

Lycoming College **ADVANCED INORGANIC CHEMISTRY 333** Spring 2011 Dr. Mahler

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

Office Hours: **Heim 202, MWF 10:00 – 11:00 AM, MW 1:30 – 2:30 PM**, by appointment, or drop by.

**CLASS and LAB:** as arranged. 1-2 hours of lecture a week, lab meets in Heim 207.

Materials for Course: *Inorganic Chemistry, 3<sup>rd</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.

Prerequisites: CHEM 330, MATH 129, and one year of physics; 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 23, 2012). The final exam will include a comprehensive, multiple-choice test, prepared by the American Chemical Society.

<u>Exams:</u>	<u>Hour Exam 1</u>	Thursday, February 2, 2012 (in lab)
	<u>Hour Exam 2</u>	Thursday, March 1, 2012 (in lab)
	<u>Hour Exam 3</u>	Thursday, April 5, 2012 (in lab)
	<u>Final Exam</u>	8:30 to 11:30 AM, Wednesday April 25, 2012 (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.

*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.*

### 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 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. Physical 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, this course seeks to help students enrolled in it to “develop communication and critical thinking skills” and “explore ... scientific traditions” while “increasing receptivity to new concepts and perspectives”.

Lecture Attendance and Absences: Lecture attendance with textbook and calculator is required. All unexcused lecture absences after three will be penalized 2 percent (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 and Lab 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** subsequent missed exams will receive a grade of zero. Because students often work in groups in lab, absences hurt everyone and should be avoided. 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 six quizzes, all on Thursdays: January 19 and 26, February 16 and 23, and March 22 and 29. 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 will have a set of recommended problems given for it (which students are strongly encouraged to work). In addition, many days there will be graded homework problems 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.

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 one 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 be reserving 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. The syllabus will be there and at: <http://www.lycoming.edu/chem/spring2012/333syl.htm>. Homework and exam keys will be reviewed in class and/or posted on Moodle.

Departmental and ACS policies: The following are not allowed to be used during quizzes and exams: programmable calculators, cell phones, PDA's, headphones, or other personal electronic devices. Personal electronic devices (except calculators) are also not to be used in the laboratory.

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. It is assumed that the 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 will cover much detailed and difficult material this semester, so our pace must be geared toward 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: A field trip during the lab period to a nuclear reactor is planned, with the date to be determined. A final schedule with groups and dates of field trips will be distributed in class. There will be a Periodic Table Quiz at start of the last three labs.

The last lab period of the semester will be devoted to a student presentation on systematic chemistry of the elements.

Lab reports will be due the week after the experiment is completed. Each lab report will include a reagent table. Possible experiments to be done in lab include: Symmetry (workshop), Potassium Metal Fluoride synthesis, Copper (I) Chloride synthesis, Unknown Vanadium compound synthesis and identification, Air-sensitive synthesis of a Cr compound, and the Synthetic Tournament experiment. Schedule will be determined and distributed by the end of the first week of the semester.