Chemistry 330 - QUANTITATIVE ANALYSIS

Course Description: Chem 330 is a study of the common techniques and theory of gravimetric, volumetric, electrochemical, optical and chromatographic methods of analysis. Laboratory meets four and one-half hours per week. (Fall, Spring, Summer)

Course Information

Lecture:	**M- F**	**9:00 am - 11:30 pm**	**Snell Hall 4115**
Lab:	**T,W,R**	**12:30 am – 5:00 pm**	**OCH 3009**

Professor: Dr. Darwin Dahl Office: COOH 2111 Phone: 5074
Office hours: TBA

Textbook: Textbook: "Quantitative Chemical Analysis" by Daniel C. Harris 9th edition

Note: The eBook is free and linked through Blackboard. Purchase of a print copy is optional.

Student log in instructions: https://community.macmillan.com/docs/DOC-6225-sapling-learning-student-single-sign-on

Grading Policy:

Three hour exams will be given during the semester. A comprehensive final exam will be given and will consist of the ACS Standardized Exam. The following grading policy will be followed:

3 hour exams	**40%**
Homework (Sapling assignments)	**10%**
6 Laboratory experiments	**35%**
Final exam (comprehensive)	**15%**

Projected grading scale:

88 - 100	A
77 - 87	B
65 - 76	C
52 - 64	D
- 51	F

The deadline for laboratory reports will be 1 week after completion of the experiment unless otherwise stated. A penalty of **5% per day** will result for reports turned in late. The procedure for submitting reports will be reviewed in class.

Absences

No make-up examinations or Labs will be scheduled.

Significant Dates:

June 4	**Class begins**
June 11	**EXAM I**
June 19	**EXAM II**
June 26	**EXAM III**
June 29	**FINAL EXAM [9:00 am – 11:00] ACS EXAM**

Tentative Lecture Schedule

Exam I Material

Chapter 1:	**Chemical Measurements -**	A review of solutions and their concentrations and stoichiometric calculations. Review of Titrations
Chapter 6:	**Chemical Equilibrium-**	A review of chemical equilibrium
Chapter 8:	**Activity and the Systematic Treatment of Equilibrium**	Activity and Activity coefficients in relations to solubilities and Systematic methods for solving multiple-equilibria
Chapter 27:	**Gravimetric and Combustion Analysis**	Treatment of Gravimetric procedures

Exam II Material

Chapter 4:	**Statistics**	Statistical treatment of errors
Chapter 9:	**Monoprotic Acid/Base Equilibria**	Strong acid/base and Weak acid/base equilibria
Chapter 10:	**Polyprotic Acid-Base Equilibria**	Equilibria involving polyprotic acid-base reactions, buffer solutions and alpha fractions
Chapter 11:	**Acid-Base Titrations**	Titrations and practical applications

Exam III Material

Chapter 12:	**EDTA Titrations**	Complex-formation reactions, EDTA equilibria and applications
Chapter 18:	**Fundamentals of Spectrometry**	Electromagnetic radiation, spectrum
Chapter 19:	**Applications of Spectrophotometry**	Applications
Chapter 20:	**Spectrophotometers**	Block diagrams of instrumentation

Exam IV Material

Chapter 14:	**Fundamentals of Electrochemistry**	Redox, potentials and cells
Chapter 15:	**Electrodes and Potentiometry**	Indicator and Reference electrodes
Chapter 16:	**Redox Titrations**	Titration curves and applications
Chapter 23:	**An Introduction to Analytical Separations**	Chromatography overview
Chapter 24:	**Gas Chromatography**	Gas Chromatography overview
Chapter 24:	**HPLC**	HPLC overview

Students with disabilities who require accommodations (academic adjustments and/or auxiliary aids or services) for this course must contact the Office for Student Disability Services, Garrett 101. The OFSDS telephone number is (270)745-5004 V/TDD.

Student Learning Objectives:

Students will demonstrate proficiency using chemical knowledge and problem solving skills in the following topics: basic statistics, acid-base chemistry and equilibria, solubility, redox reactions, and separation techniques.

Laboratory Schedule

Text: Procedures in Quantitative Analysis, Dahl et al.

Laboratory Experiments will be located in Blackboard!

Note: Prior to lecture on the day of your scheduled experiment, obtain the necessary standard or unknown and place in the oven to dry. Make sure and record the **unknown #** in your laboratory notebook! ***You will need to provide your own safety glasses/goggles..***

Lab: TWR 12:30 - 5:00 pm OCH Room 3009

Date:	TOPIC
June 6	Check-in and Glassware Calibration
June 7	Excel Spreadsheet Calculations and Graphing
June 12, 13	Determination of Soda Ash using HCl
June 14	* Potentiometric Analysis of a Phosphoric and Sulfuric Acid Mixture
June 19,20	Complexometric Titration of MgO with EDTA
June 21	*** Ion-exchange lab "Self-developed" Formal Report.**
June 26	*****Spectrophotometric Analysis of a Permanganate-Dichromate Mixture
June 27	*****Alcohol Determination by Gas Chromatography and **Checkout.**

*** denotes working with a partner!**

Chem 330 Laboratory
Excel Spreadsheet Exercise: Calculations/Graphing

The intent of these exercises is to familiarize yourself with the use of a spreadsheet and to be able to graph various types of data. The program we will use is excel.

A. Prepare a plot of Density of water vs Temperature.

Referring to the handout, reproduce the spreadsheet and corresponding graph as shown. Additionally, generate the best-fit equation for the data obtained. To obtain the equation use *a third-order polynomial* fit and selecting *4* significant digits.

B. pH dependance on the solubility of HgS in water.

Reproduce and complete the spreadsheet below and generate graphs as requested in Part B "Turn in;"

	pH	[H+]	[OH-]	[Hg2+]	[S2-]	[HS-]	[H2S]	C.B. Error	lg[Hg2+]	lg[S2-]	lg[HS-]	lg[H2S]
Ksp=	2											
5.00E-54	3											
Kb_1=	4											
0.9	5											
Kb_2=	6											
1.10E-07	7											
Kw=	8											
1.00E-14	9											
	10											

Formulas

Turn in:

Part A: -Spreadsheet calculation
-Graph
-Best-fit equation and correlation coefficient (r)

Part B: -Spreadsheet calculation
-Graph (Fig 9-3)
-Graph Charge Balance Error vs pH
- report pH at 0 error; **This is the solubility!**

	A	B	C	D	E	F	G	H
1	Calculating Density of H2O with Equation 2-4							
2	(from the delightful book by Dan Harris)							
3								
4	Constants:	Temp (C)	Density (g/mL)					
5	a0 =	5	0.99997					
6	0.99989	10	0.99970					
7	a1 =	15	0.99911					
8	5.3322E-05	20	0.99821					
9	a2 =	25	0.99705					
10	−7.5899E-06	30	0.99565					
11	a3 =	35	0.99403					
12	3.6719E-08	40	0.99223					
13								
14	Formula:							
15	C5 = $A$6+$A$8*B5+$A$10*B5^2+$A$12*B5^3							
16								
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