Inorganic Chemistry I
The University of Toledo
Department of Chemistry and Biochemistry
College Natural Science and Mathematics
(CHEM 3610) (CRN 12732)

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Term: Spring 2017
Class Location: BO 1049
Class Day/Time: MWF 8:30 to 9:25 am
First Class: 1/17/18
Credit Hours: 3

COURSE/CATALOG DESCRIPTION

The application of modern theories to the elements and their inorganic compounds. Physical chemical principles are used throughout.

STUDENT LEARNING OUTCOMES

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Source of Outcome</th>
<th>How Student Achievement of this Outcome Measured?</th>
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</thead>
<tbody>
<tr>
<td>1. Communicate effectively</td>
<td>OTM guidelines</td>
<td>Assignments require a hand written free response by the students. Also, participation-oral assignments are graded throughout the semester. Assessed by instructor of record.</td>
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<td>2. Evaluate arguments in a logical fashion</td>
<td>OTM guidelines</td>
<td>Questions on problem sets and examinations require interpretation of data. Assessed by instructor of record.</td>
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<td>3. Employ the methods of inquiry</td>
<td>OTM guidelines</td>
<td>Material contained in the course material require students to analyze data relevant to other disciplines. Assessed by the instructor of record.</td>
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<td>4. Acquire an understanding of our global society</td>
<td>OTM guidelines</td>
<td>Students are given projects and assignments wherein the course content is placed in a broader context of human interactions with the planet. Assessed by the instructor of record.</td>
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<tr>
<td>5. Engage in our democratic society</td>
<td>OTM guidelines</td>
<td>Course content is provided on topics relevant to today’s society so they will be better informed citizens. Assessed by the instructor of record.</td>
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</table>
Note: E-Mail communication through your Rocket.toledo.edu account

TEACHING STRATEGIES
Certain methods go along with the above-described teaching aims. I generally adhere to the methodical pattern of “from the simple to the more complex”. Teaching should begin with simpler ideas or examples that build a foundation for developing the more complicated themes later. This methodology has the advantage of connecting earlier information to the topic under discussion. In this way, a topic or subject can be presented as “an extension” of an idea for which the students have some familiarity. The connectivity of knowledge has ramifications beyond a particular class and is a tool that the students can employ throughout their studies at The University of Toledo, and into their professions.

Additionally, in every lecture I draw upon examples from “everyday” observations to put the subject material in a familiar context. The sciences stem from human observations of nature: something the students have unknowingly been doing all of their lives. Many of the topics covered in chemistry have ample examples in “everyday” experiences.

PREREQUISITES AND COREQUISITES
CHEM 2420 or CHEE 2230 and 2330

REQUIRED TEXTS AND ANCILLARY MATERIALS


Other Texts:
Gary L. Miessler, Donald A. Tarr, PRENTICE HALL (2010), Paperback, 754Pages. (ISBN 0136128661)
Greenwood and Earnshaw, Chemistry of the Elements, Reed, 1998.

UNIVERSITY POLICIES
Policy Statement on Non-Discrimination on the basis of Disability (ADA). The University is an equal opportunity educational institution. Please read The University’s Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.

Academic Accommodations
The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office.

ACADEMIC POLICIES
Academic Dishonesty: You are urged to refer to the university’s policy on Academic Dishonesty in the university catalogue. Violation of this policy can result in a course grade of F with additional university sanctions possible. Please refer to http://www.utoledo.edu/dl/students/dishonesty.html
Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict with a major responsibility must provide some written documentation to verify the conflict. This situation may occur for students on official university business. The exam will be given at another arranged time before the scheduled test date.

Students who miss an exam due to illness, car accident or similar extreme circumstance should inform their instructor of their difficulties as soon as possible. These difficulties must also be documented by a physician’s note, an accident report, etc. An email to your instructor and a telephone call within 24 hours is expected. Students must complete an Absence Report Form (obtained from the chemistry office, BO 2022). Documentation supporting your excuse must be attached to the form. In all other circumstances a missed exam will result in a grade of zero points.

COURSE EXPECTATIONS

Attendance during the term is necessary as the instructor will be asked to report on student attendance and this can affect your financial aid, so be certain to attend all classes. Hand in to the instructor any information related to your missing classes. You will remain enrolled in the course regardless of your attendance. There are no class meetings on 1/15/18 (Martin Luther King Day) and 3/5 – 3/9/18 (Spring Break).

SUGGESTIONS TO IMPROVE YOUR GRADE

The in-text Examples are very important to prepare for quizzes and examinations: read the text, work the Examples; then read further until the next Example. If you have some trouble with the Example then do additional problems from the end of the chapter and bring these to the attention of the instructor during office hours.

Practice re-reading problems; after you finish responding and solving a problem go back and re-read the question to be certain that you have answered all parts. A lot of points are lost because only the first half of a question was addressed.

There are Key Words in each chapter, make flash cards and be certain you learn the meaning of the terms and their uses. It will be difficult to do well in this course (and in all other courses to be taken at the university) if you do not understand what the words mean.

Rewrite your lecture notes, which should contain everything spoken and written and will probably be a bit messy, and leave the opposing side blank so you can add notes from the textbook. This should take only 20 minutes, but is well worth the effort.

GRADING

Examinations:
1 (100 points) February 16, Friday (material from 1/17 up to 2/14)
2 (100 points) March 23, Friday (material from 1/17 up to 3/21)
3 (100 points) April 27, Friday (material from 1/17 up to 4/25)
Final (200 points) April 30, Monday, 8:00 – 10:00 (comprehensive)
50% based on ACS standardized examination

Quizzes: on Monday
January 29 February 12, 26
March 12 April 2, 16

Assignments:
Not graded, but used in the construction of quizzes and examinations.
Grades will be based on three exams (100 points each, 300 points total), a comprehensive final exam (200 points), and six quizzes (20 points each, 100 points total – drop lowest quiz grade); for a total of 600 points. **Note**, 100 points Honor's Paper for a total of 700 points for CHEM 3610:091 students.

In addition, students registered for the Honors Section (section 091) will also write a paper on a topic in inorganic chemistry. This paper will be worth 100 points, which goes to giving the Honor’s Credit – students will need to achieve at least a B on the Honor’s Credit.

**Honors students (100 points)** will independently research a topic in inorganic chemistry, prepare a one-page abstract, and a five-page paper on the subject. The abstract must include a minimum of 10 key references cited in the text. References must be listed using standard ACS format as found in the ACS Style Guide and in the January 2018 issue of Journal of the American Chemical Society. The abstract should be single-spaced, with 1” margins, and in Times or Times New Roman size 12 font. In the paper, students must define the topic, provide pertinent background and examples and explain the relevance to society. Details to present may include synthetic schemes, bonding descriptions, mechanistic details, and commercial significance. The presenter must be prepared to answer questions from the instructor of the course.

Topics could include, but are not limited to, the following:

- Water shift reaction
- Fischer Tropsh
- C–H Bond activation
- Chemical Vapor Deposition
- Hydroformylation
- Nanotechnology
- Hydrogenases
- Nitrogenase
- Methane reforming
- Shell Higher Olefins Process
- Zeolites
- Renewable Energy

**Abstract due:** 2/9/18  
**Paper due:** 4/13/18  
**Interview scheduled** 4/23/18 to 4/27/18 (last week of classes).

**Grading scale**  
The following final grading scale will be applied:

- A, 100-92  
- A-, 91-90%
- B+, 89-88  
- B, 87-82  
- B-, 81-80%
- C+, 79-78  
- C, 77-72  
- C-, 71-70%
- D+, 69-68  
- D, 67-62  
- D-, 61-60%
- F, < 59%

**An Outline of Topics:**

**Chapter 1 (week 1 and 2):** Atomic Structure  
A. Synthesis of the Elements  
B. Structure of Hydrogenic Atoms  
C. Many-electron Atoms  
D. Applications: Periodic Trends  

Example 1.1, 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11,  
Exercise 1.9, 1.10, 1.11, 1.14, 1.15, 1.16, 1.17, 1.18, 1.19, 1.20, 1.21, 1.22, 1.23, 1.24, 1.26, 1.28, 1.29

**Chapter 2 (week 3 and 4):** Molecular Structure  
A. Lewis Structures
B. Valence-bond Theory  
C. Molecular Orbital Theory  
D. Molecular Orbital of Polyatomic Molecules  
E. Structure and Bond Properties

Example 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.9, 2.10  
Exercise 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.8, 2.9, 2.10, 2.11, 2.12, 2.16, 2.17, 2.18, 2.19, 2.20, 2.22, 2.29

Chapter 3 (week 5 and 6): Structure of Simple Solids  
A. Structure of Solids  
B. Metals and Alloys  
C. Ionic Solids  
D. Energetics of Ionic Bonding  
E. Electronic Structure of Solids

Example 3.2, 3.4, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15, 3.16, 3.19, 3.20  
Exercise 3.1, 3.5, 3.6, 3.7, 3.8, 3.9, 3.12, 3.13, 3.15, 3.18, 3.19, 3.22, 3.24, 3.25, 3.28, 3.30, 3.31, 3.32, 3.33, 3.34, 3.40, 3.43

Study projections in figures 3.8, 3.9, 3.18, 3.20, 3.22, 3.23, 3.30, 3.32, 3.34, 3.35, 3.36, 3.38, 3.39, 3.42, try drawing the 3D structure of simpler ones and compare to projection

Chapter 4 (week 7 and 8): Acids and Bases  
A. Bronsted Acidity  
B. Lewis Acidity  
C. Reactions and Properties of Lewis Acids and Bases  
D. Hard/Soft Acid-Base  
E. Applications of Acid-Base Chemistry

Example 4.1, 4.2, 4.4, 4.6, 4.7, 4.8, 4.9, 4.10  
Exercise 4.1, 4.2, 4.3, 4.4, 4.8, 4.10, 4.12, 4.13, 4.14, 4.15, 4.17, 4.21, 4.22, 4.24, 4.25, 4.26, 4.30, 4.32, 4.33, 4.36, 4.38, 4.47,

Chapter 5 (week 9 and 10): Oxidation and Reduction  
A. Reduction Potentials  
B. Trends  
C. Nernst Equation  
D. Redox Stability  
E. Chemical Extraction of the Elements

Example 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8  
Exercise 5.1, 5.3, 5.4, 5.8, 5.12, 5.13, 5.22,

Chapter 7 (week 11 and 12): Introduction to Coordination Chemistry  
A. Geometry  
B. Ligands  
C. Isomerism

Example 7.1, 7.2, 7.3, 7.4, 7.5, 7.6  
Exercise 7.1, 7.2, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12, 7.13, 7.14, 7.16

Chapter 8 (week 13 and 14): Physical Techniques
A. Diffraction Methods  
B. Absorption Spectroscopy  
C. Resonance Techniques  
D. Ionization Techniques  

Example 8.1, 8.2, 8.3, 8.4, 8.5, 8.7,  
Exercise 8.1, 8.3, 8.8, 8.10, 8.12, 8.13, 8.20,