Analysis of Equilibrium Systems
Chem 2011
Winter Quarter, 2006
GENERAL INFORMATION

Instructor: Professor Sandra S. Eaton

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office hours	M 10-11 am; T 9-10 am; W 1-2 pm; F 10-11 am

Text: *Exploring Chemical Analysis*, D. C. Harris, W. H. Freeman, 3rd ed., 2005 and *Chemistry*, M. S. Silberberg, McGraw Hill, 4th edition, 2005 or 3rd edition, 2003. (The Silberberg text was used in Chem 1010. Which edition you have will depend on when you took General Chemistry. Reading assignments are shown below for both editions.)

Analysis of Equilibrium Systems (CHEM 2011/2041) provides an introduction to chemical equilibria and kinetics. The emphasis is on aqueous solutions because of their importance in living systems and in environmental science. CHEM 2041, Analysis of Equilibrium Systems Laboratory, is a corequisite for CHEM 2011 and students who register for 2011 are also expected to register for 2041.

Assignments: The tentative lecture schedule, which is given on the following pages, lists the lecture topic and reading assignment for each class meeting. You should read the assignment for each date before coming to class. Working problems is a key part of learning the material for this course - working a problem asks you to apply the principles that we are discussing to concrete examples. It is best to work relevant problems following each lecture to help reinforce what you have read and heard.

- You are expected to work each of the "Ask Yourself" questions in the assigned chapters. Detailed answers to these questions are given at the back of the book.
- You are expected to do the end-of-chapter problems that are listed in the following course outline. These problems will not be collected. Short answers to these problems are given at the back of the book and detailed solutions are given in the Solutions Manual. You will learn more from a problem if you endeavor to work through it before looking at the solutions. If you have difficulty working an assigned problem, look carefully at the detailed solution, then work a related problem to ensure that you understand the material.
- Weekly quizzes will give you feedback on how well you are developing your understanding of the material, and guide your study toward the goals of this course. These quizzes will be based on assigned reading and practice problems and given on Thursdays as shown in the following schedule.

Quantitative Reasoning (Numeracy)

There are basic math skills that you probably were introduced to in high school that are important for success in this class. A list of these skills will be given to you on the first day of class and also is posted in the "class handouts" folder on the Blackboard page for the class. To help you to evaluate your familiarity with these skills you will be given a quiz during the

recitation period on Thursday Jan 5th. If you do not receive a grade of 8 or higher on this quiz, you will need to review the relevant topics and repeat the quiz until you score 8 or higher. Your score on this quiz does not contribute to your grade for the class. Mentors will be available at a help desk on the balcony of the Olin Building to help you review and improve your quantitative reasoning skills throughout the quarter.
Help desk hours will be 3-5 pm Monday – Thursday.

Thursday sessions.

Four types of activities will occur in the Thursday morning sessions.

a. Quizzes will be given as shown below.
b. On some days examples of how to work up data from a laboratory experiment will be discussed.
c. Students will work in groups to solve more complicated than the practice problems from the text.
d. On the days before in-class exams, review sessions will be held.

Date	Quiz?	Topics/activities
Jan. 5	Numeracy skills	Units, significant figures
12	yes	Statistics, least squares analysis of lab data
19	yes	Workup for $Fe(SCN)^{2+}$ lab
26	no	Review for exam
Feb. 2	yes	Buffers
9	yes	Titrations
16	no	Review for exam
23	yes	Polyprotic acids
Mar. 2	no	Review for exam
9	Written part of lab final.	Rate laws and mechanisms

Quizzes and Exams

As shown on the following lecture schedule, there will be three hour-exams and a final exam. One missed hour exam, or your lowest hour exam grade, will be dropped in computing your grade in the course. The final exam will be comprehensive. In addition, there will be 5 in-class quizzes on Thursdays. There will be no make-up quizzes. One missed quiz or your lowest quiz score will be dropped. If you will be off-campus for a University-sponsored activity, such as an athletic event, you are responsible for arranging to take the quiz while you are away, which usually will involve having the quiz faxed to a staff member who will administer it.

Blackboard

Class handouts and answer keys will be available through the web on Blackboard.

Grading

2 hour exams	50% total (25% each)
Quizzes	15%
Final exam	35%

Note that CHEM2041 is graded separately.

Tentative Course Outline

Note: Readings from Harris are denoted with **H**.
Readings from Silberberg 3rd edition are denoted with **S3.**
Readings from Silberberg 4th edition are denotes with **S4** and are essentially the same as in the 3rd edition. You are likely to find that it is helpful to read about the same topics from both the Harris and Silberberg texts.

Date	Topic	Reading	Practice problems
1/4	Units, Species in Solutions	**H**: 13-22 **S3**: 132-136, 344-347 **S4**: 135-139, 351-355	**H:** 1-7, 1-8, 1-10
1/6	Preparing Solutions	**H**: 23-25	**H:** 1-12, 1-13, 1-14, 1-17, 1-21
1/9	Equilibrium Constants	**H**: 25-29 **S3**: 714-723 **S4**: 722-732	**H:** 1-25, 1-28, 1-29
1/11	Statistics	**H**: 71-81	**H**: 4-3, 4-6, 4-13
1/13	Volumetric Analysis	**H**: 109-116	**H**: 6-1, 6-2, 6-6, 6-11
1/16	DU holiday		
1/18	Solubility Product	**H**: 117-120 **S3**: 824-829 **S4**: 832-838	**H**: 6-16, 6-17, 6-20
1/20	Acids and Bases	**H**: 153-156 **S3**: 758-763 **S4**: 768-773	**H**: 8-1, 8-3, 8-4
1/23	Strengths of Acids/Bases	**H**: 156-163 **S3**: 764-771 **S4**: 773-781	**H**: 8-7, 8-10, 8-11
1/25	Weak acid Equilibria	**H**: 163-167 **S3**: 772-776 **S4**: 782-785	**H**: 8-15, 8-17, 8-20, 8-23
1/27	Exam I	covers material through 1/23	
1/30	Weak Base Equilibria	**H**: 167-169 **S3**: 779-784	**H**: 8-27, 8-28, 8-31, 8-32

		S4: 788-793	
2/1	Buffers	**H**: 175-181 **S3**: 806-812 **S4**: 814-820	**H**: 9-3, 9-6, 9-8, 9-9
2/3	Preparing Buffers	**H**: 181-185 **S3**: 813-814 **S4**: 821-823	**H**: 9-12, 9-17, 9-22
2/6	Indicators	**H**: 185-189 **S3**: 815-816 **S4**: 824-825	**H**: 9-21, 9-25
2/8	Strong acid/base titrations	**H**: 193-196 **S3**: 816-818 **S4**: 825-827	**H**: 10-1, 10-6, 10-7
2/10	Weak acid titrations	**H**: 196-200, 209-211 **S3**: 818-821 **S4**: 827-829	**H**: 10-2, 10-8, 10-11, 10-12, 10-20
2/13	Weak base titrations, and endpoints	**H**: 200- 205, 211 **S3**: 821-822 **S4**: 830	**H**: 10-3, 10-15, 10-17
2/15	Polyprotic acids and bases	**H**: 219-228 **S3**: 776-779 **S4**: 786-788	**H**: 11-2, 11-7, 11-11
2/17	Exam II	Covers material from 1/25 to 2/13	
2/20	Identifying principal species	**H**: 228-231	**H**: 11-14, 11-15, 11-16, 11-17
2/22	Polyprotic titrations	**H**: 231-237 **S3**: 822-823 **S4**: 830-831	**H**: 11-25, 11-30, 11-31
2/24	Effect of ionic strength	**H**: 243-251	**H**: 12-2, 12-9, 12-10, 12-14
2/27	Charge and mass balance	**H**: 251-259	**H**: 12-23, 12-28, 12-29
3/1	EDTA titrations	**H**: 265-275	**H**: 13-1, 13-8, 13-9
3/3	Exam 3	Covers material from 2/15 to 3/1	

3/6	Chemical kinetics, rate laws	**S3**: 664-677 **S4**: 672-686	**S4**: 16.20, 16.28, 16.34, 16.38, 16.45
3/8	Chemical kinetics, temperature dependence	**S3**: 677-691 **S4**: 686-700	**S4**: 16.50, 16.51, 16.62
3/10	Chemical kinetics, mechanisms	**S3**: 691-699 **S4**: 700-708	**S4**: 16.72, 16.74, 16.75
3/13	Summary examples		
3/15	Final exam 8:00 - 9:45 am	Comprehensive	