

CHEMISTRY 232 - ANALYTICAL CHEMISTRY
COURSE SYLLABUS
SPRING 2009

INSTRUCTOR:

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OFFICE HOURS:

Mon. 8:45-9:45
Tues. 1:45-2:45
Wed. 8:45-9:45
(or whenever I'm around)

THEME: Analytical chemistry is the branch of chemistry which typically asks two questions: “What?”, and “How Much?”. In other words, analytical chemists seek to identify the components of a mixture, and/or determine the amount of one or more of these components. Within this context a strong course emphasis will be on the development of the skills necessary to succeed as a professional chemist (e.g., laboratory skills, report writing, oral communication, computer literacy).

TIME: *Lecture:* MWF 11:50-1:00, Ivers 380; *Lab:* T 8:30am-6pm, Ivers 362

COURSE WEB PAGE: <http://www4.cord.edu/chemistry/jensen/chem232/> - This page is directly accessible from my homepage. It contains links to the course syllabus, PowerPoint slides, lab information, the assignment schedule, exam keys, old exams, and other information related to the course. Every attempt will be made to keep this page as up-to-date as possible.

REQUIREMENTS:

Text: *Quantitative Chemical Analysis*, by D.C. Harris (7th Edition), W.H. Freeman, 2007.
Analytical Chemistry Laboratory Manual (Spring '09), available from the Chem Club.

Lab Supplies: Goggles and a laboratory notebook with numbered pages are required.

Calculator: A scientific calculator *with an equation solver* is required. I recommend a Texas Instruments model TI-83 or higher.

GRADES: The course grade will be based on the total points accumulated from four regular exams, a final exam, homework/quizzes, lab reports, and a literature presentation. Each of these is weighted as follows:

Exams 1-4	40 %	(10 % each)
Final Exam	10	
Lab	20	
Quizzes	15	
Homework	10	
<u>Literature Presentation</u>	<u>5</u>	
TOTAL	100 %	

The “guaranteed” grading scale is as follows: A- : 91% B- : 81% C- : 71% D- : 61%
The guarantee is that while these cutoffs MAY go down, they WILL NOT go up.

EXAMINATIONS: There will be four examinations held during the regular class time. Most of these exams will also include a take-home portion. The dates for the in-class portions of the exams are:

January 21, February 11, March 18, and April 20

Make-up exams will be allowed **only** for **documented** illnesses or absences approved in advance! At the end of the semester I will take your lowest score from Exams 1-4 and weight it only half as much as the other three.

The ACS-standardized final exam will be held at the time indicated by the college's final exam schedule: **Thursday, April 30 at 11:00 a.m.**

LAB: Specific information about laboratory policies and procedures will be given in the lab manual.

QUIZZES: At the end of **each** class period a short 5-point quiz will be given. Each quiz will consist of 1-2 questions based on the material covered in the previous lecture. In case you have to miss a class, I will allow you to take a quiz before the rest of the class, but not after. At the end of the semester the lowest *five (5)* quiz scores will be thrown out.

HOMEWORK: A homework assignment consisting of chapter-end problems will be given as we begin each new chapter. We will decide on due dates for each assignment and assignments are due at the start of class on the due date. Each non-spreadsheet assignment is worth 20 points: Two problems will be graded at 5 points each, and 10 points will be given for completion of the entire assignment. Spreadsheet problems are worth 10 points each. I allow you to turn in three (3) assignments up to one week late at no penalty. After these three, no late assignments will be accepted.

LITERATURE PRESENTATION: As an introduction to the chemical literature, I'm asking that each of you select one *research* article (no correspondences, or technical notes) from a 2006-2009 issue of the journal *Analytical Chemistry* which deals in some way with a topic we have covered or will cover. (We have full on-line access to this journal!) You will make a PowerPoint presentation over the contents of this article during the last week of labs. It is important that you select an article that you understand *thoroughly*. Your presentation should last 12-14 minutes, plus some time for questions at the end. *I must OK the article you want to use*, since I don't want two people reviewing the same article. When submitting an article for approval, I ask that you also give me a copy of the abstract. Prior to your presentation you must also provide me with a copy of your PowerPoint slides, preferably in the "Handouts" format from the Print menu.

SEMINAR ATTENDANCE: The chemistry department has instituted a seminar attendance policy in each of its courses. Each student in a chemistry course is required to attend a certain number of chemistry seminars, the exact number of which is determined by the course instructor. I am asking that you attend **both Werth Lectures plus three (3) more chemistry seminars** this semester. Make sure your attendance is properly recorded. Each seminar will count as a homework grade (20 pts each). In addition to the Werth Lectures, scheduled seminars include senior seminars and chemistry/physics colloquia.

E-MAIL LISTSERVE: An e-mail listserv will be set up for this class (chem232@cord.edu) and you will be automatically subscribed. Feel free to use this list whenever you have a question or comment for the entire class. I'll use this list frequently to communicate with the class, so be sure to check your email at least once a day.

ACADEMIC INTEGRITY: Each student is expected to adhere to the policies outlined in the college's academic integrity handbook. Cheating of any kind will not be tolerated. Students will be asked to consider signing an integrity pledge on each quiz/examination. This pledge reads as follows:

"I affirm that I have neither committed nor witnessed a violation of academic integrity in the completion of this quiz/examination."

Any student found to have violated academic integrity will receive no credit (0 points) for the particular quiz/exam in question. A second offense will lead to automatic removal from the course. For any violation of academic integrity a report outlining the nature of the violation, as well as the consequences levied, will be sent to the Academic Dean's Office.

Working through laboratory data is often better accomplished in a group setting. Please feel free to work together on laboratory calculations, as long as lab reports are the work of the individual. I also encourage group efforts in completing homework assignments. Often it is common to copy the work of another, with that person's consent, in completion of a particular problem. This IS acceptable. The focus, however, should be on the understanding, not just the completion, of the assignment.

CONCORDIA'S GOALS FOR LIBERAL LEARNING:

1. Instill a love for learning
2. Develop foundational skills and transferable intellectual capacities
3. Develop an understanding of disciplinary, interdisciplinary, and intercultural perspectives, and their connections
4. Cultivate an examined cultural, ethical, physical, and spiritual self-understanding
5. Encourage responsible participation in the world

DEPARTMENT GOALS: The Chemistry Department faculty has agreed upon the following list of goals that graduating seniors are to develop by the time they complete the chemistry major. The goals particularly emphasized in this course are shown in *italics*.

A chemistry major should:

1. *Have a firm understanding of the core principles of chemistry as they apply to each of the major subdivisions of the discipline.*
2. *Be able to effectively communicate their knowledge of the field, both through writing and speaking.*
3. *Be comfortable and competent in the use of modern technology for the acquisition, analysis, and presentation of chemical data and information.*
4. *Possess good problem-solving skills, and be able to apply these skills both independently and collaboratively.*
5. *Be able to gather experimental data safely and accurately using a wide variety of laboratory instruments and methods.*
6. *Be able to apply their knowledge of chemistry to the explanation and interpretation of new or unfamiliar chemical information.*
7. *Be able to select, interpret, and utilize relevant scientific literature from a variety of sources including libraries, electronic databases, and the Internet.*
8. *Understand and honor the ethical issues related to the use and misuse of chemical information and materials.*
9. Be able to apply their knowledge and skills to professional experiences such as teaching, conducting research, and participating in internships.
10. *Gain an understanding of the relationship of chemistry to other sciences and to the needs of society as a whole.*

COURSE SCHEDULE

<u>DATE</u>	<u>LECTURE</u>	<u>LAB</u>
Jan 5 7 9	Chapter 1 – Measurements Chapter 3 – Experimental Error	#1: Statistical Comparison of Titration Techniques
12 14 16	Chapter 4 – Statistics	#2: Statistical Evaluation of Acid/Base Indicators
19 21 23	Chapter 5 – Quality Assurance and Calibration Methods EXAM I – Chapters 0, 1, 2, 3, 4	#3: Gravimetric Determination of Iron
26 28 30	Chapter 6 – Chemical Equilibrium	#4: Effect of Sampling Size on Sampling Error
Feb 2 4 6	Chapter 18 – Fundamentals of Spectrophotometry Chapter 20 – Spectrophotometers	<u>Rotation 1: Spectroscopic Techniques</u> #5: Spectrophotometric Determination of an Equilibrium Constant #6: FIA Determination of Iron #7: UV-Vis Analysis of Soft Drinks
9 11 13	EXAM II – Chapters 6, 8, 18 & 20 Chapter 23 – Introduction to Analytical Separations Chapter 24 – Gas Chromatography Chapter 25 – High-Performance Liquid Chromatography Chapter 26 – Chromatographic Methods and Capillary Electrophoresis	Rotation 1: Spectroscopic Techniques (cont.)
16 18 20		Rotation 1: Spectroscopic Techniques (cont.)
23 25 27	NO CLASS – Spring Break NO CLASS – Spring Break NO CLASS – Spring Break	NO LAB
Mar 2 4 6	Chapter 8 – Activity and the Systematic Treatment of Equilibria	<u>Rotation 2: Chromatographic Techniques</u> #8: Mg by Ion-Exchange Chrom. #9: Caffeine by HPLC #10: Intro to SPME-GCMS
9 11 13	Chapter 9 – Monoprotic Acids and Bases	Rotation 2: Chromatographic Techniques (cont.)
16 18 20	EXAM III – Chapters 23-26, 8, 9 Chapter 10 – Polyprotic Acids and Bases	Rotation 2: Chromatographic Techniques (cont.)
23 25 27	Chapter 11 – Acid-Base Titrations	#11: Potentiometric Titration of a Polyprotic Acid
Apr 30 1 3	Chapter 12 – EDTA Titrations	#12: Determination of Iron in an Ore by a Redox Titration
6 8 10	Chapter 14 – Fundamentals of Electrochemistry NO CLASS – Easter Break	NO LAB
13 15 17	NO CLASS – Easter Break	NO LAB
20 22 24	EXAM IV – Chapters 10,11,12,14 Chapter 15 – Electrodes and Potentiometry Chapter 16 – Redox Titrations	Literature Presentations
27 30	FINAL EXAM (ACS, 11:00 – 1:00)	

COMPLETE LIST OF ASSIGNED READING AND PROBLEMS

Chapter	Pages to Read	Problems	Spreadsheet Problems
Ch 0 – The Analytical Process	1-8	None	None
Ch 1 – Measurements	9-17	6, 11, 13, 14, 18, 20, 21, 22, 23, 24, 26, 30, 31, 32, 33, 35	Handout
Ch 3 – Experimental Error	39-50	2, 7, 12, 13, 16, 18, 19, 21, 22	None
Ch 4 – Statistics	53-72	3, 4, 9, 11, 12, 13, 14, 16, 17, 18, 19, 20, 21, 22, 23, 29	16, 32, 33
Ch 5 – Quality Assurance and Calibration Methods	78-91	15, 18, 19, 20, 22, 23, 25, 28, 29d, 30	24, 26a, 27
Ch 6 – Chemical Equilibrium	96-116	worksheet, 3, 4, 5, 9, 17, 19, 25, 36, 37, 38, 40, 42, 45, 48, 50, 51	28
Ch 18 – Fundamentals of Spectrophotometry	378-397	3, 9, 10, 11, 12, 16, 17, 18, 19, 21, 22, 23, 26	26
Ch 20 – Spectrophotometers	424-437	None	None
Ch 23 – Introduction to Analytical Separations	501-516	1, 7, 8, 15, 18, 19, 20, 21, 25, 27, 37, 39, 42, 43, 44	None
Ch 24 – Gas Chromatography	528-549	None	None
Ch 25 – High-Performance Liquid Chromatography	556-565, 570-574	None	None
Ch 26 – Chromatographic Methods and Capillary Electrophoresis	603-615	None	None
Ch 8 – Activity and the Systematic Treatment of Equilibria	140-154	3, 4, 6a, 9, 10, 12, 17, 18, 19, 20, 22, 24, 25, 28	Handout
Ch 9 – Monoprotic Acid-Base Equilibria	158-176	3, 6, 13, 22, 23, 24, 36, 37, 38, 39, 40	None
Ch 10 – Polyprotic Acid-Base Equilibria	180-195	3, 5, 6, 12, 19, 20, 23, 24, 28, 30	7, 35
Ch 11 – Acid-Base Titrations	199-221	2, 6, 17, 25, 28, 30, 45	34, 35, 64, 69
Ch 12 – EDTA Titrations	228-245	3,5,7,30,31,32,33,34,35	11
Ch 14 – Fundamentals of Electrochemistry	270-291	Appendix D – 1, 2ab, 3bf, 4ab Ch 14 – 8, 9, 10, 12, 14, 16, 17abc, 19, 24, 25, 28, 35, 36, 37	None
Ch 15 – Electrodes and Potentiometry	298-317	2, 3, 8, 26, 35, 36, 40	None
Ch 16 – Redox Titrations	327-343	3, 7, 17, 19, 24, 25	None