30%

**FINAL ASSESSMENT** during Apr. 11-29 (to be announced). Worth 35%

TOTAL:  $10\%+20\%+5\%+30\%+35\%=100\%$

**ASSESSMENT DATES & MARK BREAKDOWN:**

1. Quiz 1 (10%\*, Tuesday 1<sup>st</sup> February): 1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.
2. Midterm assignment (20%, due Tuesday March 1<sup>st</sup> at 4:10 pm). Students of CHM1263S will have an additional question to answer.
3. Abstract of presentation (5%, due Tuesday March 15<sup>th</sup> at 4:10 pm)
4. Quiz 2 (10%\*, Monday 29<sup>th</sup> March): :1 hour, to be written anytime within a 24-hour window between 12:00 a.m. – 11:59 p.m. ET.
5. Student Presentation (30%, during the week of April 4-6): done online.
6. Final assessment (35%, in the Final Assessment period April 11-29): 3 hours, location and date to be announced. Students of CHM1263S will have an additional question to answer.

\*note that if both quizzes are written, the higher grade earned on the two quizzes will be counted. Each quiz will be multiple-choice in nature.

**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**

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- Each member of this course is expected to maintain a:
  - (i) professional and respectful attitude during all course activities, including classes, laboratories, 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.
- The instructor will respond to email within 24 hours on weekdays).
- This course, including your participation, may be recorded on video and may be available to students in the course for viewing remotely and after each

session. Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation, and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. For questions about recording and use of videos in which you appear, please contact your instructor.

- Students may create audio-recordings of the lectures for their personal use. Recordings are intended to permit lecture content review so as to enhance understanding of the topics presented. Audio-recordings are not substitutes for attending class. Students should note that since audio recordings are to be permitted, their voice may be recorded by others during the class. Please speak to the instructor if this is a concern for you. In accordance with the Accessibility for Ontarians with Disabilities Act, 2005, persons who have special needs will be accommodated. Students agree to the following terms when creating audio recordings of lectures: (a) Recordings are not to be distributed without the permission of the instructor via the Internet, using social media such as Facebook, peer-to-peer file sharing such as One Drive or Dropbox, or other distribution channels. (b) Recordings are not to be shared with other classmates unless they are to be used in collaborative assignments, or if the instructor permits for other reasons. Non-compliance with these terms violates an instructor's intellectual property rights and the Canadian Copyright Act. Students violating this agreement will be subject to disciplinary actions under the Code of Student Conduct.
  - Deadlines for assignment submissions are given in section III above. 10 % will be deducted daily for late assignments, quizzes and tests.
  - If you believe that an error has been made in the marking of your work please contact Professor Morris.
  - If you miss classes, assignments or tests for medical reasons please inform Professor Morris immediately by email.
  - No extensions or make-up work will be considered.
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## VI TECHNOLOGY REQUIREMENTS

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- 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

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### 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](https://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 virtual 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 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/](http://www.academicintegrity.utoronto.ca/)).

### **Plagiarism Detection**

The instructor is familiar with literature on the subjects of the student presentations and assignment and will not tolerate word for word or figure for figure duplication without the permitted referencing of the source material.

### **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.