

Fall 2009 -- CH 461 & CH 461H  
EXPERIMENTAL CHEMISTRY II

**Instructor:**

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**Textbook:** Harris, "Quantitative Chemical Analysis" 7th edition (also used in CH 421 and 422); if you already have the 6th Edition from CH 421 or CH 422, you may continue to use that edition.

**Course Content -- Laboratory Experiments:**

1. Chemical Instrumentation
  - A. Electronic Instrumentation
  - B. Optical Instrumentation
2. Determination of Riboflavin: A Comparison of Techniques
  - A. Molecular Absorption Spectrophotometry
  - B. Molecular Fluorescence Spectrometry
  - C. HPLC
3. Enzyme Kinetics
4. ICP Atomic Emission and Flame Absorption Spectrometry
5. Coulometric Titration
6. Special Project

**Grading**

Lab Reports (weighted roughly according to time required for experiment)	80%
Lab Quizzes	10%
Instructors' evaluation of lab technique, safety practices, preparation, etc. etc.	10%

**Objectives.** A student who completes CH 461 or CH 461H successfully should be able to:

Exp	Objective
1A	Calculate voltage, current, or resistance in simple circuits with Ohm's law.
1A	Design a voltage divider and calculate output voltage.
1A	Describe internal resistance; calculate effective internal resistance from load resistance and output voltage.
1A	State basic principles of op-amps and use them to calculate currents and voltages for various op-amp circuits: voltage amplifier, voltage follower, low pass filter, integrator.
1A	Calculate voltage, current, charge, or capacitance in simple circuits with capacitors.
1B	Explain characteristics of light sources, monochromators and photodetectors.
1B	Determine experimentally characteristics of light sources, monochromators and photodetectors.
1B	Explain quantitatively and determine experimentally the effect of slit width in a monochromator on the light throughput and wavelength resolution.
1B	Explain quantitatively and determine experimentally how the magnitude of signal fluctuations (noise) depends on the time constant or cutoff frequency of the signal processing electronics.
2A	Use Beers Law to relate $A$ , $a$ , $\epsilon$ , $b$ , and $c$ .
2A	Calculate concentration from experimental measurements of $E_r$ , $E_s$ , $E_d$ , %T and $A$ .
2A	Sketch a block diagram of a single-beam and a double-beam spectrophotometer and describe how each processes $E_r$ , $E_d$ , $E_s$ to obtain %T and $A$ .
2A	Determine detection limit in absorption spectrophotometry.
2B	Describe the physical basis of molecular fluorescence and the components of spectrofluorometers.
2B	Describe the components of the signal in fluorescence spectrometry ( $E_f$ , $E_d$ , $E_{sc}$ , $E_d$ ) and determine their values experimentally.
2B	Determine a spectrofluorometric calibration curve and use it to determine the concentration of an unknown.
2B	Determine detection limit in fluorescence spectrophotometry.
2C	Describe the components of a high performance liquid chromatograph.
2C	Predict change in retention with change in solvent composition in ion-pairing reverse phase HPLC.

- 2C Use HPLC to separate and determine the concentration of components of a solution.
- 3 Describe the Michaelis-Menten model of enzyme kinetics and the assumptions on which it is based.
- 3 Identify the three special cases of  $[S]_0 \ll K_m$ ,  $[S]_0 \gg K_m$  and  $[S]_0 = K_m$  in a plot of  $v_0$  vs.  $[S]_0$  and associate  $K_m$  and  $v_{max}$  with the data on the plot.
- 3 Use an Eadie-Hofstee plot to determine the parameters  $K_m$  and  $v_{max}$ .
- 3 Use initial rates with  $[S]_0 \ll K_m$  to determine the concentration of a substrate in a sample.
- 3 Use initial rates with  $[S]_0 \gg K_m$  to determine the specific activity of an enzyme.
- 4 Describe basic physical principles of atomic emission and atomic absorption.
- 4 Describe basic components of an inductively coupled plasma atomic emission spectrometer (ICP-AES) and a flame atomic absorption spectrophotometer (AAS).
- 4 Use ICP-AES and AAS to determine concentrations of elements in various samples.
- 4 Select and use appropriate methods of sample preparation (dry ashing, microwave digestion, acid dissolution) to prepare samples for atomic spectrometry.
- 5 Determine charge passed from current and time; relate charge passed to number of moles titrant generated with Faraday's law.
- 5 Describe the configuration of a coulometric cell including the reactions at both electrodes.
- 5 Perform a coulometric titration with spectrometric endpoint detection and determine concentration of an analyte.
- 6 Formulate a complete procedure for chemical analysis, including method selection, sampling, preparation of sample for analysis, preparation of standards, incorporation of quality assurance measures, and analysis of data.
- 6 Carry out the chemical analysis and report results including uncertainty.

**Reading assignments:**

Experiment Number	Handouts, Lecture Notes	Harris Section	Harris pages, 6th Ed.	Harris pages, 7th Ed.
1A	Lab Info 1A			
1B	1B	18.1 20.1-20.4*	408-409 463-478	379-380 426-438
2A	2A	18.2-18.4 20	409-418 462, 471	380-387 424-425; 432
2B	2BC	18.6	422-426	392-397
2C	2BC	25.1-25.2*	607-624	556-573
3	3			
4	4	21.1 21.2* 21.5-21.5	495-496 501-502 505-511	454-455 456; 460-461 463-468
5	5	17.1* 17.3	373-375 380-383	349-350 355-357
6	6	0.1 - 0.2	1-9	1-8

\* Not the entire section

**Fees**

Lab fee, \$44.00

Lab manual, printing, etc.: \$28.00

Required goggles, \$ 6.00

Optional: lab coat, \$ 4.00

**Expectation for Student Conduct** - <http://oregonstate.edu/admin/stucon/achon.htm>

**Accommodations for Students with Disabilities.** Accommodations are collaborative efforts between students, faculty and Services for Students with Disabilities (SSD). Students with accommodations approved through SSD are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through SSD should contact SSD immediately at 737-4098.

## CH 461 Course Schedule 2009

Week	Tuesday	Thursday
1	29-Sep Exp 1A Electronics Lecture 1:00 - 1:50 Lab 2:00 - 4:50	1-Oct Exp 1A Electronics Lecture 1:00 - 1:50 Lab 2:00 - 4:50
2	6-Oct Exp 1B Optics Lecture 1:00 - 1:50 Lab 2:00 - 4:50 <i>Spreadsheet Due</i>	8-Oct Exp 1B Optics Lecture 1:00 - 1:50 Lab 2:00 - 4:50 <i>Report 1A, Quiz 1 Due*</i>
3	13-Oct Exp 2A Absorbance Lecture 1:00 - 1:50 Lab 2:00 - 4:50	15-Oct Exp 2A Absorbance Lecture 1:00 - 1:50 Lab 2:00 - 4:50 <i>Report 1B, Quiz 2 Due*</i>
4	20-Oct Exp 2B&C Fluorescence&HPLC Lecture 1:00 - 1:50 Lab 2:00 - 4:50	22-Oct Exp 2B&C Fluorescence&HPLC Lab 1:00 - 4:50 <i>Quiz 3 Due*</i>
5	27-Oct Exp 3 Enzyme Kinetics Lecture 1:00 - 1:50 Lab 2:00 - 4:50 <i>Report 2A Due*</i>	29-Oct Exp 3 Enzyme Kinetics Lab 1:00 - 4:50 <i>Report 2B, Quiz 4 Due*</i>
6	3-Nov Exp 4 ICP & AA Lecture 1:00 - 1:50 Lab 2:00 - 4:50 <i>Report 2C Due*</i>	5-Nov Exp 4 ICP & AA Lab 1:00 - 4:50 <i>Report 3 Due*</i>
7	10-Nov 6 Project (Lecture) / 4 ICP AA (Lab) Lecture 1:00 - 1:50 Lab 2:00 - 4:50	12-Nov 6 Special Project Lab 1:00 - 4:50
8	17-Nov Exp 5 Coulometry Lecture 1:00 - 1:50 Lab 2:00 - 4:50	19-Nov 6 Special Project Lab 1:00 - 4:50 <i>Report 4 Due*</i>
9	24-Nov 6 Special Project Lab 1:00 - 4:50 <i>Report 5 Due*</i>	26-Nov Thanksgiving Vacation
10	1-Dec 6 Special Project Lab 1:00 - 4:50	3-Dec 6 Class Presentation of Project Lab 1:00 - 4:50
Exam Week	Monday, 7-Dec <i>Report 6 Due*</i>	

\* All reports due at beginning of class (lecture or lab) on the day indicated.

## SAFETY GOGGLES

Safety GOGGLES are **mandatory** for experiments which involve a possible chemical hazard and are to be worn at all times in the wet laboratory (GBAD 309). These can be purchased from the issue room. Notify the course instructor if you wear contacts and turn in the request form.

## LABORATORY NOTEBOOKS

Everyone should have a laboratory notebook with provision for making a duplicate copy. In the laboratory, make sure that you record all pertinent instrumental settings and keep all hardcopies and instrument traces. Much of your data will also be recorded on the "data sheets" provided with most experiments. All other data such as weighing data, details of solution preparation, or additional observations should be recorded in your laboratory notebook. You will not be allowed to record data on scratch paper because it is unprofessional and it is easy to lose. Have an instructor check your daily work and initial the notebook before you leave lab for the day. When you turn in your report, include the duplicate copy of the appropriate pages in your laboratory notebook.

## DUE DATES FOR LAB REPORTS

All lab reports are due as indicated on the course schedule (usually, but not always, one week from the date of the scheduled completion of the lab). Reports are due at the **beginning of the lab or lecture period** on the date indicated. You may only work on your laboratory reports during the scheduled laboratory time if you are completely finished with the scheduled experiment for that day.

## PENALTY FOR LATE LAB REPORTS

Late lab reports are penalized 2% of the total possible laboratory points in the term for each day late. Every student has three free "late days" for the whole term. Note that this is a stiff penalty and about 5 late days above the three free days is equivalent to 10% of the total laboratory points and will lower your grade a whole grade point.

## PREPARATION BEFORE THE LABORATORY

Before each laboratory, read and understand the experiment and pertinent handout sheets and lecture notes. If solution preparation is required, work out the details and outline the procedure in your laboratory notebook before coming to class. This policy will almost insure that you will finish the laboratory in the allotted time and may help you to finish the experiment in much less than the allotted time. Part of your performance grade is based on the instructor's perception of your preparation.

## ATTENDANCE

You are expected to attend all scheduled laboratory periods and be present at the scheduled starting time. **Unexcused absences or tardiness will lower your performance grade.** Please inform in advance a faculty member involved with the course of an expected legitimate absence or bring a doctor's excuse in the case of a sudden illness. Time conflicts with other courses must be discussed with the course instructor prior to the first meeting. Generally, time conflicts with other courses are not allowed.

## QUIZZES IN THE LABORATORY

During the term, four or more lab quizzes will be given at the times listed in the schedule. These quizzes will test your understanding of the material in the laboratory writeups. Web quizzes may be employed in which case they are due at the beginning of the lab or lecture on the date indicated.