

## Course Syllabus for Instrumental Analysis (Chem 5640)

**Instructor:** Dr. Robert Brown

**Class Times/Location:** 11:30 AM - 12:20 PM MWF/W 007

**Office:** W 026 **Office Phone:** 797-0545 **Email:** brownusu@cc.usu.edu

**Office Hours:** MWF 1:30-2:30 PM and also by individual student appointments.  
(office hours are subject to change with any changes being announced in class)

**Course Text:** Principles of Instrumental Analysis (6<sup>th</sup> Edition) by Skoog, Holler and Crouch, published by Thomson Brooks/Cole. **Note:** Supplementary course material, along with class handouts, will be provided in class or on the web and will be announced in-class. Students may also find the following supplemental texts useful: "Principles of Electronic Instrumentation" (3rd Ed.) by Diefenderfer and Holton and "Contemporary Instrumental Analysis" by Rubinson and Rubinson.

**Course Learning Objective:** This course will be concerned with the theory and practice of instrumental methods for the separation, identification and quantitative analysis of chemical substances. Satisfactory completion of this course will afford students a working knowledge of analytical instrumentation typically employed in chemical and biochemical research laboratories. It will also provide the student with an appreciation of the relative strengths and limitations of different instrumental based analysis methods.

Specific Course Learning Objectives Include:

- \* Demonstrate knowledge of sampling methods for all states of matter.
- \* Assess sources of error in chemical and instrumental analysis and account for errors in data analysis.
- \* Recognize interferences in chemical and instrumental analysis.
- \* Comprehend the concept of and perform instrument and method calibration.
- \* Apply and assess concepts of availability and evaluation of analytical standards and formulate standardization methodology.
- \* Integrate a fundamental understanding of the underlining physics principles as they relate to specific instrumentation used for atomic, molecular, and mass spectrometry, magnetic resonance spectrometry and chromatography.
- \* Understand and be able to apply the theory and operational principles of analytical instruments.
- \* Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for elemental and molecular analyses.

**Very important note:** Reading the textbook is an essential component of the class. Students should read ahead and be prepared to ask/answer questions during class on the material as it is covered. In addition to class lectures based upon material in the textbook, we may cover material in more detail or discuss recent advances in instrumentation beyond what is covered in the textbook. In these cases, supplementary course material will be provided to the student either as handouts or as web links.

**Exams:** Three one hour exams will be held at normal class times as indicated on the attached class schedule. Exams will comprise material and problems similar to those

discussed during class lecture, textbook example problems and problems assigned at the end of each chapter of the text. In class examinations will generally concentrate on new material covered since the last exam. The final examination will be comprehensive and cover material from the entire semester. It will be based upon the nationally administered American Chemical Society Instrumental Analysis exam. The class results from the ACS standard exam will also be used anonymously as part of the Department of Chemistry's assessment process (see page 4 of the USU general catalog) for more information on assessment. The final examination is currently scheduled for Friday, May 2 from 9:30-11:20 AM.

**Missed Exam Policy:** Missed exams which have a well documented and acceptable cause can be made up by a student, at the discretion of the instructor, by taking an appropriate make up exam to be schedule at a mutually agreeable time. Excusable absences include: (1) illness when verified by a note from the Student Health Center or your doctor; (2) a family emergency which will require a note from your academic advisor and (3) any regularly scheduled university activities (e.g., sports teams) **only with prior approval** and a note from the person in charge of the activity stating explicitly the reasons for the absence. Students should notify the instructor in advance, if possible, prior to missing any exam. Students missing an exam will have one week to notify the instructor that they have a valid excuse and to produce the necessary documentation.

**Grading:** Grades will be assigned according to the results from three in class exams, recitation quizzes and the final examination using the following point distributions:

Exam I	100 points
Exam II	100 points
Exam III	100 points
Final Exam (Comprehensive)	100 points
<hr/>	
Total	400 Points

**Grading Scale (percentage of 400 points)**

**A:** 100-90%    **B:** 89-80%    **C:** 79-70%    **D:** 69-60%    **F:** below 60%

The grade designations + and - will also be used for final letter grades for the class.

**Note:** Grade cutoffs may change to lower percentages (but not higher) depending upon the exact class exam averages. Also, the attached class schedule is tentative. I will attempt to follow it as closely as possible with respect to lecture topics and exam material. However, any changes as to the exact material to be covered in lecture and on each exam will be announced in class. It is therefore important for you to attend class regularly.

**Course Withdrawal:** Students may withdraw from Chemistry 5640 as outlined in the most recent edition of the Utah State University schedule of classes.

**Additional Provisions:** The administration of Chem 5640 will adhere strictly to the regulations outlined in the most recently published USU Schedule of Classes.

**Spring Holidays:** Because of the two spring semester Monday holidays (Martin Luther King, Jr. Day, January 21 and President's Day, February 18), students will attend their Monday schedule of classes on Tuesday, February 19.

**Final Note:**

*In coordination with the Disability Resource Center, reasonable accommodations will be provided for qualified students with disabilities. Please meet with the instructor during the first week of class to make arrangements. Accommodations and alternative format print materials (large print, diskette or Braille) are available through the Disability Resource Center, which is located in the basement of the University Inn (phone number 797-2444).*

## **Instrumental Analysis (Chem 5640) Tentative Course Outline**

- I. Measurement Principles and Electronics
  - a. Introduction to the analytical process (2 lecture) Chapter 1
  - b. Basic electronics (2 lectures) Chapter 2, 3, 4
  - c. Signals and noise (1 lectures) Chapter 5
- II. Basics of Spectroscopy
  - a. Introduction to Spectroscopic Methods (2 lecture) Chapter 6
  - b. Components of Optical Systems (3 lecture) Chapter 7
- III. Atomic Spectroscopy
  - a. Atomic absorption spectroscopy (3 lecture) Chapter 9
  - b. Atomic Emission Spectroscopy (2 lecture) Chapter 10

### **End of Material for First Exam (tentatively scheduled for February 13)**

- IV. Molecular Spectroscopy – Electronic transitions
  - a. Introduction to UV-Vis molecular spectroscopy (3 lectures) Chapter 13
  - b. Applications of UV-Vis spectroscopy (2 lecture) Chapter 14
  - c. Fluorescence, phosphorescence and chemiluminescence (2 lectures) Chapter 15
- V. Molecular Spectroscopy – Nuclear transitions
  - a. NMR (3 lecture) Chapter 19
- VI. Molecular Spectroscopy – Vibrational excitation
  - a. IR absorption spectroscopy (2 lectures) Chapter 16
  - b. Applications of Infrared Spectrometry (2 lectures) Chapter 17

### **End of Material for Second Exam (tentatively scheduled for March 19)**

- VII. Additional Instrumental Methods for Organic Structural Analysis
  - a. Mass Spectrometry (3 lecture) Chapter 20
- VIII. Separation Science
  - a. Fundamentals of chromatographic separations (3 lecture) Chapter 26
  - b. Gas chromatography (3 lecture) Chapter 27
  - c. High performance liquid chromatography (3 lecture) Chapter 28

### **End of Material for Third Exam (tentatively scheduled for April 18)**

- d. Electrophoresis (2 lecture) Chapter 30