# Chemistry 656 Thermodynamics Spring 2009

Class meets MWF 11:40-12:35 in 200 Life Sciences.

Text: Fundamentals of Classical and Statistical Thermodynamics by B. N. Roy (Wiley, 2002), as well as supplementary notes (on topics not discussed in the text)
Professor: J. Goodisman, 3-014 SciTech, 3-3035, goodisma@syr.edu
Office Hours: MWF, 3-4 PM and by appointment

It is assumed that everyone has had exposure to thermodynamics in an undergraduate class like physical chemistry. In this course, we will include some basic statistical mechanics as applied to thermodynamics, and discuss a few more applications of thermodynamics than the typical undergraduate presentation. We will also take a somewhat more advanced, and more mathematical, approach. All the mathematics, which involves some use (and understanding) of partial derivatives and differential equations, will be explained as we go along.

There will be two one-hour exams, each worth 100 points, and the two-hour final exam (see the schedule below). There will also be nine problem sets, each worth about ten points, which will be graded. The days they are handed out are indicated in the syllabus. Solutions are due back one week later, in general. Students may work together on problem sets, or get help from me or anyone else, but each student must submit a set of written solutions to get credit.

In the syllabus below (which is probably an upper limit on what we will do), the section numbers in the text are indicated.

| Sunday date | Monday | Wednesday | Friday |
|---|---|---|---|
| **Jan. 11** | Preliminaries and definitions, units, 1.1-1.8 | Work, heat, enthalpy, kinetic theory, 1-9-2.5 | Ideal and real gases, Zeroth Law, 2.6-3.3 |
| **Jan. 18** | Martin Luther King Day | Temperature, First Law, 3.4-4.6 | Work of compression, 4.7<br>*1st problem set given* |
| **Jan. 25** | Heat and heat capacity, 5.1-5.3 | Reversible and irreversible processes, 5.4-5.5 | Enthalpy, real and ideal gases, 5.5-6.1<br>*2nd problem set given* |
| **Feb. 1** | Applications of 1st law, 6.2-6.5 | Carnot and other cycles, entropy, 6.6-6.10 | 2nd law and entropy, 7.1-7.5 |
| **Feb. 8** | Statistical interpretation of thermo., 7.6-7.10<br>*3rd problem set given* | Entropy and temperature, 7.11-7.16 | Combined 1st and 2nd Laws, 7.17-8.3 |
| **Feb. 15** | Entropy changes, 8.4-8.8 | first hour exam | 3rd law of thermodynamics, 8.9-9.6<br>*4th problem set given* |
| **Feb. 22** | Entropy and forbiddenness, 9.7-10.2 | Free energy, 10.3-10.5 | Equilibrium conditions, 10.6-10.9 |

| | | | |
|---|---|---|---|
| **March 1** | Free energy, activity, and fugacity, 10.10- 10.13 | Applications of free energy, 10.14-10.17<br>*5th problem set given* | Surfaces, adsorption<br>*my notes* |
| **March 8** | Spring Break | Spring Break | Spring Break |
| **March 15** | Surfaces, adsorption<br>*my notes* | Chemical equilibrium, 11.1-11.3<br>*6th problem set given* | Chemical equilibrium, 11.4-11.8 |
| **March 22** | Chemical potential, 11.9-11.12 | Gibbs-Duhem equation, mixing, 11.12-11.15 | Ionic species,<br>*my notes*<br>*7th problem set given* |
| **March 29** | Ionic species and electro-chemistry, *my notes* | Thermodynamics of the electrochemical cell,<br>*my notes* | Introduction to statistical mechanics, 12.1-12.4 |
| **April 5** | Equilibrium and phase space, 12.5-12.7<br>*8th problem set given* | Indistinguishability, 12.8-12.12 | Good Friday |
| **April 12** | Application to thermo-dynamics, 13.1-13.3<br>*9th problem set given* | Interpretation of thermo-dynamic functions, 13.4-13.7 | Meaning of equilibrium constant, 13.8-13.11 |
| **April 19** | Phase equilibria, 14.1-14.7 | May Fest | Phase transitions, 14.8-14.10 |
| **April 26** | Maxwell distribution, 15.1-15.2 | April 27 (Monday) was the last day of classes | |