Physical Chemistry II: Thermodynamics and Reaction Kinetics
Syllabus for Spring 2019 Term

GENERAL INFORMATION

RUTGERS CATALOG DESCRIPTION

50:160:345-346 Physical Chemistry I,II (3,3): Thermodynamics with chemical applications, kinetics, quantum mechanics, statistical mechanics, transport, and structure. **Prerequisites for 50:160:345 include:** Chemistry prerequisites: 50:160:116, 126. Math pre- or corequisites: 50:640:221, and 50:640:250 or 314. Physics prerequisites: 50:750:131-134 or 50:750:203-206. **Prerequisite for 50:160:346:** 50:160:345.

Course Format: Lectures

Instructor: **Dr. Guillaume Lamoureux**
Office: BSB 422
Office Hours: Tuesdays from 11:00 to 12:00 (after the lecture)
Any other time: By appointment
Email: guillaume.lamoureux@rutgers.edu
Website: http://lamoureuxlab.org/teaching.html

Lectures: Tuesdays and Thursdays from 9:35 to 10:55
Location: BSB 108

Textbook: **Atkins, De Paula & Keeler, *Atkins' Physical Chemistry*, 11th Edition.**
(The textbook is available for sale at https://universitydistrict.bncollege.com and for short-term loans at the Robeson Library Reserve. If you are considering using an earlier edition of the book, please check with the instructor first.)

Review Material: In preparation for the course, please review the following chapters from **N. J. Tro, *Chemistry: Structure and Properties*, 2nd Edition** (or the equivalent chapters from any other General Chemistry textbook):
- Stoichiometry (Chapter 7)
- Thermochemistry (Chapter 9)
- Gases (Chapter 10)
- Liquids and Solids (Chapter 11)
- Solutions (Chapter 13)
- Chemical Kinetics (Chapter 14)
- Chemical Equilibrium (Chapter 15)

COURSE OBJECTIVES

This course is an introduction to thermodynamics and reaction kinetics. After passing the course, the student will be able to (1) apply the principles of thermodynamics to situations involving physical transformations and chemical reactions, and (2) analyze reaction kinetics data, extract rate constants, and interpret their significance. The following topics will be covered: (1) properties of gases, (2) internal energy, enthalpy & the First Law, (3) entropy, free energy & the Second and Third Laws, (4) phase equilibrium, (5) simple mixtures, (6) chemical equilibrium, (7) molecular motion in gases and liquids, (8) theory of reaction rates and experimental techniques, and (9) reaction mechanisms.

COURSE GRADE

The final grade for the course is composed as follows: **18% for the assignments, 25% for the first in-class exam, 25% for the second in-class exam, and 32% for the final exam**. The minimum passing grade for the course is 60%.

EXAMINATIONS

The in-class exams will be held on **February 14** and **March 28**. The final exam date is set by the Office of Scheduling and will be announced later during the term. If you are absent from an in-class exam, you must produce a note appropriately signed (e.g., by a doctor or an employer) on letterhead paper. This note must be delivered to the instructor as soon as possible, and no later than on the Monday following the exam. If the absence is not valid, you will receive a mark of zero for the missed exam. If the absence is valid, you will be granted permission to write a make-up test no later than a week after the missed exam. No excuses will be accepted for missing the make-up test.

PLAGIARISM AND OTHER FORMS OF ACADEMIC DISHONESTY

Please review Rutgers University's Academic Integrity Policy (http://academicintegrity.rutgers.edu/academic-integrity-policy/). Any form of unauthorized collaboration, cheating, copying or plagiarism found in this course will be reported and the appropriate sanctions applied. Ignorance of the policy is no excuse and will not result in a reduced sanction.

GRADED ASSIGNMENTS

There will be 3 graded homework assignments during the term. Each assignment will be handed out by the instructor at the end of class and will be due one week later, at the beginning of class. Late assignments will be deduced **10% per day late**. Any assignment handed in more than 5 days late will be given a grade of zero.

READING MATERIAL AND PRACTICE PROBLEMS

The student is expected to read the appropriate sections of the textbook ahead of time. In addition to the graded assignments, a list of suggested practice problems from the book will be provided with each section. It is the student's responsibility to use these problems to practice in applying the course material.

SOME ADVICE

Note-taking: Overheads will be distributed ahead of each lecture, and it is advised to print them out, read them ahead of class, and annotate them during class. Take copious notes during the lectures and keep expanding them as you study and practice the material. Given the nature of the material (equations and graphs), taking notes on electronic devices is not recommended. **Reading/studying:** It is best to read the material on your own first but make sure you eventually meet with your classmates to revise the important concepts and compare your understanding with theirs. The best way to understand something is to try explaining it to somebody else. **Practice problems:** Make the most of the time you spend on each practice problem by asking yourself: What are the concepts or skills being learned? What other similar questions could be asked on the topic? How would the solution/answer change if piece of information "X" in the statement of the problem was changed to "Y"? Could the problem be posed in more general/specific terms?

CALENDAR OF LECTURES

Please note that this calendar may change as the semester proceeds. The chapter numbers refer to the 11th edition of the textbook.

Date	Topics	Reading
Jan. 22	Introduction, The perfect gas	1A
Jan. 24	The kinetic model, Real gases	1B & 1C
Jan. 29	Internal energy, Enthalpy	2A & 2B
Jan. 31	Internal energy, Enthalpy (cont'd)	
Feb. 5	Thermochemistry	2C
Feb. 7	Thermochemistry (cont'd)	
Feb. 12	Entropy	3A & 3B
Feb. 14	Entropy (cont'd)	3C
Feb. 19	Problems in class	
Feb. 21	**In-class Exam #1 (covers Chapters 1 and 2)**	
Feb. 26	Helmholtz and Gibbs energies	3D
Feb. 28	Combining the First and Second Laws	3E
Mar. 5	Phase diagrams, Phase transitions	4A & 4B
Mar. 7	Phase diagrams, Phase transitions (cont'd)	
Mar. 12	Mixtures, The properties of solutions	5A & 5B
Mar. 14	Phase diagrams of binary systems: liquids	5C
Mar. 19	SPRING RECESS (no classes)	
Mar. 21	SPRING RECESS (no classes)	
Mar. 26	Problems in class	
Mar. 28	**In-class Exam #2 (covers Chapters 3, 4, and 5)**	
Apr. 2	Chemical equilibrium	6A & 6B
Apr. 4	Transport in gases, Motion in liquids	16A & 16B
Apr. 9	Rates of chemical reactions	17A
Apr. 11	Integrated rate laws	17B
Apr. 16	Reactions approaching equilibrium	17C
Apr. 18	Arrhenius equation	17D
Apr. 23	Reaction mechanisms	17E
Apr. 25	Examples of reaction mechanisms	17F
Apr. 30	Examples of reaction mechanisms (cont'd)	
May 2	Problems in class	
TBA	**Final Exam (covers Chapters 6, 16, and 17)**	