

CHEM 253: Thermodynamics and Kinetics

Fall 2013 Course Syllabus

Instructor: Dr. Bryan M. Wong

Office Location & Contact Information: 416A Stratton Hall, bmw336@drexel.edu

Office Hours: T 3:30 – 4:30 PM, F 3:00 – 4:00 PM, or by appointment

Class Schedule: TR 2:00 – 3:20 PM, F 2:00 – 2:50 PM

Required Textbook: [*Physical Chemistry: A Molecular Approach*](#) by Donald A. McQuarrie and John D. Simon

Course Website: <http://sites.google.com/site/chemdrexel253/>

COURSE DESCRIPTION

This course covers gas properties, gas laws, state functions, First, Second, and Third Laws of Thermodynamics, phase transformations, phase diagrams, chemical equilibrium, spontaneous reactions, Gibbs Free Energy, molecular motion, diffusion, rates of chemical reactions, rate laws, molecular reaction dynamics, transition states, and electron transfer.

COURSE OBJECTIVES

The objectives of this course are to:

1. Introduce the laws of thermodynamics, understand their implications, and become familiar with their use and applications
2. Understand physical transformations in pure materials as well as the properties of simple mixtures
3. Understand reaction rates and explore integrated rate laws for a variety of elementary and complex chemical reactions
4. Introduce concepts of reaction dynamics such as transition states and electron transfer processes that are relevant to modern material systems

GRADING

Students are required to complete weekly problem sets, two midterms and a final exam. The grade for the course will be determined as follows:

Homework (25%): Submitted at the start of lecture on Friday

Two midterm exams (each 25%): Each exam will be held during class and will be announced at least one week in advance (see class schedule on the course website). No computers, tablets, or smart phones are permitted. No make-up exams will be given except in extreme circumstances. In the event that you miss an exam, the final exam score will count 50% towards the overall grade given for the course. If possible, a student should discuss her/his individual circumstance/schedule conflict in advance with Prof. Wong.

Final exam (25%): A cumulative final examination will count 30% towards the final grade. The date will be determined by the official university final exam schedule.

HOMEWORK

Homework contributes 25% of the final grade. Students are permitted and encouraged to discuss lectures and homework as a part of the learning process. For most homework assignments, this means that students may discuss approaches to solving problems. However, the final solutions and written preparation must be done independently. Assignments that are nearly identical or copied may be considered as academic dishonesty. Problem sets will be assigned every week except during the weeks of midterms. No late homework will be accepted after the solutions have been posted. The purpose of homework is to give students a better command of principles by applying them to problem solving. Numerical work will often be involved, and doing this correctly is important. Occasionally, homework will involve numerical work that requires use of a computer.

EXAMS

Exams contribute 75% of the final grade. There will be 2 mid-term exams and a final comprehensive exam (each contributing 25% to the final grade). Letter grades will be assigned to each exam, and these will be averaged (along with the final and homework grades) to determine the final grade. The purpose of exams is to enable the instructors to gauge each student's command of the principles. The exams will usually involve minimal numerical work, although concrete examples are better than abstract ones. There is less emphasis on getting correct numerical answers than on the homework. Like homework, exams are intended to be a learning tool.

COMMUNICATION

All course information and instructions will be communicated via the CHEM 253 webpage. A link to the course web page is available at <http://sites.google.com/site/chemdrexel253/>. Questions and/or concerns should be emailed directly to Prof. Wong (bmw336@drexel.edu). Scheduled office hours are another excellent opportunity to communicate with the course instructor.

ACADEMIC POLICIES

This course follows standard Drexel University policies, including the following:

http://www.drexel.edu/provost/policies/academic_dishonesty.asp

http://drexel.edu/studentaffairs/community_standards/overview/

<http://www.drexel.edu/oed/disabilityResources/students/>

http://www.drexel.edu/provost/policies/course_drop.asp

DISABILITIES STATEMENT

Students with disabilities requesting accommodations and services at Drexel University need to obtain a current accommodation verification letter (AVL) before special accommodations can be made. AVL's are issued by the Office of Disability Services (ODS). For additional information, contact the ODS at <http://www.drexel.edu/oed/disabilityResources>, 3201 Arch St., Suite 210, Philadelphia, PA 19104, V 215.895.1401, or TTY 215.895.2299.

CLASS SCHEDULE

Lecture Schedule				
Week		Description	Reading	HW
01	09/24	Introduction to course and to thermodynamics. Zeroth law. Temperature	16.1-16.4,	
01	09/26	scales. Properties of ideal and real gases. Equations of state for liquids	19.1,19.2	
01	09/27	and solids. Work and heat. Heat Capacities.		1
02	10/01	First law. Joule experiment. C_p , C_v , and Enthalpy. Hess' Law. Standard	19.3-	
02	10/03	enthalpies.	19.12	
02	10/04			2
03	10/08	Adiabatic processes. Introduction to second law. Mathematics of second	20.1-20.4,	
03	10/10	law. Carnot cycle. Thermodynamic Equation of State. Reversible and	21.1-21.5,	
03	10/11	irreversible expansions.	21.8, 21.9	3
04	10/15	Third Law. Conditions for equilibrium. Free energies. First midterm	No	
04	10/17	exam on Friday.	Reading	
04	10/18			
05	10/22	Free energies. Maxwell relations, $G(T,P)$, $S(T,P)$, Real gases.	22.1-22.4,	
05	10/24	Introduction to phase equilibrium.	20.5	
05	10/25			4
06	10/29	Phase equilibrium. Clapeyron. Clausius-Clapeyron. Ideal Mixtures.	22.5-22.8	
06	10/31			
06	11/01			5
07	11/05	Ideal gas mixtures. Ideal solutions. Gibbs' phase rule, Raoult's law.	23, 24.5-	
07	11/07	Fractional distillations.	24.9	
07	11/08			6
08	11/12	Dilute solutions. Henry's Law, Colligative Properties. Second midterm	No	
08	11/14	exam on Friday.	Reading	
08	11/15			
09	11/19	Chemical Equilibrium. K_p , K_c for ideal gases. Le Chatlier's principle and	25	
09	11/21	effects due to concentration, temperature, and pressure.		
09	11/22			7
10	11/26	Chemical kinetics: rate laws. Reaction mechanisms and transition state	26, 27	
10	11/28	theory.		
10	11/29			8
11	12/03	Finish chemical kinetics, introduction to electron transfer and reaction	28, 29	
11	12/05	mechanisms for modern materials. Final review.		
11	12/06			9
12		Finals week		