

# CHM 4411, Physical Chemistry: Chemical Thermodynamics and Kinetics Fall 2013

*"In this house, we obey the laws of thermodynamics!"*

*-Homer J Simpson*

**Instructor:** Dr. Benjamin J Killian, LEI 202A, 392-0528, killian@chem.ufl.edu  
Office Hours: Mon, 6<sup>th</sup> Pd; Tue, 4<sup>th</sup> Pd; Wed, 3<sup>rd</sup> Pd

**Teaching Assistants:** Ebo Ewusi-Annan, CLB 207, exe147@ufl.edu  
Yajing Yang, yjyang@ufl.edu

**Objectives:** In this course you will learn the physical and mathematical bases of macroscopic and statistical thermodynamics and applications to chemical systems.

**Texts:** Atkins and De Paula, *Physical Chemistry* 9<sup>th</sup> Ed. W. H. Freeman and Co., New York (2010)  
You should also find additional physical chemistry texts for additional practice problems and supplemental reading.

**Grade Distribution:**

Exams:	4 @ 200 pts.	800 pts.
Homework:	~10 weighted to 200 pts. total	200 pts.
Quizzes	~10 weighted to 200 pts. total	200 pts.
<b>Total</b>		<b>1200 pts.</b>

**Grading Scale** (in % using usual rounding conventions for fractions):

<u>Letter Grade</u>	<u>Percentage</u>	<u>Letter Grade</u>	<u>Percentage</u>	<u>Letter Grade</u>	<u>Percentage</u>
A	>90	B-	>68	D+	>53
A-	>84	C+	>64	D	>50
B+	>78	C	>60	E	<50
B	>72	C-	>56		

**Tips for Success:** This course is not easy. It may very well be one of the hardest courses you take while an undergrad. However, with attention you can pass this course and *<gasp>* actually learn something! Firstly, please be on time to lectures. Material will come primarily from the lectures. We will be jumping around in the text from time to time. If you must miss a lecture, be sure to acquire the notes from a classmate. Remember, 2 hours is a lot of material to miss. If you must show up late, please be courteous to your instructor and fellow students by not being disruptive.

My lectures will only go so far toward teaching you this material. On a daily basis you should read the material and work problems. Work all assigned problems more than once. Practice on other problems. When you get graded material back, rework the problems. Try to find different ways to get the correct answer. Practice is crucial to mastering this material.

This subject matter is very mathematical. You will have to call upon the Calculus that you probably haven't had to use for several years. Dust off your old Calculus text and make friends with it again. Don't get bogged down in the math. Understand the concepts and fill in the blanks later.

Finally, be sure to maintain a positive attitude. Thermodynamics can be a little dry. I will do everything I can to make it interesting for you. No matter how boring and tedious you find the material, remember that the universe runs on thermodynamics.

**Course Mechanics:** Homework will be assigned weekly, and will generally comprise 5 problems. Be sure to show your work on homework assignments *with correct units throughout*. Homework must be submitted on paper. No e-mailed assignments will be accepted. I, as well as TAs, will be available to answer questions during office hours. If you need to speak with me outside of office hours, please make an appointment. The final homework grade will be based on a scale of 200 points. Each assignment will be equally weighted.

There will be quizzes throughout the semester. These are intended to indicate problem areas before they are encountered on exams. Be sure to understand the quiz questions completely. *No make-up quizzes will be given.* The final quiz grade will be based on a scale of 200 points. Each quiz will be equally weighted.

There will be four (4) exams through the course of the semester, each worth 200 points. The first three exams will be during regular class time. The final exam will be on December 13th, at 7:30 AM. If you must miss an exam, you must make arrangements at least three business days prior.

During quizzes and exams, you are expected to do your own work. I do not require that you use a non-programmable calculator; however, I reserve the right to require you to reset it if warranted. Students may not share calculators. Cell phones, mp3 players, personal computers, and all other electronic/wireless devices are prohibited during quizzes and exams. *Violations will result in a grade of zero on the assignment.*

**Students with Disabilities:**

Appropriate accommodations will be provided, according to the policy at [www.chem.ufl.edu/~itl/disabilities.html](http://www.chem.ufl.edu/~itl/disabilities.html).

**Academic Honesty:**

Students are expected to obey the University of Florida Honor Code, detailed at [www.chem.ufl.edu/~itl/honor.html](http://www.chem.ufl.edu/~itl/honor.html). Violations will be reported to the Office of Student Judicial Affairs.

The sale or transfer of graded or ungraded course materials to another student for use in this course (current or future semesters) is in violation of the Honor Code. All violations will be reported.

**Schedule of Lecture Topics:** The following broad topics will be covered through the semester, as time permits. Exam dates are tentative, but exam material will be clearly delineated at least one week prior to the exam.

<b>1. Fundamentals and Gas Laws:</b>	Chapter
a. Math review	N/A
b. Energy Levels and Partition Functions	15
c. Ideal and Real Gases	1
d. Kinetic Theory of Gases	20
<b>2. The First Law:</b>	
a. Energy, Heat, and Work	2/16
b. Legendre Transforms (an introduction)	N/A
c. Enthalpy and Thermochemistry	2/16
d. A first look at Differential Forms	2
e. Indicator Diagrams	2
<b><u>Progress Exam 1</u></b>	
<b>3. The Second Law:</b>	
a. Carnot Cycle and efficiency	3
b. Entropy and Spontaneity	3/16
c. Legendre Transforms and Free Energies	N/A
d. Differential forms and Maxwell Relations	3
<b>4. Equilibrium and Transitions:</b>	
a. Chemical potential	3/4
b. Phases and Phase Changes	4/5
c. Chemical equilibrium	6
d. Pure Liquid Mixtures	5
e. Colligative Properties	5
<b><u>Progress Exam 2</u></b>	
<b>5. Equilibrium and Solutions:</b>	
a. Activities	5
b. Acid/Base Reactions	N/A
c. Electrochemistry	6
d. Solubility	N/A
<b>6. Kinetics and Reaction Dynamics:</b>	
a. Introduction to Kinetics	21
b. Integrated Rate Laws	21
c. Elementary Reaction, Complex Mechanisms, Simplifications	21
d. Temperature Dependence and Equilibrium	21
e. Unimolecular Reaction and Transition State Theories	22
f. Catalysis	23
<b><u>Progress Exam 3</u></b>	

**Cumulative Final Exam**