Winter 2006

Instrumental Analysis (Chemistry 426-001)

Lecture material discussion: SEB 237, Time: 12:00- 1:47pm

Lab: SEB 238, Monday Time: 12:30-4:30pm

Instructor: Dr. Xiangqun Zeng

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Office Hours: Monday, Wednesday 2:00 to 3:00 pm or by appointment.

Course Objective: In this course, you will be exposed to the theoretical and practical of the instrumentations used in modern analytical chemistry. The course is divided roughly into five major fields; (1) measurement basic; (2) spectroscopy; (3) electrochemistry; (4) chromatography and (5) microscopy. You are expected to learn how to search scientific journals and apply what you learned from this course to solve real world problems. In addition, it is expected that you extend your knowledge about certain techniques beyond the course material covered in the textbook. At the end of this course, it is expected that you will not only master the basic instrumental techniques, but you will also acquire the ability for independent problem solving and you will be able to apply these techniques to new experiments and new situations and if necessary be able to modify them.

Textbook: Principles of Instrumental Analysis, fifth Edition, Skoog, Holler and Nieman.

Required items: Calculator with logarithms, exponential and scientific notation.

Homework: Reading literatures and textbook about the instrumental techniques discussed in the lectures are an important part of homework assignments. Problems from the textbook will be announced weekly. Experience shows that your grade in the course is proportional to the effort you make in reading and doing the assignments! The homework is not graded. A copy of solution manual will be placed in the library.

Exams: There will be two exams. One midterm, the other is final. Midterm is 200 points. Final exam will be 300 points. For the laboratory portion, active attendance and a final research lab report will be used for the grade.

Grade: > 85% A (3.6-4.0); 75-85 % B (3.0- 3.5); 60%-75 % C (2.0-2.9); D < 60% (1.0-1.9)

Tentative Lecture and exam schedules

Lecture Number	**Topics** Principle of Instrumental Analysis, Skoog, West and Holler, 5th	Text Reference
1	Introduction of Instrumental Methods; Measurements, Signal and Noise	Chapter 1, 4
2,3	Measurement Basics (Operational Amplifiers, Digital Electronics, Instrument Interfacing)	Chapter 2,3
4	Introduction to Spectrometric Methods and Components of Optical Instruments	Chapter 6, 7
5-7	Introduction to Atomic Spectroscopy (Atomic Absorption, Emission, Fluorescence, X-ray)	Chapter 8, 9, 10
8		
9-10	Molecular Spectroscopy: UV/Vis, Infrared and Raman Spectroscopy	Chapter 13, 15, 16, 17
11-12	Analysis of Surfaces with Scanning Probe Microscope	Chapter 21
13	**Interim exam**	**Feb. 21**
Winter Recess (Feb.25 to Mar. 5)		
14		
15-17	Introduction to Electroanalytical Methods of Analysis: Potentimetry (biosensor), Polarography, Cyclic Voltammetry, Electrochemical Quartz Crystal Microbalance	Chapter 22, 23, 24, 25
18		
19-24	Introduction to Chromatography (GC, HPLC, SFC, CE)	Chapter 26, 27, 28,29, 30
25-26	Molecular Mass Spectrometry and GC-MS and LC-MS	Chapter 20
27	Automated Methods for Analysis	Chapter 33
28	**Final Exam (According to University Scheduled Time)**	

Lab: Inclusion of Student-Centered Pedagogies and Integrate Research into Instrumental Analyses (CHM426) Curriculum

The Instrumental Analysis course's goal is to introduce student's to the theory and practice of modern analytical instrumental techniques encountered in research and commercial laboratory environments. Instrumental analysis courses are superb vehicles for using student–centered pedagogues, primarily because of their relatively small class sizes. Small classes make strong interactions among students and the instructor possible. Students who take this course are ordinarily in their senior year, have broad background of chemistry and are frequently becoming involved in undergraduate research. Thus integrating research into the instrumental analysis course curriculum is logical and well accepted by students. This is not surprising since it is generally accepted that one of the most effective ways to accomplish effective learning is to involve students in original research. Solving new problems leads to discovery, encourages creativity and generates student interest in science. Students naturally become self-motivated and enjoy being independent learners.

This semester, I plan to develop an Instrumental Analysis laboratory curriculum, which involves several mini projects and one major project. Mini projects will be taught by my graduate students and postdoc for different instrumental analysis techniques which include: three spectroscopy techniques (Surface Plasmon Resonance Spectroscopy, ATR FT-IR, and RT-FT-IR), three electrochemistry techniques (Potentiometry, Cyclic Voltammetry, Electrochemical Quartz Crystal Microbalance) and Two Imaging techniques (Scanning Tunneling Microscopy and Atomic Force Microscope). Students will learn the theory and practice of basics of above listed instrumental methods. The major project will be a hand-on research project, which based on my research of biosensors. In the major project, the research topic will be selected so students will use as many concepts and techniques parallel to solve the open end research problems.

32-421, fall 2006, Lab: Monday 12:30 pm - 4:00 pm (tentative)	
Labs	Mini projects (working with Dr. Zeng's graduate students and postdocs to understand the operation and concepts of the following techniques.)
1	ATR-FT-IR (Dr. Lei Yu or Xiao xia) on Jan. 9
2	Repeat ATR-FT-IR by Scott on Jan 23
3	RT-FT-IR (Dr. Lei Yu) on Jan. 30
4	Repeat RF-FT-IR by Scott on Feb.6
5	SPR (Yijun Tang and Dr. Xiao) on Feb. 13
6	Repeat SPR by Scott on Feb. 20
7	Potentimetry : Ion selective Electrode (Zhihong Shen) on Mar. 6.
8	Repeat potentiometry by Scott on March 13
9	Cyclic Voltammetry (Kuang Yu Hou) on Mar. 20
10	Repeat CV by Scott on Jan 16 on Mar. 27
11	Electrochemical Quartz Crystal Microbalance (Richard) on April 3
12	AFM (Dr. Lei Yu demonsrtation) on April 10