SYLLABUS

Introduction to Inorganic Chemistry

CHMB31H3, Fall 2023

Instructor Information

Instructor	Email	Office	Office hours will be announced on Quercus early in the semester.
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Introduction

Welcome to the amazing, complex, and colorful world of inorganic chemistry, a chemistry discipline that deals with all chemical elements (natural and artificial), their properties, reactivities and all compounds they create. Of currently known 118 elements, 92 occur in nature, while the rest were made in the laboratories. These 118 elements, these 118 LEGO blocks, are what all the stuff is made of: from the most distant stars and galaxies to the tiniest grain of dust in my office. Inorganic chemistry is everywhere.

Inorganic chemistry has a lot to cover, and material can be rather overwhelming. *Essential* for successful mastering of inorganic chemistry is solid understanding and knowledge of material from introductory chemistry courses (CHMA10H3 and CHMA11H3/CHMA12H3 or their equivalents). Using this knowledge as a basis, inorganic chemistry can be turned into a piece of cake (a somewhat big piece, but still a piece...).

A Note on Course Delivery for Fall 2023

CHMB31 classes and labs are scheduled to be in-person. Our course had a WebOption in previous years – lectures were videotaped in the classroom and then posted online for future viewing. This academic year we'll try to keep this tradition **if there are sufficient resources on campus**. I still, however, encourage you to come to the lectures to stay on a learning schedule and be a part of our community. **There is strong evidence indicating that having a schedule and well-defined timetable enhances knowledge retention and overall performance in a course.**

There is no equivalent to WebOption for the labs, and in-person presence for the labs is mandatory.

Course Content

To make our early journey easier and organized, the course is divided in two parts. The first part will cover introductory topics. You have already encountered most of this material in CHMA10H3 and CHMA11H3/CHMA12H3 and it would be a good idea to refresh your memory even before the classes start (the detailed topic list is given below). We shall review these basic concepts and further expand and apply them to the problems closely related to the inorganic chemistry material. The second part of the course will cover the descriptive inorganic chemistry—the chemistry of the elements—of hydrogen and elements of Groups 1, 2 and 13-18 (or as we call them the main group chemistry).

Upon completion of this course, you should:

- Have a clear understanding of the periodic trends and navigate through the periodic table.
- Be able to apply the periodic trends to predict the reactivities and properties of elements and their compounds.
- Discuss molecular and simple solid-state structures.
- Apply your knowledge to solve simple reactivity and structural problems from main group chemistry.
- Obtain basic understanding of the connections between inorganic chemistry and society at large (industry, environment, history of science, politics etc.).

A detailed list of our topics is (the chapter numbers are from our textbook Atkins' Inorganic Chemistry 7th edition):

Part I: Fundamental concepts

1. Inorganic chemistry – a general introduction to the discipline and our course

2. The Elements – what are they? (Chapter 1 and on-line materials)

a. Atoms and their structure

b. Nucleus, radioactivity, fission, and fusion

c. Nucleosynthesis: the birth of elements in stars and laboratory (basics of stellar and interstellar inorganic chemistry and artificial nuclear reactions)

d. The electronic structure of the atom

e. The periodic table of the elements: Overview

NOTE: Topics 2a, 2b, 2d and 2e are related to the first-year chemistry material and it would be a good idea to refresh your old knowledge early!

3. Molecules, compounds, and bonding (Chapter 2 and on-line materials)

a. Lewis bonding model and VSEPR theory

b. Valence bond (VB) theory

c. Basics of molecular orbital (MO) theory

NOTE: Topics 3a, and 3b have been covered in detail in the first year. In this case, solid prior knowledge **is expected**!

4. Structure of simple solids (Chapter 4 and on-line materials)

a. Describing the structure of solids

b. Metals and alloys; metallic bonding

c. Ionic solids; ionic bonding

d. Thermochemistry and energetics of solid formation

5. Reactions/Reactivity:

a. Chemical equilibrium

b. Thermodynamics

c. Types of inorganic reactions

d. Redox reactions and electrochemistry (Chapter 6)

e. Acids, bases and their reactions (Chapter 7)

NOTE: Topics 5a, 5b, and 5c are not covered in the textbook but we really need them. You can use your CHMA10H3/CHMA11H3/CHMA12H3 textbook and/or notes as sources (that should be adequate) to review this important material; solid prior knowledge **is expected**! Topics 4d and 4e are covered in the textbook but as you'll see most of it is again an important revision of first year material with some new concepts added.

Part II: Main group chemistry

6. Periodic table revisited (Chapter 9)

a. Periodic trends

b. Basic classes of inorganic compounds and their periodic characteristics

7. Hydrogen (Chapter 10)
8. The Group 1 elements (Chapter 11)
9. The Group 2 elements (Chapter 12)
10. The Group 13 elements (Chapter 13)
11. The Group 14 elements (Chapter 14)
12. The Group 15 elements (Chapter 15)
13. The Group 16 elements (Chapter 16)
14. The Group 17 elements (Chapter 17)
15. The Group 18 elements (Chapter 18)

I am deliberately avoiding assigning topics to a particular week of the semester because this gives us flexibility to slow down for topics that are more complex and repeat (if needed) what needs to be repeated. We will also insert tutorials and practice as time allows – particularly before the term tests.

The readings and practice problems from your textbook (textbook details are given later in the syllabus) will be given to you at the end of each lecture in your lecture notes. The lecture notes for each topic will be available on Quercus in *pdf* format. They will be accompanied with other useful materials to help you expand your knowledge, test it, and challenge it. The lecture notes provide you with the overview of important concepts, ideas etc. and are ***the basis*** for class discussions, lectures, lab work and later the exams. They will be your primary source - master them first, then move to the textbook to expand your knowledge and then (only if you want to) check other sources.

Knowledge of material from both lecture notes and relevant textbook readings is expected.

This course (unfortunately) does not have tutorials. However, just like during previous years, we shall have some practice time during lectures. There will be in-class practice definitely before each term test. We can also organize tutorial/discussion/help sessions at the same time when practicals are scheduled for the practical sections that are free on that day.

Laboratory Component of CHMB31H3

The laboratory component starts during the week **of September 11th** and runs every other week. There are five experiments to be performed; all designed to demonstrate basic points from the lectures:

- Experiment 1: Acid-base and redox chemistry
- Experiment 2: The chemistry of groups 1 and 2
- Experiment 3: The chemistry of groups 13 and 14
- Experiment 4: The chemistry of groups 15 and 16
- Experiment 5: The chemistry of group 17 and inorganic analysis

Experiment/lab schedule (note: PRA005 and PRA006 will remain closed and unavailable if course enrolment is low)

Week of:	**Practical groups**	**Experiment**
Sept. 11th	PRA001, PRA003 & PRA005	Experiment 1
Sept. 18th	PRA002, PRA004 & PRA006	
Sept. 25th	PRA001, PRA003 & PRA005	Experiment 2
Oct. 2rd	PRA002, PRA004 & PRA006	
Oct. 9th	**Reading week – no classes, no labs**	
Oct. 18th	PRA001, PRA003 & PRA005	Experiment 3
Oct. 23th	PRA002, PRA004 & PRA006	
Oct. 30st	PRA001, PRA003 & PRA005	Experiment 4
Nov. 6th	PRA002, PRA004 & PRA006	
Nov. 13th	PRA001, PRA003 & PRA005	Experiment 5
Nov. 20st	PRA002, PRA004 & PRA006	

Although every effort has been made to ensure that the experiments closely follow the lecture content, due to scheduling and other issues related to the organization of the course, this is not always be the case.

Keep in mind that the laboratory component is mandatory. You will find other details regarding the practical (i.e. requirements, best practices, lab evaluation details etc.) in the introduction part of the lab manual. The complete lab manual will be posted on Quercus portal as a .pdf file and is *free of charge*.

Evaluation Methods and Marking Scheme

Laboratory component	= 25%
2 term tests, 20% each	= 40%
Final exam	= 35%

Laboratory component. Details about laboratory evaluation will be provided in the introductory section of your lab manual (to be posted on Quecus). In short, the evaluation of CHMB31H3 labs will not differ significantly from other first and second year labs: quizzes, lab preparation, record keeping, lab performance and lab reports will be used as evaluation methods.

- Late Penalties for Lab Report Sheets
    - -10% of the total per day for 5 days (weekends count as two days unless you email a scanned copy of it to the lab coordinator). After 5 days a grade of zero will be assigned

Term tests. The term tests will be composed of short answer questions and will be 90 min (an hour and half) in length. Additional details will be communicated through Quercus prior to each exam. While the time/date for the tests will be announced once the scheduling is completed, you can take **as a rough guide** that the first term test is generally around the reading week while the second one is in mid/late November. The first term test will cover all material from the lecture 1 up to the week of the test or reading week (depends on which one is first). The second term test covers the material between first term test and second term test. **You will have examples of past term tests and final exams posted on Quercus.**

The final exam is cumulative with about 1/3 of questions covering material from the first half of the course (material from the first term test) and 2/3 of questions covering the second part of the course (material covered after the first term test). The final will have both multiple choice and short answer questions and will take three hours to write.

Missed term test policies

If you **miss a term test**, you must declare your absence using ACORN tool available at:
https://www.utsc.utoronto.ca/registrar/acorn-absence-declaration-tool

You are also required to fill the departmental absence form available at:
https://www.utsc.utoronto.ca/physsci/self-declaration-absence-form-0

If clicking on the link above does not work, please copy the address, and paste it in your browser.

After you complete the declarations, you have two choices:

a) write a make-up test which is usually scheduled 5-10 business days after the original exam date, *or*

b) add the value of the missed test to your final exam (for example, if you miss a term test for a valid reason and chose this option, your final exam will be worth 35% + 20% = 55% of your final mark).

Obtaining the passing grade in CHMB31H3

To receive the passing grade (> 50%) in CHMB31H3 at the end of the course, you must pass the final exam and at least one of the two term tests *or* final exam and lab component.

Achieving Success in Inorganic Chemistry

As mentioned previously, **stay on the top of your material**: read, practice, and take notes on regular basis. Much of the material requires knowledge from CHMA10H3 and CHMA11H3/CHMA12H3–**do not be shy** to go back and refresh your memory. **Take advantage of office hours**–note the questions that come up as you study, come to the office hours and discuss

them. **Ask questions during the lectures**– while the question is fresh in your mind and the material is still new.

CHMB31H3 Resources

Your required textbook:

Weller, Overton, Rourke, and Armstrong. **Inorganic chemistry**. 7th ed. Oxford University Press, 2018. *(Note*: the previous, sixth, edition is also acceptable!)

Not required, but recommended:

Hadzovic, A. **Solutions manual for Inorganic Chemistry**. 7th ed. Oxford University Press, 2018. *(Note*: the previous, sixth, edition is also acceptable!)

I do understand that it is going to be challenging to obtain the textbooks these days. Our UTSC bookstore has ordered the copies for you. If you cannot obtain the book from the bookstore, any other way is acceptable. The textbook publishers are not very cooperative to provide e-copies to the university libraries, unfortunately. One point is important to mention: these two textbooks are **used in all four inorganic chemistry courses** on our campus. So, if you plan on taking any remaining three (CHMC31Y3, CHMD39H3 and/or CHMD69H3) it is worth to invest and have your own copies. Some lectures have alternative readings posted on Quercus (I think the first five), so you are good for the first two or three weeks of our course! If I manage to produce more material, you will be notified, of course. **Speaking of these, if you use these readings, I would like your honest opinion.**

Other good books IF you are interested in reading more:

Greenwood N.N., Earnshaw A. **Chemistry of the Elements**. 2nd edition. Oxford: Butterworth-Heinemann, 1997. (Call No. QD466 .G74 1997 SCAR; available also on-line at http://simplelink.library.utoronto.ca/url.cfm/2717)

This is an excellent inorganic chemistry textbook. Importantly for us, it has a very good coverage of nucleosynthesis and formation of elements in the stars. The rest of it is an advanced reading. If you would like to explore and learn more about the elements, their properties and compounds, this book is a great starting point. It covers in detail the elements, their properties and compounds.

Miessler G.L., Tarr D.A. **Inorganic Chemistry.** 3rd edition. Upper Saddle River: Pearson Education; 2004. (Call No. QD151.3 .M54 2004)

Huheey J.E., Keiter E.A., Keiter R. L. Inorganic chemistry: Principles of structure and reactivity. 4th edition. New York: HarperCollins College Publishers; 1993. (Call No. QD151.2 .H84 1993 SCAR)

Some popular books (non-textbooks) on chemical elements:

Atkins P.W. **The Periodic Kingdom: A journey into the land of the chemical elements**. New York: Basic Books; 1995. (Call No. QD466 .A845 1995 SCAR)

Emsley, J. **Nature's building blocks: An A-Z guide to the elements**. Oxford: Oxford University Press; 2001. (Call No. QD466 .E486 2001 SCAR)

Ball, P. **The ingredients: A guided tour of the elements**. Oxford: Oxford University Press; 2002.

Wothers, P. **Antimony, Gold and Jupiter's Wolf: How the elements were named.** Oxford: Oxford University Press, 2019.

There are many other popular science books dealing with the elements, their birth and occurrence, their compounds and history. Some of them can be found in UTSC library!

On the web

VISUAL ELEMENTS PERIODIC TABLE:
http://www.rsc.org/chemsoc/visualelements/pages/periodic_table.html
A beautiful and artistic representation of periodic table and the elements

WEBELEMENTS www.webelements.com

Provides a lot of data for each element (but I find it a bit messy)

WEBMINERAL www.webmineral.com

Minerals are only one place where we can find inorganic chemistry in nature.

THE GUIDED TOURS OF METALLOPROTEINS http://www.chem.utoronto.ca/coursenotes/GTM/main.htm

The other place where we find inorganic chemistry is in us and all other living creatures!

Office hours and contact info

I can be reached via e-mail: **m.zimmer.deiuliis@utoronto.ca**

My office is in the Environmental Sciences and Chemistry Building, 5th floor, room EV564. However, our office hours will likely be scheduled virtually. **If you would like to get in touch outside the office hours (for any reason), please e-mail me and we'll schedule the time**.

Academic Integrity

Academic integrity is one of the cornerstones of the University of Toronto. It is critically important both to maintain our community which honors the values of honesty, trust, respect, fairness and responsibility. It also protects you, the student within our community as well as the value of the degree towards which you are all working so diligently. Detailed information about how to act with academic integrity, the Code of Behavior on Academic Matters, and the processes by which allegations of academic misconduct are resolved can be found online: Student Academic Integrity | Faculty of Arts & Science (utoronto.ca) and FAQ | Vice Principal Academic & Dean (utoronto.ca)

Section B of the University of Toronto's Code of Behaviour on Academic Matters (http://www.governingcouncil.utoronto.ca/policies/behaveac.htm) lists actions that are considered academic offences. Some of the most common offences are:

- To use someone else's ideas or words in their own work without acknowledging that those ideas/words are not their own with a citation and quotation marks, i.e. to commit **plagiarism**.
- To include **false**, **misleading** or **concocted** citations in their work.
- To obtain **unauthorized** assistance on any assignment.
- To provide **unauthorized** assistance to another student. *This includes showing another student completed work*.
- To submit their own work for credit in **more than one course** without the permission of the instructor.

- To **falsify** or **alter** any documentation required by the University. This includes, but is not limited to, doctor's notes.
- To use or possess an unauthorized aid in any test or exam.

There are other offences covered under the Code, but these are by far the most common. Please respect these rules and the values which they protect. Offences against academic integrity will be dealt with according to the procedures outlined in the Code of Behavior on Academic Matters.

Accessibility

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodations, please feel free to approach me and/or the AccessAbility Services Office (ability@utsc.utoronto.ca) as soon as possible. I will work with you and AccessAbility Services to ensure you can achieve your learning goals in this course. Enquiries are confidential. The UTSC AccessAbility Services staff are available by appointment to assess specific needs, provide referrals and arrange appropriate accommodations. More details are available at: http://www.utsc.utoronto.ca/ability/.

GOOD LUCK AND SEE YOU SOON!!