Department of Chemistry

CHEM 3650 Winter 2016

Chemistry of the Elements II

Lecturer: Marcel Schlaf MACN 339, x 53002, mschlaf@uoguelph.ca

Lab-instructor: Rob Reed SCI 3114, x 53805, rwreed@uoguelph.ca

Lab-demos: TBA

Objective of the course:

This course aims to give a comprehensive introduction to concepts used by inorganic chemists to describe the structure, properties, and reactivity of compounds of the transition metals.

Course Materials:

Get a molecular modeling set - you will be allowed to use it during exams.

Suggested textbook: Inorganic Chemistry, 6th Ed.
Shriver – Weller – Overton – Rourke – Armstrong

Freeman, 2014, ISBN-13: 978-1-4292-9906-0; ISBN-10: 1-4292-9906-1
(There is also a solutions manual available for this book).

Lecture notes etc are available for download at:

https://schlafgroup.homeserver.com/Home/default.aspx
(login and password required)

Other materials:

See course reserve list on the UofG Library website !!!

Textbooks on Inorganic Chemistry

1) B.E. Douglas, D.J. Daniels, J.J Alexander
"Concepts and Model of Inorganic Chemistry"
Wiley, 1994, QD475.D65

2) K.F. Purcell, J.C. Kotz
"Inorganic Chemistry"
Saunders, 1977, QD151.2.P87
(if you can ever get a hold of this book – buy it. It is simply the very best there is, but unfortunately out of print - an newer abridged version is available but not half as good)

3) A. Earnshaw, N.N. Greenwood
"Chemistry of the Elements
QD466 .G74 1997

4) J.E. Huheey, E.A. Keiter, R.L. Keiter
"Inorganic chemistry : principles of structure and reactivity"
HarperCollins College Publishers, 1993, QD 151.2.H84

5) F.A. Cotton, G. Wilkinson
"Advanced Inorganic Chemistry"
Wiley, 1988, QD151.2.C68

6) J.D. Atwood
"Inorganic and Organometallic Reaction Mechanism"
Brooks/Cole, 1985, QD501.A89

7) C. Elschenbroich, A. Salzer
"Organometallics"
VCH, 1989, QD 411.E4413

8) Gary O. Spessard, Gary L. Miessler
"Organometallic chemistry"
Prentice-Hall, 1997, QD 411.S65

There are many other textbooks that cover inorganic chemistry – look around. Very good articles on many of the topics covered in the course can also be found in the *Journal of Chemical Education*. Also: why not just type in a keyword on the topic of your interest in your favorite browser – who knows what's out there…

Very strongly suggested accompanying courses to this course:
CHEM 386: Quantum Chemistry
CHEM 387: Symmetry and Spectroscopy
CHEM 375: Organic Chemistry I
CHEM 376: Organic Chemistry II

Prerequisites: CHEM 364
For those students, who did not take this course with me or Dr. Kathryn Preuss, please see on the Schlaf Group Server (https://schlafgroup.homeserver.com/Home/default.aspx) for the notes on this course.

Warning: A good foundation in MO theory and symmetry will be required to do well in this course … but not to worry: I will review some of the material again in class.

Lecture and Exam times and dates:

Lecture: MWF, 10:30-11:20 h, MACK 227

Start: 11/01/2016

End: 08/04/2016

No classes from 15/02-19/02/2016 (breakweek) and 25/03/2016 (Good Friday).

Total 36 lectures (12 weeks)

Lab times will depend on your chosen/assigned section !

Laboratory: SC2107, 2108, 2109.

Midterm 1: Wednesday, February 10th, 2016, in class (50 min.)

Midterm 2: Wednesday, March 23th, 2016, in class (50 min.)

Final: ***Time and location TBA***

Dr. Schlaf's office hours:

Any time I am here! If I am too busy I may have to ask you to come back some other time. You can also ask questions by email (mschlaf@uoguelph.ca) ANYTIME. I will respond as soon as possible, but may not check my email on weekends or evenings. Emails that do not meet commonly accepted standards of communications between professionals will NOT be answered, neither will text messages, tweets or similar "social media" stuff.

Evaluation:

Theoretical part (70 % of total mark):

Midterm 1:	20 % (≈ 28 % of lecture portion)
Midterm 2:	20 % (≈ 28 % of lecture portion)
Final:	30 % (≈ 45 % of lecture portion)

Laboratory (30 % of total mark):

Lab and lab report marks 30 % (Lab reports and performance marked by lab demos)

A pass/fail lab exam will be part of the laboratory evaluation.

Note: You must achieve 50 % in each of the course segments separately to pass the course, i.e. you must have a minimum of 15 % of your total course marks from the lab and a minimum of 35 % of total course marks from the lecture portion of the course !

Topics of lectures:

1) The transition metals: An overview of their atomic properties

What are the transition metals and how do they differ from the main group elements?

Periodic trends, stability of oxidation states, electronic configurations

2) Coordination compounds of transition metals

What is a "complex" and what is a "ligand"?

Coordination numbers and shapes of complexes

Chelates and the chelate effect: what is it really?

3) Isomerism in complexes

"How many ways are there to stick a set of ligands onto a metal?"

stereoisomers, coordination isomers, linkage isomers, …

Chirality in complexes and CD spectroscopy

4) Bonding models: VB, Crystal/Ligand Field Theory, and MO Theory Applied to Transition Metal Complexes.

"Can we understand the structure based on symmetry and electronic configuration?"

The 18 electron rule

The evolution of bonding theory in transition metal chemistry

Levels of theory in bonding to transition metals

5) Important Classes of Ligands and Their Properties: The Concept of Synergy in Bonding

"Building blocks for the synthesis playground"

Halogenides and Pseudohagenides

Carbonyl and NO Complexes

Pyridines and Amines

Phosphines, Arsines and Stibines

p-complexes and Sandwiches complexes

Carbenes

Thiolates and Thioethers

6) Electronic Spectra of Transition Metal Complexes

The correlation of spectroscopic and magnetic behavior with electronic structure

d-d transitions and selection rules and Tanabe-Sugano Diagrams

7) Reactions and Mechanisms

"Changes, changes, changes - structure and reactivity together"

The trans-effect and the trans influence

Substitution: Associative and dissociative mechanisms and their kinetic signatures

Electron transfer reactions

8) Substance (Abuse) Fridays …

... right now the plan is to lecture on theory on Mondays and Wednesdays and cover ores, extraction, metallurgy of the transition metals and their typical compounds/complexes, synthesis and reactivity and applications on Fridays …

We will see what time permits !

The LEGAL STUFF:

The course will be conducted in compliance with all policies and regulations laid out in the published University of Guelph Academic Calendar, specifically:

E-mail Communication
As per university regulations, all students are required to check their <mail.uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

When You Cannot Meet a Course Requirement
When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course instructor (or designated person, such as a teaching assistant) in writing, with your name, id#, and e-mail contact. See the undergraduate calendar for information on regulations and procedures for Academic Consideration.

Drop Date
The last date to drop one-semester courses, without academic penalty, is Friday, November 6th 2015. For regulations and procedures for Dropping Courses, see the Undergraduate Calendar.

Copies of out-of-class assignments
Keep paper and/or other reliable back-up copies of all out-of-class assignments: you may be asked to resubmit work at any time.

Accessibility
The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability or a short-term disability should contact the Centre for Students with Disabilities as soon as possible.

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

Academic Misconduct
The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need

to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member or faculty advisor.

The Academic Misconduct Policy is detailed in the Undergraduate Calendar.

Recording of Materials

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, a classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

Resources

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs.