CHM 4411, Physical Chemistry:
Chemical Thermodynamics and Kinetics
Spring 2014

"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: M, 4th Pd; W, 6th Pd; R, 3rd Pd; F 4th Pd

Teaching Assistants: Ebo Ewusi-Annan, CLB 207, exe147@ufl.edu

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

Texts: McQuarrie and Simon, *Physical Chemistry: A Molecular Approach*. University Science Books (1997)
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.
Total		**1200 pts.**

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

Letter Grade	Percentage	Letter Grade	Percentage	Letter Grade	Percentage
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 on Feb. 4th, Feb. 27th, and Apr. 3rd. The final exam will be on April 28th, at 5:30 PM. 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.

Academic Honesty:
Students are expected to obey the University of Florida Honor Code, detailed at 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 material will be clearly delineated at least one week prior to the exam.

1. **Fundamentals and Gas Laws:**   Chapter
   a. Math review   MC[†] H
   b. Energy Levels and Partition Functions   17,18
   c. Ideal and Real Gases   16,18
   d. Kinetic Theory of Gases   27
2. **The First Law:**
   a. Energy, Heat, and Work   19
   b. Legrandre Transforms (an introduction)   N/A
   c. Enthalpy and Thermochemistry   19
   d. A first look at Differential Forms   N/A
   e. Indicator Diagrams   19
3. **The Second and Third Laws:**
   a. Carnot Cycle and efficiency   20
   b. Entropy and Spontaneity   20
   c. Absolute Entropy and Third Law   21
   d. Legendre Transforms and Free Energies   22
   e. Differential forms and Maxwell Relations   22
4. **Equilibrium and Transitions:**
   a. Chemical potential   23
   b. Phases and Phase Changes   23
   c. Chemical equilibrium   23,24,25,26
   d. Pure Liquid Mixtures   24,25
   e. Colligative Properties   25
5. **Equilibrium and Solutions:**
   a. Activites   24
   b. Acid/Base Reactions   N/A
   c. Electrochemistry   N/A
   d. Solubility   N/A
6. **Kinetics and Reaction Dynamics:**
   a. Introduction to Kinetics   28
   b. Integrated Rate Laws   28
   c. Elementary Reaction, Complex Mechanisms, Simplifications   28,29
   d. Temperature Dependence and Equilibrium   28
   e. Unimolecular Reaction and Transition State Theories   28,29
   f. Catalysis   29

[†]MC stands for MathChapter