CHEM 162 - Thermodynamics and Kinetics
Spring 2015, MWF 8:30-9:20, Cook B-112
Prof. W.R. Leenstra

Introduction
Chem 162 is the second half of the year-long course in physical chemistry and covers the disciplines of thermodynamics and kinetics (and an introduction to statistical mechanics if time allows). Whereas the preceding course, Chem 161 - Quantum Chemistry, looks at chemistry from the ground up (electrons to atoms to molecules), in this course we will explore a variety of chemical properties from a macroscopic perspective. The topics themselves are expansions on ones introduced in the first-year course in chemistry.

Textbook
The textbook we will be using is "Physical Chemistry" by Silbey, Alberty and Bawendi (4^{th} ed.). We will aim to cover Part I: Thermodynamics (Chapters 1-8) and Part III: Kinetics (Chapters 18-19). As those who have taken the first semester know, there typically is much more material in these chapters than can be reasonably covered; this is also true in the second semester. While this textbook was chosen for its clear writing style and because it appears to align with my pedagogic approach, you should understand that for most upper level courses the textbook is an aid, not the "bible". Depending on the material/chapter, various sub-topics will not be covered in class (or the reverse). The rule of thumb to use in this course is that if a concept is not discussed in lecture, you don't need to know the corresponding passage of a chapter; however, you are responsible for all material discussed in class. Also, be aware that much of the content may be presented by me differently from the way the author has done a given topic. Occasionally I may copy passages out of other books when such might be helpful as an additional resource for you.

Minor, Prerequisites, Preparation
Chem 162 is one of the courses that can be used to fulfill the minor in Chemistry, after a year of organic chemistry. One other option, this spring semester, is Chem 131 (Inorganic Chemistry). The difference lies in the prerequisites. Whereas Chem 131 requires a year of organic chemistry, this course in physical chemistry requires a year of physics instead, plus a year of calculus. Chem 162 does not include extensive integrations or differential equations as does Chem 161, thus, only the one year of calculus (Math 21/22) is sufficient. As you would see in a cursory inspection of the first few chapters of our textbook, you would be quite lost without that one year of calculus already mastered. One other option is Chem 121 (Quantitative Analysis), offered next fall semester.

Topics
The topics, in order of discussion, are:

Zeroth law and equations of state [ideal/real gases,]
First law of thermodynamics [heat and work, thermochemistry]
Second law of thermodynamics [Carnot cycle, entropy]
Chemical equilibrium [Gibbs energy, Maxwell's equations]
Phase equilibria [phase diagrams, Clapeyron equation]
Solutions [ideal vs. real systems, Raoult's law]
Kinetics [rate laws, mechanisms]

Course Grading

Assessments will be carried out in three different categories: semester exams, homework, and final exam, with point assignments of 300, 100, and 200, respectively. These are:

Semester Exams. We will have three semester exams at approximately equal intervals. From experience, I know that students appreciate not having the one-hour time constraint for their exams. Instead, I will design exams that can be finished in less than two hours, and have them outside of lecture's class times, on Tuesday/Thursday evenings from 6 p.m. till 8 p.m. The three exams are spread out as evenly as possible on the following schedule:

Exam 1 — Thursday, February 12; covering material of 12 lectures (1-12)
Exam 2 — Tuesday, March 24; covering material of 13 lectures (13-25)
Exam 3 — Tuesday, April 21; covering material of 12 lectures (26-37)

I do not give make-up exams. However, if you have potential conflicts with these times, I will allow some flexibility in your exam start time on those days.

Exams count as 100 points each, for a total of 300 points. In general terms, on exams will appear a mix of calculational problems, short-answer questions, longer-answer explanations, and multiple-choice questions. In order to discourage last-day cramming, I will not answer questions on the material on the day of the exam.

Homework. The content in this course is pretty challenging and very extensive, so in order to encourage you to keep up with the material in manageable pieces, I will assign regular HW sets (via Blackboard) that illustrate the concepts/calculations I feel are important, to be turned in. They will consist of a textbook problem or two almost every time we have a lecture.

Each homework set will be worth a maximum of 3 points. You will earn 3 points for doing it correctly, with all the steps shown and documented in proper English, and presented professionally; 2 points for a deficiency in any of the above categories; 1 point for serious deficiencies; and 0 for not turning anything in. Rebecca Harvey will be the grader of the HW sets; any question regarding the HW grading should be worked out with her. The total points accumulated for your homework will be normalized to 100 points, the equivalent of one exam.

We will only grade homework done on 8.5 x 11.0 inch writing paper that is not torn out of a spiral-bound notebook. You can buy a writing pad at the bookstore for a couple of dollars.

Final Exam. Our two-hour final exam is scheduled for Friday, May 5, at 8:00 a.m. in our regular classroom, Angell B-112. It is cumulative (comprehensive) in nature, and multiple-choice in format, and will be worth 200 points. Please plan your travel with this date constraint in mind.

Grade. Your grade for the course will be based on the total number of points you accumulate out of 600, relative to the class average. Thus, there is no meaningful letter grade that can be assigned to any individual exam. I can only indicate approximate ranges based on a "curve". Although I cannot at this time predict the difficulty of the exams and the overall strength of the class, but I can say that the average score for the course has always been around 65-70%. In a large statistical sample, for this course the average performance earns a B. But please note that the average could also be a little lower, or much higher, depending on the overall performance of the class. This grading scheme is based on the assumption that attendance is perfect, that students come prepared, and are engaged.

Office Hours

My office is Cook A-119. I will be available for official office hours Monday, Wednesday, and Friday 10:00-11:00. After the first week of add/drops, I will collect everyone's schedule to analyze whether these office hours catch most of you, and will try to make myself available at other times. I strongly encourage you to do group study among yourselves (and come see me in groups). But at any rate, I encourage you very strongly to use these times to clear up difficulties in understanding the material as soon as possible, while the subject is still fresh in your mind. As mentioned already, the only time I will not answer questions is on the day of the exam because I want to discourage "cramming" at the last moments.

If you need to see me, I prefer to not set up an appointment via email. That usually entails a number of back-and-forth correspondences. Instead, I prefer you to call me at my office phone (802-656-0273). If I happen to not be in, leave a contact phone number.

Responsibilities

It should go without saying that you are expected to show up to each class. Secondly, I expect you to come prepared for each lecture by having reviewed the material from the previous lecture, and having read the pertinent parts of the textbook. And finally, I expect you to be alert and ready to participate in class. If you are indeed too exhausted to keep your eyes open, I will ask you to leave the classroom. I consider this a simple matter of common courtesy and mutual respect.