

Introduction to Inorganic Chemistry

CHMB31H3

Syllabus

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 and reactivities. There are 92 naturally occurring elements and as you can imagine, the material can be rather overwhelming. Essential for successful mastering of the inorganic chemistry material is solid understanding and knowledge of material from introductory chemistry courses (CHMA10 and CHMA11). Using this knowledge as a basis, inorganic chemistry can be turned into a piece of cake (a somewhat big piece, but still a piece...). Keep in mind that these 92 naturally occurring elements, these 92 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. This means that inorganic chemistry is everywhere.

Our course material is divided in two parts. The first part will cover introductory topics. You have already encountered this material in CHMA10 and CHMA11 courses and it would be a good idea to refresh your memory (the detailed topic list is given below). During this part we shall not only review these basic concepts but also further expand and apply them to the problems that are more inorganic chemistry related. The second part of the course will cover the descriptive chemistry (i.e. the chemistry of the elements) for hydrogen and elements of Groups 1, 2 and 13-18 (or the main group chemistry).

Here is a detailed list of our topics (the chapter numbers are from our textbook Shriver & Atkins' Inorganic Chemistry 5th edition):

Part 1: Fundamental concepts

1. Inorganic chemistry – a general introduction to the discipline and our course
2. The Elements – what are they? (Chapter 1)

- a. Atoms and their structure
- b. Electronic structure
- c. Structure of nucleus, radioactivity, fission and fusion
- d. Nucleosynthesis: the birth of elements in stars and laboratory (basics of stellar and interstellar inorganic chemistry and artificial nuclear reactions)
- e. The periodic table of the elements: Basics

NOTE: Topics 2a., 2b., 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)
 - 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 great detail in the first year. In this case, solid prior knowledge **is expected!** We shall devote significant portion of our time to MO theory (3c.)

4. Review of Important concepts:
 - a. Chemical equilibrium
 - b. Thermodynamics
 - c. Types of inorganic reactions
 - d. Redox reactions and electrochemistry (Chapter 5)
 - e. Acids, bases and their reactions (Chapter 4)

NOTE: Topics 4a., 4b., and 4c. are not covered in the textbook but we really need these topics. You can use your CHMA10 and CHM11 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 CHMA10/CHM11 material with some new concepts added.

5. Structure of simple solids (Chapter 3)
 - a. Describing the structure of solids
 - b. Metals and alloys; metallic bonding
 - c. Ionic solids; ionic bonding
 - d. Thermochemistry and energetics of solid formation

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)

Some special topics that will be covered only if the time permits:

1. Special topic I - Inorganic chemistry in nature I: Introduction to inorganic chemistry in living systems and medicinal inorganic chemistry
2. Special topic II - Inorganic chemistry in nature II: Introduction to mineralogy: silicate and carbonate minerals (we shall cover silicates and carbonates within Group 14; this 'Special topic' is intended as an extension.)
3. Special topic III - Inorganic Chemistry in nature III: Inorganic chemistry of atmosphere and gaseous giant planets

The readings and problems from your textbook will be given to you at the end of each lecture in your lecture notes. The lecture notes will be posted on the Blackboard regularly in *pdf* format. These notes are providing you with the overview of important concepts, ideas etc. and are basis for class discussions and lectures. They will be your primary source - master them first and after 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.** Topics 1 - 7 are reviews and expansion of CHMA10 and CHMA11 materials thus we will not spend

much time on them during the lectures. This does not mean that you will not be tested on this material – its solid knowledge is essential for inorganic chemistry.

You might know by now that there is WebOption for this course as well. Regardless of this fact, **I strongly encourage you to attend the lectures regularly.** There is a lot of material to be covered. If you do not attend the lectures and wait for the Web cast, you will easily end up having to watch hours and hours of material – *really not a good idea to master this subject.* If you come to the lectures and use WebOption only in a case of sickness or class conflicts, or to fill in your notes, you'll remain on the top of the material covered and be more successful in the course (in comparison to only relying on WebOption).

This course (unfortunately) does not have tutorials in the program. However, just like during previous years, we shall have some practice time during the class and some extra practice opportunities scheduled outside the class. These will be announced during the semester in collaboration with ChemClub and other clubs and organizations.

Laboratory Component of CHMB31H3

The laboratory component starts during the second week of classes and runs every other week. There are in total 5 experiments to be performed, each designed to demonstrate basic points from the lectures. 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 this course and classes in general this is not always the case.

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

Marking Scheme

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

Both term tests will be composed of short answer questions and for each you'll have 90 min to write. Some details will be communicated on the Blackboard portal and/or in class prior to each exam. The first term test is going to be in late October (date/place TBA). It will cover all material from the lecture 1 up to the week of the test. The second term test (late November; date/place also TBA) is going to cover the material covered between first term test and second term test.

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 3 hours.

Office hours and contact info

My office is located in the Science Wing, 6th floor, room SW633. The office hours schedule will be posted on the Blackboard portal prior to the start of the semester. You can pay me a visit any before the semester starts and announcement of the regular office hours.

I can also be reached via e-mail: alen.hadzovic@utoronto.ca.

CHMB31 Resources

Your textbook (the same like last year):

Atkins, Overton, Rourke, Weller, Armstrong and Hagerman. Shriver and Atkins' Inorganic chemistry. 5th edition. New York: W.H. Freeman and Company, 2010.

Other suggested books

Greenwood N.N., Earnshaw A. Chemistry of the Elements. 2nd edition. Oxford: Butterworth-Heinemann, 1997. (Call No. QD466 .G74 1997 SCAR this book will be placed on 24 hour short- term loan; 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 particular 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.

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

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!

GOOD LUCK AND SEE YOU SOON!!

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