

Analytical Chemistry I
Course # 004:111:0001 (CHEM:3110)
Syllabus

I. Logistics

Instructor	Professor Betsy Stone Chemistry Building W376 Tel. (319) 384-1863 betsy-stone@uiowa.edu
Instructor Office Hours	11:30 – 1:00pm Monday and Friday By appointment
Class Location/Time	W107 PBB 10:30 – 11:20am MWF
Grader and Office Hours	Zhenzhu Xu Chemistry Building E208 12:30 – 2:30pm Tuesday

II. Course Description and Objectives

Description	Analytical Chemistry I is targeted at students pursuing higher education in the chemical sciences. The goal of this course is for students to master applying concepts and solving problems in analytical chemistry, with an emphasis on solution equilibria and electrochemistry.
Objectives	Throughout this course, we will focus on the following learning objectives: <ol style="list-style-type: none">1. Understand the fundamental concepts of chemical equilibrium2. Parameterize solution behavior and calculate solution concentrations given the appropriate equilibrium constants3. Apply knowledge of equilibrium constraints to a range of systems of interest including solubility, acid/base chemistry, complex formation, oxidation/reduction, hydrolysis, and phase partitioning.4. Investigate solution behavior using electrochemical methods, including potentiometry, voltammetry, and ion selective electrodes.
Prerequisite	The background needed for successful completion of this course

Skill Set includes first-year chemistry, stoichiometry, algebra, spreadsheet skills, and interpretation of chemical information.

Co-requisite Coursework 004:131 or 004:132, if not taken as a prerequisite

III. Course Outline

1. Introduction and Review

- a. The Analytical Process
- b. Chemical Measurements
- c. Experimental Error

2. Chemical Equilibrium, Part 1 (Fundamentals, Acids, and Bases)

- a. Chemical Equilibrium
- b. Activity and the Systematic Treatment of Equilibrium
- c. Monoprotic Acid-Base Equilibria
- d. Polyprotic Acid-Base Equilibria
- e. Acid-Base Titrations

3. Electrochemistry

- a. Fundamentals of Electrochemistry (and Appendix D)
- b. Electrodes and Potentiometry
- c. Redox Titrations
- d. Electroanalytical Techniques

4. Chemical Equilibrium, Part 2 (Complexation, Precipitation, Advanced Topics)

- a. EDTA Titrations
- b. Gravimetric Analysis, Precipitation Titrations, and Combustion Analysis
- c. Advanced Topics in Equilibrium

Required Text *Quantitative Chemical Analysis*, Daniel C. Harris, 8th edition, W. H. Freeman and Company, 2010. The textbook and an optional *Solutions Manual* are available at the bookstore.

Students opting to use an earlier edition of the book will be held responsible for material in the 8th edition. Appendix 1 lists course topics and the corresponding chapters in the 8th and 7th editions.

Course Website The course website is under ICON (<http://icon.uiowa.edu>). Login with your username and password. Announcements, syllabus, course content, supplemental readings, and grades will be posted here. Please check for homework updates that may contain clarifying information.

Practice Problems Appendix 1 lists problems from the course textbook (8th and 7th editions) and are recommended to practice applying concepts and problem solving skills. These problems will not be collected or graded. Answers to some of these problems may be found in the textbook; the optional *Solutions Manual* will contain detailed solutions.

IV. Grading

Grading Scheme Your final course grade will be based on *total points earned* for exams, quizzes, and assignments. The course components are scored as followed:

3 mid-semester exams	450 points	(45%)
Final exam	200 points	(20%)
Assignments*	250 points	(25%)
Quizzes*	100 points	(10%)
Total	1000 points	(100%)

*There will be 6 problem sets and 5 quizzes. Your 5 best-scoring problem set grades and 4 best quiz grades will be used in your final grade calculation; the lowest scores will be dropped.

Letter Grades	A range	90-100%
	B range	80-90%
	C range	70-80%
	D range	60-70%
	F range	< 60%

The lower limits for letter grades may be adjusted, but will never be raised. For example, the A range for final grades may be 88-100%, but will not be 95-100%. Plus or minus grades will be appended to letter grades.

Problem Sets There will be 6 graded problem sets in this course. Problem sets are designed to highlight important concepts and practice problem-solving skills. They are intended to be challenging and will require time and thought. Do not wait until the last minute to start on these assignments.

A complete assignment will show all work, clearly state all assumptions, and provide clear and concise explanations when asked. Numerical answers must be reported with the correct number of significant figures and units. Graphs must be properly titled and all axes must be labeled. Written explanations shall be given in complete, grammatically-correct sentences.

Problem sets are due at the start of class. Assignments turned in late will be penalized 10 points per day and will only be accepted 48 hours beyond the original due date.

Exams

There will be four exams in this course. Three mid-term exams will be held on Thursday evenings (following the schedule in Appendix 2) and will cover the following material:

Exam 1: The Analytical Process, Chemical Measurements, Experimental Error, Chemical Equilibrium, Activity, The Systematic Treatment of Equilibrium

Exam 2: The Systematic Treatment of Equilibrium, Monoprotic Acid-Base Equilibria, Polyprotic Acid-Base Equilibria, Acid-Base Titrations

Exam 3: Fundamentals of Electrochemistry (and Appendix D), Electrodes and Potentiometry, Redox Titrations, Electroanalytical Techniques

The **final exam** is cumulative and will be held during final exam week. The time and location of the final exam will be announced.

Quizzes

There will be 5 in-class quizzes on dates to be announced. Quizzes will test student knowledge of central concepts, ability to synthesize information, and quantitative analysis skills. They are intended to test student understanding of course material prior to exams.

Re-grading

Adjustments to grades will only be considered within one week after an assignment or exam is returned. The re-grade request must be accompanied by a written, detailed description of the grading concern. Re-grading will involve re-assessment of the entire assignment and may increase or decrease of the grade.

Extra Credit

Any extra credit will be given at the discretion of the instructor. Extra credit opportunities may appear in the form of classroom participation, pop-quizzes, or exam questions.

V. Course Conduct

Attendance

Attendance is mandatory for all exams and quizzes. In the case of an excusable absence (e.g. illness, mandatory religious obligation, certain University activities, or unavoidable circumstances), an [Explanatory Statement of Absence](#) must be provided to the instructor in advance of foreseeable absences or within 72 hours of unforeseeable absences. For class periods, attendance is *expected*.

Preparedness	Students are expected to be prepared for class to start at 10:30AM sharp. Students are expected to be prepared to participate in class activities, having read the assigned textbook chapter(s), and should have a calculator, writing utensils, and class notes.
Classroom Etiquette	Students shall conduct themselves in a manner that will not disrupt the learning of other students. Cell phones may not be used in class for any reason. All personal devices must be silenced prior to the start of class. Students may not use internet in class, unless instructed.
Exam Conduct	<p>Calculators: Programmable calculators or calculators on mobile devices are not permitted. Students are encouraged to use a non-programmable calculator with scientific notation and logarithm capabilities. If such a calculator is not available, contact the instructor 24 hours in advance of the exam to request to borrow a permissible calculator.</p> <p>Time Limit: Exams are limited to the allotted two-hour period and time limits are strictly enforced. Please show up on time for exams and turn in your exam promptly at the end of the period when asked.</p> <p>Personal Belongings: During exams, all personal belongings, including books, bags, notes, mobile devices, and computers, must be fully enclosed in backpacks and left at the front of the room.</p>
Homework Assignments	<p>The homework for this course is designed to help you master your knowledge related to the topics covered during lecture. As such, you may work on the homework problems with others or use online resources.</p> <p>The work that you turn in must be <i>your own</i>. Keep in mind:</p> <ul style="list-style-type: none"> • You may not copy from one another. • For computer-based assignments, each student is responsible for generating and developing their own files. (For example, one spreadsheet generated in collaboration by two individuals does not constitute individual work and is <i>not acceptable</i>.) <p>Any questions about what constitutes acceptable student collaboration should be directed to the instructor.</p>
Expected Workload	This is a 3 credit hour course, so under University policy you should expect (on average) to spend 6 additional hours on this course outside of classroom time per week.

VI. Administrative Details

Chemistry Center Chemistry Building E225

(319) 335-1341

Here, you may obtain signatures to add/drop chemistry courses.

**Department of
Chemistry Office**

Mark Arnold, Departmental Executive Officer
Chemistry Building E331
(319) 335-1350

**Administrative
Home**

The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at <http://clas.uiowa.edu/students/handbook>.

**Electronic
Communication**

University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondences ([Operations Manual, III.15.2](#), k.11).

**Accommodations
for Disabilities**

A student seeking academic accommodations should first register with Student Disability Services and then meet privately with the course instructor to make particular arrangements. See www.uiowa.edu/~sds/ for more information.

**Academic
Honesty**

All CLAS students or students taking classes offered by CLAS have, in essence, agreed to the College's [Code of Academic Honesty](#): "I pledge to do my own academic work and to excel to the best of my abilities, upholding the [IOWA Challenge](#). I promise not to lie about my academic work, to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty." Any student committing academic misconduct is reported to the College and placed on disciplinary probation or may be suspended or expelled ([CLAS Academic Policies Handbook](#)).

**CLAS Final
Examination
Policies**

The final examination schedule for each class is announced by the Registrar generally by the tenth day of classes. Final exams are offered only during the official final examination period. *No exams of any kind are allowed during the last week of classes.* All students should plan on being at the UI through the final examination period. Once the Registrar has announced the date, time, and location of each final exam, the complete schedule will be published on the Registrar's web site and will be shared with instructors and students. It is the student's responsibility to know the date, time, and place of a final exam.

**Making a
Suggestion or a
Complaint**

Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. Complaints must be made within six months of the incident (CLAS

[Academic Policies Handbook](#)).

- Understanding Sexual Harassment** Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI [Comprehensive Guide on Sexual Harassment](#) for assistance, definitions, and the full University policy.
- Reacting Safely to Severe Weather** In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the [Department of Public Safety website](#).

*These CLAS policy and procedural statements have been summarized from the web pages of the [College of Liberal Arts and Sciences](#) and The University of Iowa [Operations Manual](#).

Appendix 1: Units, Topics, Chapters, and Practice Problems

Unit and Topics	Harris, 8 th Edition		Harris, 7 th Edition	
	Ch.	Practice Problems	Ch.	Practice Problems
1. Introduction and Review				
The Analytical Process	0	1, 2, 3, 4, 5, 6	0	1, 2, 3, 4, 5, 6
Chemical Measurements	1	A-E, 3, 4, 7, 11, 13, 14, 19, 20, 26, 28, 33, 37, 45, 46	1	A-C, 3, 4, 7, 11, 13, 14, 19, 20, 26, 28, 33
Experimental Error	3	A, 4, 7, 9, 10, 12-14	3	A, 4, 7, 9, 10, 12-14
Review (Appendices)	A, B, D	<i>as needed</i>	A, B, D	<i>as needed</i>
2. Chemical Equilibria, Part I				
Chemical Equilibrium	6	A, B, E-H, K, 4, 5, 8, 10, 14, 19, 25, 30, 39	6	A, B, E-H, K, 4, 5, 8, 10, 14, 19, 25, 31, 40
Activity and the Systematic Treatment of Equilibrium	7	A-I, 2, 11, 16-19, 21, 25, 30	8	A-I, 2, 11, 15-18, 20, 24, 28
Monoprotic Acid-Base Equilibria	8	A-I, 2, 3, 6, 10, 14, 23, 32-34, 36, 44, 45	9	A-I, 2, 3, 6, 10, 14, 23, 32-35, 43, 44
Polyprotic Acid-Base Equilibria	9	A-F, 4-6, 11, 13, 16, 19, 24-26, 28, 29, 31, 32	10	A-F, 4-6, 10, 11, 14, 17, 22-24, 26, 27, 29, 30
Acid-Base Titrations	10	A, C, F-I, 1, 2, 4, 6, 10, 14, 15, 23, 34, 35, 45, 47, 60, 61, 64, 73	11	A, C, F-I, 1, 2, 4, 6, 10, 14, 15, 23, 34, 35, 45, 47, 57, 58, 61, 70
3. Electrochemistry				
Fundamentals of Electrochemistry	13	A-C, E, I, 1, 3-6, 8, 12, 17, 22, 24, 25, 29	14	A-C, E, I, 1, 3-6, 8, 12, 17, 22, 24, 25, 29
Electrodes and Potentiometry	14	D-F, 2, 4, 5, 26, 34, 40	15	D-F, 2, 4, 5, 27, 35, 41
Redox Titrations	15	A, B, D, 3, 5, 7, 15, 16, 19	16	A, B, E, 3, 5, 7, 15, 16, 19
Electroanalytical Techniques	16	A-D, F, G, 2, 9, 10, 17, 24, 27, 30, 32-35	17	A-D, F, G, 2, 9, 10, 16, 23, 26, 29, 31-34
4. Chemical Equilibria, Part 2				
EDTA Titrations	11	A-E, 3, 4, 6, 15, 17, 24, 32	12	A-E, 3-5, 14, 16, 23, 31
Gravimetric Analysis, Precipitation Titrations, and Combustion Analysis	26	A, B, 10, 16, 18, 22, 35	27	A, B, 10, 16, 18, 21, 34
Advanced Topics in Equilibrium	12	A, F, 1, 7, 11	13	A, F, 1, 7, 11

Appendix 2: Exam Schedule, Fall 2013

Exam	Date	Time	Location
Exam 1	September 19	6:30-8:30 PM	W128 CB
Exam 2	October 17	6:30-8:30 PM	W128 CB
Exam 3	November 14	6:30-8:30 PM	W128 CB
Final Exam	TBA	TBA	TBA