Chemistry 243 Syllabus -- Winter Quarter 2021

Instructor: Robert M. Corn

Lecture: TuTh 1100a-1220p

Room: ALP 2200 (zoom online for now)

Office: Chem 2139 (really zoom online)

Office hours: Wed and Fri 1100a - 1200p, or by appointment.

Canvas Page: https://canvas.eee.uci.edu/courses/32725

Web Page: https://www.chem.uci.edu/~unicorn/243/

Introduction

This course is a graduate level course in analytical chemistry and instrumental analysis. It assumes knowledge of quantitative nalysis and some physical chemistry. 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.
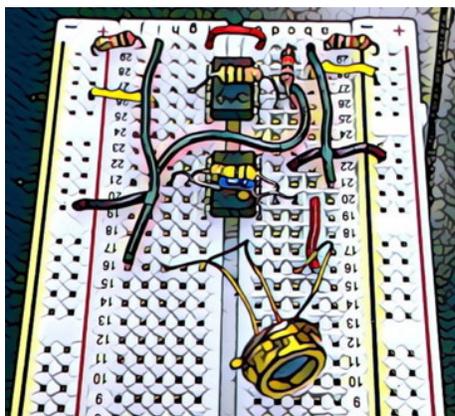
Course Structure

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. Photon Detectors

Photodiodes: Principles, Specifications and Noise

Photomultiplier Tubes

Avalanche Photodiodes, CCDs, EM-CCDs

B. Operational Amplifiers

Op Amp Principles and Basic Circuits

Potentiometry and Photocurrent Circuits

Galvanostat and Potentiostat

C. Frequency Analysis and Fluorescence

LaPlace Transforms

Bode Plots, Nyquist Plots, Spectral Analysis.

RC circuits and filters.

Fluorescence Lifetimes.

Fluorescence Modulation Spectroscopy.

D. Optical Susceptibility and Absorption

Classical forced damped SHO model

Complex Susceptibility and Dielectric Constant

Extinction Coefficients and Refractive Index

E. Mass Spectrometry

TOF measurements

FT-MS, ICR and Orbitrap instrumentation

F. Electrochemical Measurements.

Electron Transfer Kinetics and Diffusion Overview.

Electrochemical Impedance Spectroscopy.

G. Quartz Crystal Microbalance (QCM) and Adsorption Measurements

Q factor analysis and QCM Measurements

Langmuir Adsorption Kinetics and Isotherm

Antibody and Antigen Biosensors.

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 canvas site in the Files area.

Handouts and Reading Materials

Each topic section will include reading from either the recommend text, or supplemental material. All handouts will be posted on canvas in the Files area.

Final Project

At the end of the semester, you will put all of your acquired expertise into analysis together to create a final paper and a 5--10 powerpoint slide presentation on a cell phone-based analytical instrumentation methodology you would like to create. The presentations should be 10-15 minutes.

Exams and Grades

The Course will have a total of 800 points. The six 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 in the Files Canvas folder, 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

Note: Easy to read tutorial on this subject. Good as in introduction to Vector Calculus.

Title: Op Amp Applications Handbook

Walt Jung

Series: Analog Devices Series

Paperback: 896 pages

Publisher: Newnes; 1 edition (December 13, 2004)

ISBN-10: 9780750678445

ISBN-13: 978-0750678445

Note: There are many Op Amp Handbooks - this is just one example.

Title: Complex Variables and Applications

James Ward Brown and Ruel V. Churchill

Hardcover: 480 pages

Publisher: McGraw-Hill Education; 9 edition (September 3, 2013)

Language: English

ISBN-10: 0073383171

ISBN-13: 978-0073383170

Note: A classic. You can buy a less expensive older edition or kindle version of this book.