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** from 9:00 to 9:50 AM in Heim 215. **LAB**: **T** from 7:45 to 11:35 AM in Heim 204.

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 quiz or lab or test or other assignment, than to find out you do not understand it while grading your work.

Prerequisites:
Chem 330 (and its prerequisites)

Materials for Course:
Physical Chemistry, 9th ed. Peter Atkins and Julio de Paula; *ACS Style Guide, 3rd Ed*.; 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; The 2013-2014 Laboratory Manual for Chemistry 330-331W.

Evaluation and Grading:
Grades will be based on the following weighting scheme: 3 Exams (45%), a Final Exam (20%), Lab, including Writing Project (25%), and Homework and Quizzes (10%). Because this course is Writing Intensive, special emphasis will be placed on learning through writing in all assignments, but especially the Writing Project (see below, manual). 3 extra credit points (to a limit of 20, on a 1000 point scale) will be given for each Chemistry Colloquium attended. Alternative extra credit will be available for those whose schedules conflict with colloquium (but you must see me to arrange this by Friday, March 21, 2014). The final exam will be a comprehensive, multiple-choice test, prepared by the American Chemical Society, covering **both** semesters (330 and 331W).

ALL EXAMINATIONS ARE COMPREHENSIVE, ESPECIALLY THE FINAL.

The following scale will be applied to determine the final letter grade: **A** ≥ 90% > **B** ≥ 80% > **C** ≥ 70% > **D** ≥ 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. To pass the course you must pass both lecture and lab.

Exams:	Hour Exam 1	Tuesday, February 4, 2014 (in lab)
	Hour Exam 2	Tuesday, March 11, 2014 (in lab)
	Hour Exam 3	Tuesday, April 8, 2014 (in lab)
	Final Exam	8:30 to 11:30 AM, Tuesday April 22, 2014 (in the lab)

Content:
Physical Chemistry provides the theoretical basis for explaining and interpreting chemical systems by focusing on their structure and the energy and time involved as they change. In this course we will study and attempt to understand many of the basic principles and phenomena of chemical systems including Molecular Motion & Kinetics, and some aspects of Quantum Theory and Spectroscopy. Time allowing, we will also cover more Statistical Thermodynamics.

Lecture Attendance and Absences:
Lecture attendance with calculator and textbook 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 (570 321-4180). The cause of absences must be verified by the 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:
There will be seven quizzes this semester all given at the end of the period on Mondays: Jan. 13, Jan. 20, Jan. 27, Feb. 17, Feb. 24, Mar. 24, and Mar. 31. The lowest quiz grade will be dropped.

Homework:
Each chapter has a set of recommended problems which students are strongly encouraged to work. In addition, some 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.*

Almost all of the 'discussion questions' are useful (i.e. the first several exercises for each chapter). Note that answers for the (a) exercises and some problems are given in the back of the textbook.

Chapter 20 Exercises 21.1 (mean speed), 2 (mean speed, mean free path, collision frequency), 5, 6 (mean free path), 7 (collision frequency), 8 (mean free path), 10, 12, 13 (effusion), 17 (viscosity), 20 (thermal conductivity), 25 (limiting molar conductivity).
Chapter 21 Exercises 21.3, 5, 6, 7, 8, 9, 10, 11, 12 (rates, rate laws, rate constants and half lives) 14 (Arrhenius), 16, and Problem 11 (Mechanisms)
Chapter 22 Exercises 22.1, 2, 4, 5 (collision theory), 8 (diffusion controlled reactions), 9 (steric factor).
Chapter 23 Exercises 23.1 a and b (mechanisms), 2, 3, 4 (Michaelis-Menten), 6 (collision rates)
Chapter 7: Exercises 7.3 (uncertainty principle), 4, 7 (photon tricks), 8 (Black Body Radiation), 10 (de Broglie relation), 11 (Normalization), 15 (Uncertainty), 16 (Ionization, like photoelectric effect)
Chapter 8: Exercises 8.1, 2, 5, 6, 7 (particle in a box), 9, 10, 11, 17, (harmonic oscillator) 22, 23 (rotation)
Chapter 9: Exercises 9.2, 3, 8, 12, 18, 19, 26
Other chapters to be announced.

Review Sessions, Keys, and Scores:
A review session will be held the Sunday before each exam in Heim 204 (the lab) from 8:30 to 10 PM. Final exam review time is TBA. There is a class Moodle page http://moodle.lycoming.edu/course/view.php?id=1118. The syllabus will be there and at: **http://www.lycoming.edu/chem/spring2014/331syl.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 current course percentage.

Writing Project Deadlines:

- References Final Version due by Friday Jan. 17
- A list of chemical reagents and equipment needed by Friday Feb. 7
- The write-up for your own project is due in draft form by Monday Feb. 17
- The final version (two copies) is due by Monday Mar. 24
- Formal report on the project you evaluate is due in draft form by Monday Apr. 14, this includes the numerical evaluation form
- Formal report on the project you evaluate is due in final form by Monday Apr. 21 (the Monday of Finals week)
- There will be oral presentations on the Writing Projects in the lab period, Tues. Apr. 15

Writing in this Writing Intensive Course:
Every aspect of the course will incorporate writing in an effort to help you become a better scientific writer. There will be at least thirteen pages of formal writing (revised, typed) done as the Writing Project. The laboratory procedure you research, write, test, and revise will be at least six pages. The formal lab report based on another student's procedure will be at least five pages, and the evaluation of it at least two pages. There will also be at least fifteen pages of informal writing. All exams will include one to two pages of brief essay questions each, as well as sections of more numerical problems where you may be asked to write about and explain your results. Some quizzes and homework problems will involve writing about topics we have studied, and there will even be short writing exercises in lecture to assess learning about new topics. As usual, there will be several pages of writing in each lab report and a revision may be submitted for one report. Each student will also make a brief in-class oral presentation on their project (more information on this given out later).

For more help with writing, please see me or Shanna Wheeler and the staff of the Writing Center on the third floor of the Snowden Library (phone (570) 321-4392).

Academic Disonesty (from the *Student Handbook*):
Academic dishonesty is a willful perversion of truth, or stealing, cheating, or defrauding in instructional matters. Students will have engaged in academic dishonesty if they copied the work of another without attribution, willfully allowed another to copy their work, falsified information, submitted the work of another as though it were their own, or committed other acts of plagiarism or actions deemed to be dishonest by the instructor. ACADEMIC DISHONESTY IS A VERY SERIOUS CHARGE, WHICH CAN LEAD TO SUSPENSION FROM THE COLLEGE. All students should become familiar with the rules of academic honesty and apply them in ALL academic work. Instances of academic dishonesty will result in failure of the course and will be reported to the Provost.

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!).*

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!).*

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.

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:
Please refer to the 330 syllabus, laboratory manual, and lab safety contract for course expectations regarding safety, lab, and lab reports. **Lab reports will not be accepted more than two weeks after the date that they are due. Late lab reports will be penalized 10% per school day.**

College Policies and Disabilities:
Administrative procedures (withdrawals, etc.) will follow the published guidelines and rules of the college and department.

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.

Learning Objectives:*
Upon completion of the two-semester Physical Chemistry sequence, students should be able to:

- Perform calculations involving laboratory procedures (including stoichiometry, solution concentration) and experimental data
- Be able to analyze data and its associated error, and prepare graphs using graphical analysis software
- Use common laboratory tools properly (including balances, volumetric glassware, barometers, spectrometers, calorimeters, timing devices)
- Understand the fundamental principles of thermodynamics, including equations of state, state functions, chemical and phase equilibria, and statistical mechanics, and how these relate to energy in chemistry.
- Understand the fundamental principles of kinetics, including rate laws, mechanisms, kinetic molecular theory, transport properties, and reaction dynamics, and how these relate to reaction time and rates in chemistry.
- Understand the fundamental principles of quantum mechanics including wave functions, eigenvalues and operators, the particle in a box, harmonic oscillator, and rigid rotor models, basic molecular orbital theory, and how these relate to atomic and molecular structure and spectroscopy.
- Perform calculations related to thermodynamics, kinetics, and quantum mechanics) and understand how the calculated parameters relate to the chemistry of the system
- Communicate scientific data clearly in written and oral presentations

*Adapted from the American Chemical Society Committee on Professional Training's Physical 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 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".

Tentative Laboratory Schedule for Physical Chemistry II 331W, Spring 2013

Date (Tues.)	Group S (Entropy)	Group H (Enthalpy)	Group G (Gibbs Free Energy)
Jan. 7	Writing project, lecture	Writing project, lecture	Writing project, lecture
Jan. 14	Iodine Clock Kinetics Due Friday, January 24	Iodine Clock Kinetics Due Friday, January 24	Iodine Clock Kinetics Due Friday, January 24
Jan. 21	Microscale Kinetics Due Friday January 31	Microscale Kinetics Due Friday January 31	Microscale Kinetics Due Friday January 31
Jan. 28	Surface Tension Due Friday February 21	Surface Tension Due Friday February 21	Surface Tension Due Friday February 21
Feb. 4	EXAM ONE	EXAM ONE	EXAM ONE
Feb. 11	Dye Absorbance Spectra Due Friday March 14	Dye Absorbance Spectra Due Friday March 14	Dye Absorbance Spectra Due Friday March 14
Feb. 18	Test Own Project I Own Procedure (Draft) due: Monday, February 17	Test Own Project I Own Procedure (Draft) due: Monday, February 17	Test Own Project I Own Procedure (Draft) due: Monday, February 17
Feb. 25	Test Own Project II	Test Own Project II	Test Own Project II
Mar. 4	SPRING BREAK	SPRING BREAK	SPRING BREAK
Mar. 11	EXAM TWO	EXAM TWO	EXAM TWO
Mar. 18	Test Own Project III Own Procedure (Final) due: Monday, March 24	Test Own Project III Own Procedure (Final) due: Monday, March 24	Test Own Project III Own Procedure (Final) due: Monday, March 24
Mar. 25	Do Other's Project I Draft report due: Monday, April 14 (with eval)	Do Other's Project I Draft report due: Monday, April 14 (with eval)	Do Other's Project I Draft report due: Monday, April 14 (with eval)
Apr. 1	Do Other's Project II Final report due: Monday, April 21	Do Other's Project II Final report due: Monday, April 21	Do Other's Project II Final report due: Monday, April 21
Apr. 8	EXAM THREE	EXAM THREE	EXAM THREE
Apr. 16	Oral Presentations, Review	Oral Presentations, Review	Oral Presentations, Review
Apr. 22 (Tues.)	FINAL EXAM, 8:30 – 11:30 AM	FINAL EXAM, 8:30 – 11:30 AM	FINAL EXAM, 8:30 – 11:30 AM

- *Exams* (Tuesdays): Feb. 4, Mar. 11, Apr. 8; Final exam Apr. 22
- *Quizzes* (Mondays): Jan. 13, Jan. 20, Jan. 27, Feb. 17, Feb. 24, Mar. 24, and Mar. 31
- *Labs Due* (Fridays): Jan. 24, Jan. 31, Feb. 21, Mar. 14

Writing Project Deadlines

- References Final Version due by Friday Jan. 17
- A list of chemical reagents and equipment needed by Friday Feb. 7
- Own project procedure due: draft by Monday Feb. 17, final (two copies) by Monday Mar. 24
- Formal report on other's project due: draft by Monday Apr. 14, final by Monday Apr. 21
- Oral presentations on the Writing Projects in the lab period, Tues. Apr. 15