

**Analysis of Equilibrium System  
CHEM 2011-2 (CRN 2441)  
Winter Quarter, 2013**

**Instructor:** Dr. J. Alex Huffman  
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**Class Time:** MWThF, 9:00 – 9:50 AM  
**Class Location:** Olin 105  
**Office Hours:** MW 11:00 AM – 12:00 PM, Th 10:00 – 11:00 AM (may be changed *with* notice)  
Other times by arrangement; walk-in by availability

**REQUIRED COURSE ITEMS**

**Textbook:** *Quantitative Chemical Analysis*, 8<sup>th</sup> Ed., by Daniel C. Harris; Freeman Publ. (QCA)  
**Calculator:** You will need an inexpensive calculator that has the capability for square roots, logarithms, and exponents. You are responsible for understanding how to perform these operations on your calculator. Please bring your calculator with you to every class. Electronics with memory (laptops, cell phones, etc.), however, will NOT be allowed during exams and quizzes.

**SUPPLEMENTAL COURSE ITEMS**

**Textbook:** Any modern General Chemistry text will be sufficient. Reading assignments are listed in the course schedule for text (1) and will be provided later for text (2). A scan of requisite chapter readings from (1) will be provided on blackboard online.  
(1) *Chemistry*, 6<sup>th</sup> Ed., M. Silberberg; McGraw Hill Publ.  
(2) *Chemistry*, 3<sup>rd</sup> Ed., T. Gilbert et al.; Norton Publ. (used for CHEM 1010)  
**Solutions Manual:** *Solutions Manual for Quant. Chemical Analysis*, 8<sup>th</sup> Ed., D. C. Harris

**COURSE DESCRIPTION**

Analysis of Equilibrium Systems is the fifth course in the six quarter freshman/sophomore chemistry sequence. The course is an introduction to chemical equilibria and kinetics. Chemical equilibria will focus on aqueous systems, starting with simple systems. Discussions will progress to advanced applications of complex equilibria, including examples from biological and environmental systems.

Please pace yourself and work continuously. Even if you think a topic is easy I recommend that you put in time to make sure you understand details not discussed in lecture. Working more steadily will show both better results and lower stress! Students are expected to put in 2-3 hours outside of class per course credit hour. This means that for CHEM 2011 you should be prepared to spend ~6-9 hours outside of class.

**LECTURE**

The format of the class meetings will follow traditional lecture format on MWF. I will summarize new material and present illustrations and examples. You will be encouraged to practice problems during and after lectures. I will NOT be able to identify and describe every detail you will read in the text and any supplemental materials. However, I will emphasize important topics covered in the reading as well as problem solving strategies when appropriate. Please stop me at any time if you have questions.

The Thursday (Th) recitation meeting will be devoted to quizzes, problem solving, and group activities. No new lecture material will be covered on these days. However, material from the lecture will be explored in greater detail. A short quiz may be administered at each meeting. We will work on specific “challenge problems” in small groups, go over spreadsheet applications, and discuss exam solutions.

## OFFICE HOURS & TA HELP ROOM

I have posted hours when I will be available in my office for questions or issues related, or unrelated, to the course. These hours may be changed, if necessary, during the quarter, but this will be announced during lecture. I can easily arrange to meet you at other times, but please email me to set up a time. You are welcome to stop by my office at any time, however, I may be unavailable unless otherwise arranged.

Graduate teaching assistants (TAs) will staff a help room during key hours each day of the work week. If you find yourself needing additional help on course or prerequisite material I may direct you to work additionally on some of these skills with a TA.

## READING

You are encouraged to compete the assigned reading prior to the class lecture and often again after the lecture. In addition, you are also encouraged to attempt the example exercises throughout the text while completing the assigned reading. I recommend that you understand the material and how to solve the sample problems before proceeding to the next section. At the end of each chapter, a summary of important equations and terms is provided that should prove helpful in preparation for quizzes and exams.

## GRADED ASSIGNMENTS

Challenge problems will be assigned periodically during the course to be turned in for a grade. Some of these will be individual efforts and others will require group work. These problems are more difficult than the suggested book problems, and may require significant effort on your part. These problems may be assigned for completion during recitation periods or for completion out of classroom hours.

## PROBLEM SETS

Problem solving is an important component of all chemistry and most science courses. For most students, successfully solving problems requires practice. In addition to completing the example exercises in the text, I will post problem sets to help you practice. These will not be graded, but the solutions will also be posted. Quiz problems will come directly from these problem sets and exam questions will closely follow the specific lessons practiced through these exercises. I strongly suggest that you consider these as mandatory work and I recommend that you finish all of them. In some cases during office hour discussions I may suggest that you complete these problems before I answer your questions in detail.

## QUIZZES

Quizzes will be administered most weeks during Thursday recitations sections. The quizzes will be short (10-20 minutes), and will cover material from the preceding 1-4 lectures. Quiz questions will come directly from posted problem sets. An *estimated* six to nine (6-9) quizzes will be given throughout the course. Your lowest two to three (2-3) quiz scores (as specified later; approx. 33% of final total of quizzes) will be automatically dropped and only the scores on the remaining quizzes will comprise the "Quiz" portion of your final grade. Because of this **there will be NO make-up quizzes**. If there is a conflict of which I should be aware, please see me in the first week of class.

## EXAMS

Four (4) exams will be given during the quarter: three hour exams and a final. Exam problems will be similar to the problems given in the weekly quizzes and to those found on the problem sets. The lowest score from the three hour-exams will be automatically dropped, and only the top two (2) hour-exam scores will be counted towards the final course grade. **Under NO circumstances may the final be dropped or taken early.**

If you will be out of town for a University sanctioned function (e.g. athletic team or music group), you are responsible for making arrangements with Dr. Huffman at least one week in advance to take the quiz or an hour exam early. **Only in extremely extenuating circumstances, and with required documentation (e.g., letter from Student Health), will a make-up hour exam be given.**

## GRADES

At the end of the quarter, you will be graded according to your performance on cooperative learning activities and assignments, quizzes, and examinations. Cooperative learning is encouraged. Your final grade will be determined by the percentage with the following components and scale. I will not grade on a curve, but grades in both course sections will be monitored and may be slightly increased in some cases.

Component	Percentage
Assignments	10%
Quizzes	25%
Hour Exams (top 2 scores at 20% each)	40%
Final Exam	25%
<i>Total</i>	<i>100%</i>

Grade	Percentage
A	93.0 - 100
A -	90.0 - 92.9
B +	87.0 - 89.9
B	83.0 - 86.9
B -	80.0 - 82.9
C +	75.0 - 79.9
C	69.0 - 74.9
C -	65.0 - 68.9
D +	62.0 - 64.9
D	58.0 - 61.9
D -	55.0 - 57.9
F	< 54.9

## DISRUPTIONS

Tardiness is disruptive – please try to be to class on time and if you *must* leave early, please advise Dr. Huffman before class starts.

## CELLULAR PHONE AND MOBILE DEVICE POLICY

I respect the need for each individual to stay in contact with family and friends. The use of mobile devices, however, is disruptive to the learning environment. Thus, I request that the ringers of all cellular phones, pagers, and other mobile devices be muted during class. If an emergency arises, and you need to make a call on your phone, I request that you quietly leave the room and conduct your conversation out in the hallway.

## LECTURE AND TESTING ACCOMMODATIONS

I will make every effort to accommodate students diagnosed with a learning disability. I will do this in complete confidence. I request that any student requiring these accommodations inform me the first week of class. For further information, please see the University Disability Services' website:

<http://www.du.edu/disability/dsp/index.html>.

## ACADEMIC DISHONESTY & STUDENT SUPPORT

While I advocate collaborative learning and teamwork, I also firmly believe that each individual should maintain the highest ethical standards in all of life's endeavors. As such, I support and will strictly enforce the Honor Code of the University of Denver. See links for specific links below:

Pioneer Pledge: <http://www.du.edu/studentlife/ccs/pledge.html>

Honor Code Statement: [http://www.du.edu/studentlife/ccs/honor\\_code\\_2011-2012.pdf](http://www.du.edu/studentlife/ccs/honor_code_2011-2012.pdf)

I also understand that every student has unique personal and educational needs. I will do my best to help you learn or appropriately facilitate your ability to work through personal issues. Please see the Office of Student Life (<http://www.du.edu/studentlife/ccs/index.html>), including the Pioneer Care program (<http://www.du.edu/studentlife/care/>), for more detailed resources.

## IMPORTANT DATES

January 7: Classes begin, Winter Quarter

January 11: Last day to register without approval

January 21: Martin Luther King Holiday (no class)

February 15: Last day to drop with "W" without approval (6<sup>th</sup> week)

March 13: Last day of classes

**March 16 (SATURDAY): Final Exam, 8:00 – 9:50 AM**

## TENTATIVE SCHEDULE

Important Note: Schedule is approximate. Dates of hour exams may be changed, but with appropriate notice.

Meeting #	Lecture #	Date	Week-day	Topic	Reading Section	Reading Pages
1	1	Jan 7	M	Introduction to equilibrium; reversibility	<i>QCA</i> : 6.1-6.2	117-121
2	2	Jan 9	W	Q, Kc, Kp; Disturbing equilibrium (Le Chatelier)	<i>QCA</i> : 6.1-6.2	117-121
3	<i>R1</i>	Jan 10	Th	Recitation and Quiz		
4	3	Jan 11	F	Le Chatelier; Temperature; Brønsted acid	<i>QCA</i> : 6.5-6.6	126-130
5	4	Jan 14	M	Acids & conjugate pairs	<i>QCA</i> : 6.7	130-137
6	5	Jan 16	W	ICE tables; K <sub>sp</sub> ; Common ion effect	<i>QCA</i> : 6.3-6.4	121-126
7	<i>R2</i>	Jan 17	Th	Recitation and Quiz		
8	6	Jan 18	F	K <sub>sp</sub> ; Predicting precipitation	<i>QCA</i> : 6.3-6.4	121-126
-	-	Jan 21	M	<i>MLK Jr. Holiday - Official DU Holiday - No Class</i>	-	-
<b>9</b>	<b>E</b>	<b>Jan 23</b>	<b>W</b>	<b>HOURLY EXAM #1</b>		
10	<i>R3</i>	Jan 24	Th	Recitation and Quiz		
11	7	Jan 25	F	Strong acids & bases; weak acid/base equilibria	<i>QCA</i> : 8.1-8.2	162-166
12	8	Jan 28	M	Systematic treatment of equilibria	<i>QCA</i> : 7.4-7.5	150-158
13	9	Jan 30	W	Dilute or weak acid calculations	<i>QCA</i> : 8.3-8.4	166-171
14	<i>R4</i>	Jan 31	Th	Recitation and Quiz		
15	10	Feb 1	F	Dilute or weak acid calculations	<i>QCA</i> : 8.3-8.4	166-171
16	11	Feb 4	M	Buffers; Henderson-Hasselbach equation	<i>QCA</i> : 8.5	171-181
17	12	Feb 6	W	Making, adding acid or base to buffer	<i>QCA</i> : 8.5	171-181
18	<i>R5</i>	Feb 7	Th	Recitation and Quiz		
<b>19</b>	<b>E</b>	<b>Feb 8</b>	<b>F</b>	<b>HOURLY EXAM #2</b>		
20	13	Feb 11	M	Polyprotic acids	<i>QCA</i> : 9.1-9.3	185-195
21	14	Feb 13	W	Polyprotic acids/bases	<i>QCA</i> : 9.1-9.3	185-195
22	<i>R6</i>	Feb 14	Th	Recitation and Quiz		
23	15	Feb 15	F	Principle species; Introductory to titrations	<i>QCA</i> : 9.4-9.6	195-201
24	16	Feb 18	M	Titration of weak monoprotic acids/bases	<i>QCA</i> : 10.1-10.3	205-212
25	17	Feb 20	W	Titration of diprotic systems	<i>QCA</i> : 10.4	212-215
26	<i>R7</i>	Feb 21	Th	Recitation and Quiz		
27	18	Feb 22	F	Ionic strength; Activity	<i>QCA</i> : 7.1-7.3	142-150
28	19	Feb 25	M	Calculating with activity	<i>QCA</i> : 7.1-7.3	142-150
29	20	Feb 27	W	Introduction to kinetics	<i>Silb</i> : 16.1-16.2	626-634
30	<i>R8</i>	Feb 28	Th	Recitation and Quiz		
<b>31</b>	<b>E</b>	<b>Mar 1</b>	<b>F</b>	<b>HOURLY EXAM #3</b>		
32	21	Mar 4	M	Kinetics: reaction rates	<i>Silb</i> : 16.1-16.2	626-634
33	22	Mar 6	W	Kinetics: rate laws	<i>Silb</i> : 16.3-16.4	634-648
34	<i>R9</i>	Mar 7	Th	Recitation and Quiz		
35	23	Mar 8	F	Kinetics: integrated rate laws	<i>Silb</i> : 16.3-16.6	634-714
36	24	Mar 11	M	Kinetic theories and mechanisms	<i>Silb</i> : 16.7-16.8	714-726
37	25	Mar 13	W	Course review		
<b>38</b>	<b>-</b>	<b>Mar 16</b>	<b>Sa</b>	<b>FINAL EXAM, 8:00 - 9:50 AM</b>		

- *QCA* = *Quantitative Chemical Analysis* by Harris, 8<sup>th</sup> Ed.

- *Silb* = *Chemistry* by Silberberg, 6th Ed.

- Reading schedule will be provided later using *Chemistry*, 3<sup>rd</sup> Ed. by Gilbert, Kirss, Foster, Davies