

Chemistry 346, Section M001 Fall 2016

MWF 11:40 -12:35, 105 Life Sciences instructor: Prof. Bruce Hudson, 3-014A SciTech, email bshudson@syr.edu telephone ext. 5805; office hours: M W F 4:00 - 5:00, and by appointment. Textbook: Thermodynamics, Statistical Thermodynamics & Kinetics, third edition by Thomas Engel and Philip Reid (Pearson, 2013).

SYLLABUS

This is the first course in physical chemistry. Physical chemistry is the branch of chemistry that describes, analyzes and explains chemical phenomena in a general way. It is not concerned with describing specific chemical reactions or particular properties of individual chemical substances. Rather, it seeks to explain how properties are related and how they can be explained on the basis of general laws. Some of these laws are macroscopic, like thermodynamics, and some are molecular, like quantum mechanics. Because these laws are usually general and sometimes abstract, they are almost always in mathematical form. The good thing about mathematical laws, as compared to specific chemical properties, is that there is less to remember. On the other hand, memorizing isn't enough: one has to understand what the laws mean in order to know when and how to use them.

The mathematics we need to use the laws is mostly algebra, with a little trigonometry and a little calculus (like knowing how to differentiate and integrate, and understanding when to do one rather than the other). **MAT 286 or MAT 296 are required for registration for CHE 346.** PHYS 212 is a co-requisite, i.e., either you have had or are taking this course. Some students have more trouble with the mathematics than with physical chemistry itself. Even though they can do the mathematical manipulations, they have trouble when the variables are called S and T instead of x and y. Often, remembering what the symbols mean is helpful when deciding what to do with them. We will emphasize the meaning of equations and formulas when we present and use them.

The branches of physical chemistry include thermodynamics, reaction kinetics, quantum chemistry, and statistical mechanics. In this first semester, CHE 346, we are concerned with thermodynamics and its chemical applications. Thermodynamics describes the interactions of energy and matter or, if you take the name literally, the relation between heat and energy. Everybody has heard of the Laws of Thermodynamics, and we will have a lot to say about them in this course. We will discuss the three main laws and try to clarify their meaning by giving chemical applications. Although it is interesting to think about what the laws "really mean", understanding of the Laws comes more from using them rather than from thinking about them. It should be emphasized that only when you can apply thermodynamics to specific problems can you say you really understand it. Thus it is important to be able to work out problems. We will do some problems in class in the limited time we have, and there are worked problems in the text for you to look at, but you have to do problems yourself too in order to adequately understand the subject. The automated problem/answer system "Mastering Chemistry" will be used in this course as a way for you to study the material. This system provides hints for each problem.

The treatment of thermodynamics of the first 2/3 of this class will follow the usual treatment derived directly from experiments at the macroscopic level. This will be followed by what is called “statistical thermodynamics” the derivation of the laws of thermodynamics from a microscopic point of view. If this is attempted using classical mechanics it found that there are discrepancies with macroscopic observations. The use of quantum mechanics removes these difficulties. This will be followed by the related subject of chemical kinetics.

There will be four one - hour examinations and a semi-comprehensive two-hour final exam (see schedule below). The final examination will be on Thursday, December 15, from 12:45 to 2:45 PM, in our regular classroom, 105 Life Sciences. Before each exam, I will give you a set of practice problems and a review sheet listing the topics covered. The exams will consist mostly of problems, like those in Mastering Chemistry but will be shorter. There will also be some short - answer or multiple - choice questions. The best way to study for an exam is to do problems, including the ones on the problem sets and the ones in the book using Mastering Chemistry. There will be no make-ups for the hourly exams. A student with a valid medical excuse, a valid student - athlete excuse or a valid religious observance excuse (travel periods before and after the actual observance are not considered excusable by SU) who has missed one hourly exam, and who has promptly provided written documentation related to the missed exam, can have the averages of the remaining two hourly exams used as the score for the missed hourly exam. (“Prompt” means before the exam, except for medical excuses.) It must be clear from the excuse why the student could not take the exam at the scheduled date and time. No more than one hourly exam can be missed. A student with a second or third "miss" will receive a grade of zero for the missed hourly exam(s). There is no excuse for missing the comprehensive final exam. A student failing to take the comprehensive final exam at the scheduled date and time may gain the right to take a make - up final exam provided that the following conditions are met. The student must have a valid medical excuse, a valid student - athlete excuse or a valid religious observance excuse (travel periods before and after the actual observance are not considered excusable periods). The documentation pertaining to the missed final exam must be promptly presented and reasonable time must be allotted for preparing the make - up final exam. In this case, a comprehensive make up final exam, 2 hours in length, may be taken in place of the excused final exam.

Final course grades will be assigned based on total points earned on the five examinations. Each of the four hour exams will have a total of 100 points. The final exam will count 200 points for a total of 600 possible points. In a recent previous year to get a grade of A or A-, it took about 450/600 total points. It took 375 points to get a grade between B- and B+, and 250 points to get a grade between C- and C+. If your total score is less than 100 points you will not pass this course. Since we grade on a curve, the points this year may be slightly, but not significantly, different.

The topics I will cover are shown in the calendar below. The chapter numbers refer to the Engel & Reid textbook, which we will follow closely. The dates of exams, and the dates on which specific topics are noted.

CHEMISTRY 346 FALL 2016 COURSE OUTLINE

1	M AUG 29	INTRODUCTION & CHAPTER 1
2	W AUG 31	CHAPTER 2 First Law I
3	F SEP 2	CHAPTER 2 First Law II
	M SEP 5	LABOR DAY HOLIDAY NO LECTURE
4	W SEP 7	CHAPTER 3 State Functions I
5	F SEP 9	CHAPTER 3 State Functions II
6	M SEP 12	CHAPTER 4 Thermochemistry
7	W SEP 14	CHAPTER 5 Entropy & the Second Law I
8	F SEP 16	CHAPTER 5 Entropy & the Second Law II
9	M SEP 19	CHAPTER 5 Entropy & the 2nd & 3rd Laws III
10	W SEP 21	FIRST EXAM
11	F SEP 23	CHAPTER 6 Chemical equilibria I
12	M SEP 26	CHAPTER 6 Chemical equilibria II
13	W SEP 28	CHAPTER 6 Chemical equilibria III
14	F SEP 30	CHAPTER 7 Real gasses
15	M OCT 3	CHAPTER 8 Phase diagrams I
16	W OCT 5	CHAPTER 8 Phase diagrams II
17	F OCT 7	CHAPTER 9 Solutions I
18	M OCT 10	CHAPTER 9 Solutions II
19	W OCT 12	CHAPTER 10 Electrolyte solutions
20	F OCT 14	SECOND EXAM
21	M OCT 17	CHAPTER 11 Electrochemical cells, etc. I
22	W OCT 19	CHAPTER 11 Electrochemical cells, etc. II
23	F OCT 21	CHAPTER 11 Batteries, Fuel Cells
24	M OCT 24	CHAPTER 12 Probability
25	W OCT 26	CHAPTER 13 Boltzmann Distribution
26	F OCT 28	CHAPTER 14 Ensembles, Partition Functions I
27	M OCT 31	CHAPTER 14 Ensembles, Partition Functions II
28	W NOV 2	CHAPTER 14 Ensembles, Partition Functions III
29	F NOV 4	THIRD EXAM
30	M NOV 9	CHAPTER 15 Statistical Thermodynamics I
31	F NOV 11	CHAPTER 15 Statistical Thermodynamics II
32	M NOV 14	CHAPTER 16 Kinetic Theory of Gasses I
33	W NOV 16	CHAPTER 16 Kinetic Theory of Gasses II
34	F NOV 18	CHAPTER 17 Transport phenomena
	M-F NOV 21- 25	THANKSGIVING BREAK
35	M NOV 28	review for EXAM 4
36	W NOV 30	FOURTH EXAM
37	F DEC 2	CHAPTER 18 Elementary chemical reactions
38	M DEC 5	CHAPTER 19 Complex reaction mechanisms I
39	W DEC 7	CHAPTER 19 Complex reaction mechanisms II
40	F DEC 9	CHAPTER 19 Complex reaction mechanisms III

FINAL EXAMINATION: THURSDAY 15 DECEMBER 12:45-2:45

For additional help or questions, contact me by email (bshudson@syr.edu) with your question.

Academic honesty is expected of all students. Any incidence of academic dishonesty, as defined by the SU Academic Integrity Policy (<http://academicintegrity.syr.edu>), will result in both course sanctions and formal notification to the relevant College. In this course, students are allowed and encouraged to work and study together, including on the Mastering Chemistry and practice for examination problem sets. Copying on exams is not tolerated.

Disability Accommodation: Students with a disability who may need special accommodations should notify the instructor during the first week of class and have an updated accommodation letter. In order to obtain authorized accommodations, the student must register with the Office of Disability Services (ODS), 804 University Avenue, Room 309, 315 - 443 - 4498. Accommodations and related support services such as exam administration are not provided retroactively and must be requested in advance.

Religious observances policy, http://supolicies.syr.edu/emp_ben/religious_observance.htm, recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holy days according to their tradition. Under the policy, students are required to notify their instructors of any work that may be missed due to a religious observance. For fall and spring semesters, an online notification process is available through MySlice/Student Services/Enrollment/My Religious Observances, from the first day of class until the end of the second week of class. Note that travel periods before and after the actual religious observance are not considered excusable periods for missed work.