Chemistry 243 Syllabus -- Winter Quarter 2017

Instructor: Robert M. Corn
Lecture: TuTh 1100a-1220p
Room: RH 190
Discussion: TBA
Office: 2139 Natural Sciences II
Office hours: Monday 100p - 200p, or by appointment.
Web Site: http://unicorn.ps.uci.edu/243/

Introduction

This course is a graduate level course in analytical chemistry and instrumental analysis. It assumes knowledge of quantitative analysis and some physical chemistry. Knowledge of quantum mechanics is very useful, but not mandatory. The purpose of the course is to provide an overview of how to create instrumentation that makes precise, accurate, meaningful measurements on chemical systems. At the graduate level, analytical chemists are intimately involved in the development of instrumentation. This requires knowledge in some areas not traditionally covered in an undergraduate chemistry curriculum. In this course, we will go over the various areas of physics, math, engineering and chemistry that are required for the development of novel chemical instrumentation.

Course Structure

The course will have a simple structure in which the semester will be divided into five key topic areas of instrumentation and analysis. Each section will consist of a set of lectures, reading materials, and a problem set.

A. Electrical Measurements: Op Amps, Voltage Follower, Current Follower, Inverted Amplifier, Photodiodes and Photomultiplier Tubes, Photon Counting, Avalanche Photodiodes, CCDs. Oscilloscopes.

B. Frequency Analysis. LaPlace Transforms, Bode Plots, Nyquist Plots, Spectral Analysis. RC circuits and filters. Fluorescence Modulation Spectroscopy.

C. Modulated Electrochemical Measurements. Electron Transfer Kinetics and Diffusion Overview. Electrochemical Impedance Spectroscopy.

D. Surface Adsorption Measurements. Langmuir Adsorption Kinetics and Isotherm, Surface Tension and Gibbs Equation, Surface Adsorption Biosensors.

E. Resonance Measurements. Forced damped SHO, Q factor, QCM Measurements, optical resonators, plasmonic resonances.

Problem Sets

With each topic section there will be a problem set to help you sort out the various pieces of information that you receive from the lectures, books, and handouts. Collaboration on the problem sets is encouraged. Problem sets will be announced in lecture, are available here. Problem Sets MUST be received by the due date for credit. All problem sets will be available on the web site: http://unicorn.ps.uci.edu/243/

Handouts and Reading Materials
Each topic section will include reading from either the recommend text, or supplemental material. All handouts will be posted on the web at:

http://unicorn.ps.uci.edu/243/handouts/handouts.html

Final Project
At the end of the semester, you will put all of your acquired expertise into analysis together to create a 10 powerpoint slide presentation on a new (in the last two years) analytical instrumentation methodology. The presentations should be 10 minutes.

Exams and Grades

The Course will have a total of 700 points. The problem sets will be worth 100 points each, and the Presentation Project will be worth 200 points. There will be no final exam in this course.

Handouts. The primary reference materials for the course are the many handouts online, which have been divided into weekly reading material sections.

Recommended OPTIONAL Texts (in addition to the many handouts online):

Title: Div, Grad, Curl, and All That: An Informal Text on Vector Calculus Authors: H. M. Schey
ISBN: 0393925161
Format: Paperback, 163pp
Pub. Date: January 2005
Publisher: Norton, W. W. & Company, Inc. Edition Number: 4

Title: Fundamentals of Electromagnetic Phenomena Authors: Francois Lorrain, Paul Lorrain, Dale R. Corson ISBN: 0716735687
Format: Hardcover, 600pp
Pub. Date: October 2000
Publisher: W. H. Freeman Company Edition Number: 1