

Instructor: Dr. Charles H. Mahler, Phone (570) 321-4351 or (570) 322-8840 (h), mahler@lycoming.edu

Office Hours: **Heim 202, MWF 11:15 AM – 12:15 PM, MW 1:30 – 2:30 PM**, by appointment, or drop by.

**CLASS: MWF 10:15 to 11:05 AM in Heim 215, LAB: R 1:00 to 4:50 PM in Heim 207.**

*If you have questions or comments about anything in the course, please come see me. I am ready and willing to meet with you and discuss your concerns, answer questions, explain concepts, solve problems, etc. I would rather help you to understand something before a lab or test, than to find out you don't understand it while grading your work.*

Materials for Course:

*Inorganic Chemistry, 4<sup>th</sup> ed.* by Catherine G. Housecraft and Alan G. Sharpe.; Casio fx-260 solar calculator (no passing or sharing allowed in exams); Bound Laboratory Notebook with quadrille pages (for lab use only); Safety Glasses or Goggles; Experimental procedures will be distributed in class.

Prerequisite: CHEM 221 (CHEM 330 preferred, but not required); or consent of instructor.

Evaluation and Grading:

Grades will be based on the following weighting scheme: 3 Exams (45%), Final Exam (20%), Lab (20%), Presentation (5%), and Quizzes (10%).

3 extra credit points (on a 1000 point scale, to a limit of 20) will be given for each Chemistry Colloquium attended. Alternative extra credit will be available for those whose schedules conflict with colloquium (must see me to arrange this before March 21, 2014). The final exam will include a comprehensive, multiple-choice test, prepared by the American Chemical Society, as well as descriptive chemistry questions.

<u>Exams:</u>	<u>Hour Exam 1</u>	Thursday, January 30, 2014 (in lab)
	<u>Hour Exam 2</u>	Thursday, February 27, 2015 (in lab)
	<u>Hour Exam 3</u>	Thursday, April 3, 2014 (in lab)
	<u>Final Exam</u>	8:30 to 11:30 AM, Wednesday April 23, 2014 (in the lab)

**ALL EXAMINATIONS ARE COMPREHENSIVE, ESPECIALLY THE FINAL.**

The following scale will be applied to determine the final letter grade: **A**  $\geq$  90% > **B**  $\geq$  80% > **C**  $\geq$  70% > **D**  $\geq$  60% > **F**. Plus and minus grades are included in these ranges and will be determined at the end of the semester. Adjustments to this scale are possible, but unlikely.

Content:

The course will cover topics including Nuclear, Atomic, and Molecular Structure, Bonding, Simple Solid Structures and Reactivity, Acids and Bases, Oxidation / Reduction, Symmetry, and Non-aqueous Solvents. Other topics will include Systematic Descriptive Chemistry of the Elements, Coordination Compounds and Organometallic Chemistry. Details regarding which sections of these chapters we will cover will be given in class. Much descriptive chemistry will be covered with the in-class presentations.

Course Objectives:\*

Upon completion of this course, the student should be able to:

1. Describe atomic structure and related properties, including atomic spectra and orbitals, ionization energy, electron affinity, shielding and effective nuclear charge.
2. Describe radioactivity, fission and the effect of isotopes on spectroscopic techniques.
3. For covalent molecular substances: generate Lewis structures; describe bonding using valence bond theory and molecular orbital theory; predict geometry using VSEPR; and identify symmetry elements and point groups.
4. For metallic and ionic solids: describe the arrangements of atoms in the solid state, lattice energy, and the properties of semiconductors and insulators.
5. For main group elements: describe variations in bonding, acid-base chemistry of their compounds, and redox activity.
6. For coordination compounds and organometallic compounds of the transition metals: describe bonding, crystal field theory and applications, MO theory, isomerism, physical properties and typical reactions.
7. Demonstrate proficiency with laboratory techniques for the synthesis and analysis of inorganic compounds.

\*Adapted from the American Chemical Society Committee on Professional Training's Inorganic Chemistry Supplement.

Relevant Departmental and College Learning Goals:

This course contributes to the following departmental learning goals, that students who complete a major in chemistry will be able to:

1. Exhibit proficiency in the major sub-disciplines of chemistry [i.e. Inorganic Chemistry]
2. Perform wet laboratory techniques as appropriate to the major sub-disciplines of chemistry
3. Understand and use modern chemical instrumentation
4. Exhibit integrative, problem-solving skills, such as experimental design, data manipulation, and data interpretation
5. Communicate the results of chemical investigations effectively in written and oral form
6. Search the chemical literature, evaluate the results of the search, and access desired research materials
7. Demonstrate responsible conduct in the laboratory, including laboratory safety and ethical research practices

In support of the Lycoming College Mission Statement and the College Philosophy, this course seeks to help students enrolled in it to "explore new concepts and perspectives" and "develop communication and critical thinking skills" as part of a "distinguished baccalaureate education in the liberal arts and sciences".

Lecture Attendance and Absences:

Lecture attendance with textbook and calculator is required. All unexcused lecture absences after three will be penalized 2% (of total possible points) per day. **Only absences notified ahead of time may be excused.** Notification is expected as soon as possible for planned (athletic events, class trips) or emergency (illness) absences; call or e-mail me or the Department Secretary (321-4180). The cause of absences must be verified by a Dean or substantiated (note from coach or parent, doctor's excuse, etc.).

Exam Absences:

**No** make-up exams will be given. The (cumulative) final exam grade (as a %) will be substituted for **one** excused absence exam grade (as a %). Barring exceptional circumstances, **all** other missed exams earn a zero.

### Lab Absences:

Only excused absences for labs and field trips are allowed. Make up labs will vary (and may not be possible), depending on the circumstances of that week's experiment. In some cases, students may be allowed to work outside scheduled lab hours by first obtaining permission from a chemistry professor (who must be in the building while they work and be notified when they leave), and then having a "buddy" present.

### Quizzes and Homework:

There will be seven quizzes, all on Wednesdays: January 15 and 22, February 12 and 19, March 19 and 26, and April 16. There will be a Periodic Table quiz given in lab - you will be given a blank periodic table and asked to fill it in with the proper symbols. For certain elements, the properly spelled name will be required. Students must take at least one periodic table quiz, with the best performance (of up to three attempts) counting. Other quizzes are possible.

Each chapter has a set of recommended problems given for it (which students are strongly encouraged to work). In addition, graded homework problems may be assigned. These are due at the start of the next lecture (or as soon as you enter lecture, if late), and we will go over the solution in that lecture. Many students find it useful to keep a copy of the problem to review. No late homework will be accepted and the lowest homework grade will be dropped. *If you must be absent, have someone else take notes and hand in any assignments for you.* Keys for assigned problems, quizzes, and exams will be reviewed in class and/or posted on Moodle.

Initial homework (more exercises may be added): Chapter 1: 1, 3, 4, 6, 8, 10, 12, 14, 18, 19, 21, 23, 24, 25, 26, 27, 32, 33; Chapter 2: 1, 2, 4, 5, 6, 9, 10, 11, 13, 15, 17, 19, 22, 23, 24, 28; Chapter 3: 1, 4, 5, 6, 7, 8, 9, 10, 12, 14, 15, 16, 17, 19, 20 (for each molecule or ion, please find the point group too); Chapter 5: 1ab, 5, 6, 7, 8, 9, 10, 11, 14, 17a; Chapter 6: 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 15, 20, 21, 29, 30 (be able to count atoms in a cell, and do unit cell density / volume calculations); Chapter 7: 1, 3, 4, 7, 8, 9, 11, 12, 13, 15, 19, 20, 33; Chapter 8: 1, 2, 5, 6, 8, 11, 14, 17; Chapter 20: 1, 3, 4, 5, 6, 8; Chapter 27: 14, 15.

### Presentation:

All students will be required to research the descriptive chemistry of a group of elements and make a one-period oral presentation on this topic in of the last lab periods of the semester. Dr. Mahler will give a sample presentation earlier. Each presentation will cover a group of from five to fourteen elements. More details will follow. Questions from these presentations will be a part of the final exam.

### Academic Honesty:

On all exams and lab reports, copying someone else's work or allowing another to copy your work and submit it as their own is academic dishonesty and can lead to penalties such as failing the assignment or even dismissal from the college. Unless otherwise stated, all work submitted for a grade should be your own work (although you can study with others to understand the concepts). Always include citations for all sources consulted in labs or homework to avoid plagiarism. For further information on the college policy on academic dishonesty, see the *Pathfinder* or *Student Handbook*.

If you have a specific disability and choose to request academic accommodations to meet your needs, please consult with Mr. Dan Hartsock, Co-ordinator of Services for Students with Disabilities. His office is in the Academic Resource Center on the third floor of Snowden Library.

### College Policies:

Administrative procedures (withdrawals, etc.) will follow the published guidelines and rules of the college and department. Because this course meets a distribution requirement, it includes a writing component. At least 10 pages of writing must be produced by each student during the semester and some of those assignments will be formally evaluated for writing. I will reserve some class or office time to help each student with written work.

### Review Sessions, Keys, and Scores:

A review session will be held before each exam in Heim 204 (the lab) at a date and time to be determined. There is a class Moodle page at <http://moodle.lycoming.edu/course/view.php?id=1119>. The syllabus will be there and at: <http://www.lycoming.edu/chem/spring2013/333syl.htm>. Homework and exam keys will be reviewed in class and/or posted on Moodle. If requested, a spreadsheet will be posted online to let you calculate your percentage.

### Technology Policy:

While you are expected to attend and participate in this class, your cell phone, computer, MP3 player, and other personal electronic devices are **not**. Use of such devices during class will not be permitted, and will result in your dismissal from the class for the day. This will be counted as a class absence. During exams and quizzes, the use of such devices (except non-programmable calculators) will be considered academic dishonesty. *This will be reported to the Provost and will result in a grade of zero (No exceptions!).*

Electronic devices (cell phones, computers, etc.) may be forbidden in lab. If not, their use is strongly discouraged, as chemicals may damage them. If you choose to use them in lab, it is at your own risk.

The only calculator used in this class is the Casio fx-260 Solar. We have chosen it because the manufacturer's programming to round numbers in some basic scientific calculators produce erroneous results, and because some students have difficulty using scientific calculators. Using one model allows calculator use to be taught in the course. Please also use this calculator outside of class to become familiar with it. *Students found using an alternate calculator during an exam or quiz will receive a zero for the assignment (No exceptions!).*

### General Comments:

Students are responsible for knowing material in the assigned reading, problems, labs, and lectures. Working problems, studying and understanding the material are keys to doing well. I assume students are familiar with the background material in Chemistry, Physics and Mathematics. While I am glad to help you in reviewing these topics, it is your responsibility to make up any weaknesses or deficiencies you might have. Much of the course material involves a high degree of conceptual understanding (not simple memorization), so adequate preparation and study are essential. It is **not** sufficient to learn the material from the lecture alone - you should read and think about the topics covered **before** attending lecture. If you still can't get a problem or concept, please see me for help. We cover much detailed and difficult material this semester, so our pace is geared to those who are prepared to learn. In homework and exams be neat, box answers, show your work and units (partial credit will be given).

### Safety and Labs:

**Unsafe behavior in Lab will not be tolerated. Repeated unsafe behavior will result in a zero for that lab.**

In lab: 1) Eyewear must be worn at all times; 2) No eating, drinking, or smoking; 3) No horseplay; 4) No unauthorized, 'independent' experiments; 5) Wear enclosed shoes only; 6) Legs must be covered; 7) See the additional safety rules distributed at lab check-in.

You are expected to read the safety information given and to come to lab each week well prepared. A safety evaluation will be conducted. Report all accidents and injuries immediately. Know the location of all exits and emergency equipment (fire extinguishers, blankets, eye-wash, first aid kit, etc.) When in doubt, ask.

Wearing contact lenses in lab is highly discouraged. If you do wear them in lab, please let me know (no penalty - it is good to know in case of an accident). Wear older clothes - they could be stained or ruined. Above all, use common sense and your chemical intuition - THINK. As an experienced student chemist, you will be working in many situations which demand your utmost care and attention to protect the safety and health of yourself, your fellow students, and the environment. Preparation and careful, patient work are needed to obtain the results required.

#### Notebook and Lab Reports:

Your Lab Notebook should be neat, well organized, up-to-date and complete, with a Table of Contents. The Table of Contents should be updated with each experiment. Leave room to record your data, the uncertainties in measurements, and any observations about the experiment. Make a copy of each notebook page and hand these in with the report. Each page should be clearly labeled with your name, the date and the name of the experiment (abbreviations are OK). Notebooks will be graded once during the semester. When working in groups, record the names of your group members and also note who performed what tasks, i.e. temperature data (from Jack), absorbance values (from Susie). Lab reports are generally described in the lab write-up and in prelab. The Title, Objective, Approach should be in your notebook before you start any experiment. When working in groups, each member will submit their own lab report. A group may submit only one copy of supplementary material (i.e. spectra, copy of an article, etc.). Reports are generally due one week after completion of the lab work - a deadline will be given for each experiment. Lab reports are considered late at the end of the lab they are due in (but may be handed in early). Late work will be penalized 5% per school day. Additional instructions and safety information will be given in the prelab lectures.

#### Lab Schedule:

The laboratory schedule is not yet finalized, as the dates for two field trips (to the Penn State Breazeale nuclear reactor and to the GPS tungsten metal production plant) are still being determined. Once the field trip dates are set, a final lab schedule will be distributed in class.

Lab reports will be due at the start of the next lab after the experiment is completed. Each lab report will include a reagent table (as is done in Organic Chemistry 220-221). The experiments that are scheduled are:

- Symmetry (workshop), January 9;
- Check-in and Potassium Metal Fluoride synthesis, January 16;
- Copper (I) Chloride synthesis, January 23.

Other experiments planned, but not yet scheduled are:

- Unknown Vanadium compound synthesis and identification;
- Air-sensitive synthesis of a Chromium compound;
- Synthesis of a Cobalt complex model of Vitamin B-12;
- The Synthetic Tournament;
- Two field trips (Penn State Breazeale nuclear reactor, GPS tungsten metal production plant)

While most experiments will be done individually, at least one will be done in small groups of two or three students.