Chem 335 **Physical Chemistry** **Fall 2016**
Dr. Paul W. Hladky

I. Instructor's Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
08:00	**PRAG**	**Class Prep or Chem 105**	**335 Lab 3 C141**	**Class Prep or Chem 105**	**Class Prep or Chem 105**
09:00	**PRAG**	**Class Prep**	**335 Lab 3 C141**	**Class Prep**	**Class Prep**
10:00	**PRAG**	**335 Lec 1 A109**	**335 Lab 3 C141**	**335 Lec 1 A109**	**335 Lec 1 A109**
11:00	**PRAG**	**Office**	**PRAG**	**Office**	**PRAG**
12:00	**PRAG**	**PRAG**	**PRAG**	**PRAG**	**PRAG**
13:00	**Lab Prep**	**PRAG**	**Lab Prep**	**PRAG**	**Office**
14:00	**335 Lab 1 C141**	**PRAG**	**335 Lab 2 C141**	**PRAG**	**Meeting or Seminar**
15:00	**335 Lab 1 C141**	**PRAG**	**335 Lab 2 C141**	**PRAG / Dean's Council**	**Meeting or Seminar**
16:00	**335 Lab 1 C141**	**PRAG**	**335 Lab 2 C141**	**PRAG / Dean's Council**	**PRAG**

PRAG = Projects, Research, Appointments, Grading Please do not interrupt me during Class Prep times.

II. Course Description and Learning Outcomes

Chem 335. Physical Chemistry. 4 cr. Laws and principles of physical chemistry including atomic and molecular structure, thermodynamics, kinetics. 3 hrs lec, 3 hrs lab per wk. Prereq: 326, and 395 or con reg; Math 222; Physics 250; or cons instr.
Note that the catalog description given above really covers Chem 335 and 336. Chem 335 will cover thermodynamics and kinetics. Laboratory exercises will illustrate physical chemistry principles including thermochemical and electrochemical measurements, kinetics, and bulk properties of matter.

The Learning Outcomes (LO) for Chem 335 are derived from the Chemistry Department's Eight Program Learning Outcomes (PLO) and from UWSP's Learning Outcomes for Communication in the Major (CitM).

1) Students will learn the foundational principles of classical chemical thermodynamics and kinetics and apply them to both theoretical and practical problems. This LO is derived from PLO #1 and is focused on the lecture portion of the course. In many cases, students will learn the origins of the equations that were presented in General Chemistry. To achieve this LO, students will:
   i. attend lectures in which the laws of thermodynamics are introduced in the form of differentials and then applied to chemically relevant situations (properties of substances, conversion of thermal and chemical energy into other usable forms of energy such as electrical energy, phase diagrams, chemical reactions, surface/interfacial tension)
   ii. attend lectures covering topics in chemical kinetics (kinetic theory of gases, initial rate laws, integrated rate laws, reaction mechanisms, discrete and continuous dosing
   iii. attend a lecture in which some elementary Laplace transforms are derived and applied to one or more kinetics problems
   iv. read a physical chemistry textbook and take notes (chapter notes outline will be provided)
   v. solve numerical problems of varying levels of difficulty; some problems will start with differential forms that must be adapted to specific cases; answers and many solutions will be provided
   vi. prepare a concise summary of each chapter to use as a "cheat sheet" during exams

   Each student's achievement will be formally assessed through the grading of quizzes, midterm exams, and the cumulative final exam.

2) Students will learn how to collect and analyze experimental data, draw conclusions, and present their results. This LO is derived from PLOs #2, 3, 5, 6, 7, and 8 which are based on the laboratory portion of the course. To achieve this LO, students will:
   i. work safely with a variety of chemicals and equipment
   ii. perform experiments (collaboratively) that are representative of the topics of classical thermodynamics and kinetics
   iii. keep a laboratory notebook
   iv. manipulate and plot data according to theoretical relationships
   v. fit curves using standard spreadsheet trend lines
   vi. fit curves by adapting the method of least squares to relationships that standard spreadsheets do not support
   vii. propagate random errors from experimental data to calculated results
   viii. write one informal laboratory report
   ix. write one formal report

   In addition to laboratory work, some of the lecture material during the first week of classes supports this LO.

   Each student's achievement will be formally assessed through the grading of the error analysis quiz, laboratory reports, and the laboratory final exam. Students' understanding will also be informally assessed through conversations (Why is that expansion considered adiabatic when it actually occurs in a large temperature bath? Where is the frictionless piston located in that apparatus? ....) that occur during the laboratory sessions.

Communication in the Major (CitM) has two learning outcomes. Both of them are addressed in Chem 335 and they are listed below.

a) Apply discipline-specific standards of oral and written communication to compose an articulate, grammatically correct, and organized presentation/piece of writing with properly documented and supported ideas, evidence, and information suitable to the topic, purpose, and audience.
b) Critique their own and others' writing/oral presentations to provide effective and useful feedback to improve their communication.

To achieve these outcomes, students will:
   i. attend lectures covering scientific writing,
   ii. read a textbook that emphasizes physical chemical applications to biological sciences and illustrates scientific writing,
   iii. examine writing samples,
   iv. complete assignments using MS Word (equation editor, tables, drawing features) and MS Excel (formatting graphs)
   v. write detailed solutions to problems
   vi. write one informal laboratory report
   vii. write one formal report
   viii. prepare a concise summary of each chapter to use as a "cheat sheet" during exams.

Students' achievement will be formally assessed through writing assignments and a lab chalk talk.

III. Course Schedule

Chemistry 335 covers chapters 1-8, 19, 20 and 22 of the lecture text. Quizzes (Q) and exams (E) will be given during the semester (see schedule below). The quizzes will be given during the last 20 - 30 min of the class period on the Tuesday morning of the indicated week. The exams will be given on the Tuesday evening of the week indicated and students can choose a two-hour period between 6 PM (earliest start) to 10 PM (latest end). All of the quizzes and exams will be closed book. However, students are allowed to bring in an equation sheet for each of the exams and for the final lecture exam.

Schedule

Wk	Chp	Q&E	Laboratory Exercises and Experiments			
1	Rev/1		No lab (Monday is Labor Day)			
2	2		Check In; Introduction; Error Analysis Activity; Lab Problem Set (LPS)			
3	2/3	Q1	Real Gases[1] (spreadsheet and values for a, b, and c); LPS cont'd			
4	3/4		Error Quiz			
5	4	E1	Heat of Fusion of Water[1]			
6	4/5		Ht Combust[1,2]	N_2O_4 Equil[1]	Ht Cap Ratios[1]	Ht Vapor[1,3]
7	5	Q2	Ht Vapor[1,3]	Ht Combust[1,2]	N_2O_4 Equil[1]	Ht Cap Ratios[1]
8	6/7		Ht Cap Ratios[1]	Ht Vapor[1,3]	Ht Combust[1,2]	N_2O_4 Equil[1]
9	7	E2	N_2O_4 Equil[1]	Ht Cap Ratios[1]	Ht Vapor[1,3]	Ht Combust[1,2]
10	7/8		Informal report due			
11	8/22	Q3	Ksp of PbI_2[1]			
12	22		lab talks (5 to 8 minutes for each talk) during Thanksgiving week			
13	19 or 20	E3	Iodine Clock[1]			
14	20		Formal report due; Kinetics of the Decomposition of H_2O_2[1] (one report per group)			
15	20 or 19	Q4	Checkout and Laboratory Final Exam (cheat sheet = 1 sheet of paper)			
16			Comprehensive Final Lecture Exam - See Timetable for the date and time.			

[1] Each **short report** is due one week after the exercise.

[2] The **informal report** is due as shown above. It is based on the short report that was already submitted.

[3] A **formal report** is due as shown above. It is an informal report with error analysis; the error analysis will be based on a set of data that is provided by the instructor.

References for lab exercises

Experiment[1]	**Reference**	**Experiment**	**Reference**
Error Analysis	Chps II & XXII, Handout	Ht Capacity Ratios	#3
Real Gases	Handout	N_2O_4 Equilibrium	Handout
Ht Fusion	Handout	Ksp of lead iodide	*JCE*, **73**, 789, 1996
Ht of Combustion	#6	Iodine Clock	#20
Ht of Vaporization	Handout	Peroxide Decomp.	Handout

[1] *Experiments in Physical Chemistry* 7th ed., Garland, Nibler and Shoemaker unless noted otherwise.

IV. Learning Aids and Principle Assignments

Lecture (Course Content)
Chapter note sheets will be provided for each chapter. Sets of recommended problems will be provided for each chapter. Some of the problems may be review problems, some will be taken from the course text, and others will come from other sources. Answers to most, if not all, problems will be provided and solutions for many problems will also be provided. You are encouraged to work together on these problems and everyone is expected to understand how to work all of the problems. Examples of past exams, with answers, will also be provided. Quizzes and exams will be based on these problems.

Laboratory
The laboratory experiments have been chosen to illustrate the physical chemical concepts covered in the lecture. A set of problems illustrating data treatment will be handed out and solutions will be provided; this problem set will not be graded. Part of the error analysis quiz will be based these problems. Several lab reports will be collected. Grading and formatting lab reports will be discussed during lab meetings. Note, you are encouraged to work together but you may not share electronic copies of laboratory-related documents and spreadsheets. You must use your own data and write your own reports.

CitM
There will be a variety of CitM-related activities and assignments. These assignments are designed so that students may resubmit them until they are judged to be satisfactory. Because of this, points are not awarded for completing the assignments. Instead, point penalties will be imposed for not reaching a satisfactory level or not submitting an assignment.

V. Evaluation

Lecture (75%)	Three Quizzes (30 pts each; best 3 out of 4)	90 pts
	Three Exams (120 pts each)	360 pts
	Comprehensive Final	150 pts
	Subtotal	**600 pts**
Laboratory (25%)	Error Analysis Quiz	65 pts
	Eight Short Reports (5 pts each)	40 pts
	Notebook	20 pts
	Final Exam	75 pts
	Subtotal	**200 pts**
CitM (-17%)	Sentence Scrambles a, b, c (-8 pts each)	(-24 pts)
	Punctuation	(-8 pts)
	Equation Editor	(-8 pts)
	Equations in Sentences a, b (-8 pts each)	(-16 pts)
	Formatting tables, graphs and figures	(-16 pts)
	Written Solution Problems a, b (-8 pts each)	(-16 pts)
	One Informal Lab Report	(-16 pts)
	One Formal Lab Report	(-24 pts)
	Lab chalk talk	(-8 pts)
	Subtotal	(-136 pts)
Total		**800 pts**

* Grades will be assigned according to the following scheme: 90.0-100%, A; 85.0-89.9%, A-; 80.0-84.9%, B+; 75.0-79.9%, B; 70.0-74.9%, B-; 65.0-69.9%, C+; 57.0-64.9%, C; 50.0-56.9%, D+; 45.0-49.9%, D; 44.9% and lower, F. I reserve the right to adjust the grading scheme to the benefit of the students.
* The score of the lowest of the three lecture exams will be replaced by an appropriately scaled score based on the lecture final exam if it increases the student's point total.
* There are no *individualized* extra-credit opportunities in this course.

Grading Rubrics:

Hour Exams, Lecture Quizzes, Error Quiz, and the Final Exams (Lab and Lecture) - Point values for questions and problems are given on the exams / quizzes. Questions are usually multiple choice or matching and are graded either zero or full credit. Problems will have point values that are related to the number of steps needed to arrive at the correct answer. Points (usually 0.5 to 3) will be deducted for each independent error depending on the severity of the error. Problems that have two or more independent parts are graded as though they are separate problems.

Short Reports (5 pts max) - Reports should have a well-written abstract, complete and correct list of equations, complete and correct collections of data and calculated results organized in tables and graphs as appropriate. Five points will be given for a report that is acceptable (minor flaws only), four points if the report is initially unacceptable but is resubmitted in an acceptable state, and zero points otherwise.

Informal Reports - An informal report is based on a previously submitted ***acceptable*** short report. It will be judged either acceptable (no penalty) or unacceptable (see table for penalty). An unacceptable report may be resubmitted during the semester until it is acceptable.

Formal Reports - A formal report is based on a previously submitted ***acceptable*** short report. It will be judged either acceptable (no penalty) or unacceptable (see table for penalty). An unacceptable report may be resubmitted during the semester until it is acceptable.

Lab Talk (white or chalk board) - The talk will be judged unacceptable only if it isn't given. Feedback will be provided after each talk.

Lab Notebook (20 pts max) - The table of contents (4 pts) and the notebook entries for two experiments (8 pts each) will be examined. For each experiment, the point value will be based on the degree of completeness of the notebook entry.

VI. Student Conduct and Special Accommodations

UWSP policies concerning student academic standards and disciplinary procedures can be found in Section II of the UWSP **Community Bill of Rights and Responsibilities**. This document is available on the UWSP Website.

If you need special accommodations for religious beliefs or learning disabilities, you should consult the appropriate offices and policies at UWSP and then see me as soon as possible so that we can make appropriate arrangements for your situation. UWSP's University Catalog has some information and it can direct you to other resources.

VII. Bibliography and Supplies

Lecture Text. Ball, David W., Physical Chemistry, Brooks/Cole, Pacific Grove, CA, 2003.
Laboratory Text. Garland, Nibler and Shoemaker, Experiments In Physical Chemistry 7th, McGraw-Hill, New York, 2003.

Graphing Calculator
Laboratory Notebook