

Introduction to Inorganic Chemistry

CHMB31H3 F

Syllabus

The first part of the course 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 your knowledge.

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 (the main group chemistry).

We shall see how rich and varied inorganic chemistry is through several special topics. These will provide you with a short break between the central materials of the course. For example if time permits, we shall have a brief look at inorganic chemistry in nature (mineralogy, biological inorganic chemistry), chemical industry and environmental 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
- 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
- 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)

4a)-c) are not covered in the textbook but we really need these topics. You can use your CHMA10 and CHMA11 textbook and/or notes as sources (that should be adequate) to review this important material. 4d)-e) is 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 covered in CHMB31 textbook.

- 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
- 6.** Molecular symmetry (Chapter 6)
- a. The Basics: Symmetry operations and symmetry elements
 - b. Some applications of symmetry
 - c. Symmetry and molecular orbitals

Part II: Main group chemistry

7. Periodic table revisited (Chapter 9)
 - a. Periodic trends
 - b. Basic classes of inorganic compounds and their periodic characteristics
8. Hydrogen (Chapter 10)
9. The Group 1 elements (Chapter 11)
10. The Group 2 elements (Chapter 12)
11. The Group 13 elements (Chapter 13)
12. Special topic I - Inorganic chemistry in nature I:
Introduction to inorganic chemistry in living systems and medicinal inorganic chemistry (review of Hydrogen and Groups 1, 2 and 13)
13. The Group 14 elements (Chapter 14)
14. Special topic II - Inorganic chemistry in nature II:
Introduction to mineralogy: silicate and carbonate minerals
15. The Group 15 elements (Chapter 15)
16. The Group 16 elements (Chapter 16)
17. Special topic III - Inorganic Chemistry in nature III:
Inorganic chemistry of atmosphere and gaseous giant planets (review of Groups 14 - 16)
18. The Group 17 elements (Chapter 17)
19. The Group 18 elements (Chapter 18)
20. Special topic IV: Chloro-alkali industry (introduction to basic chemical industry - review of groups 17 and 18)
21. Special topic V: Introduction to solid state chemistry (if time permits)
22. Review of main-group chemistry (Hydrogen, Groups 1, 2 and 13-18)

More specific 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 uploaded on the UTSC intranet regularly in *pdf* format. These notes are giving you the overview of important concepts, ideas etc. They will be your primary source - master them first and after move to the textbook to expand your knowledge and (if you want to) check other sources. The 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.

Marking Scheme

4 problem sets (assignments) 6.5% each =	26%
2 term tests 20% each =	40%
Final exam	34%

Problem sets are non-cumulative. They will be uploaded to CHMB31 intranet site as pdf file. Each is due in 7 days in class according to the following schedule:

Problem set	Distributed	Due Date
1	Tue. Sept. 28	Tue. Oct. 5 in class
2	Tue. Oct. 19	Tue. Oct. 26 in class
3	Fri. Nov. 5	Fri. Nov. 12 in class
4	Tue. Nov. 23	Tue. Nov. 30 in class

The first term test is going to be in late October (date/place TBA) and will cover all material from lecture 1 up to the week of the test.

The second term test is going to cover material covered between first term test and second term test. Both are composed of short answer questions.

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.

CHMB31 Resources

Your textbook:

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

We have changed the textbook for this year hoping that this one would be more approachable. This same book will be used for CHMC31 (Intermediate Inorganic Chemistry) course next year.

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 and

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!