Course Syllabus for Instrumental Analysis (Chem 5640)
Spring 2019

Instructor: Associate Professor Kimberly Hageman
Class Times/Location: 12:30 PM - 1:20 PM MWF, ESLC 053
Office: Maeser Lab 281
Office Phone: 797-0114
Email: kim.hageman@usu.edu
Office Hours: Email me to set up an appointment

Course Text: Principles of Instrumental Analysis (7th Edition) by Skoog, Holler and Crouch, published by Cengage Learning. **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 "Undergraduate Instrumental Analysis" by Robinson, Frame and Frame (7th Ed.).

Overall Course Learning Objective: This course concerns 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/biochemical research and industry 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:
* Demonstrate knowledge of sampling methods for all states of matter.
* Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for elemental and molecular analyses. 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 physical 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.

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 in-class 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 lectures, 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 this web link for more information on university assessment: http://www.usu.edu/aaa/). The final examination for the course is currently scheduled for Wednesday, May 1 from 12:30pm to 2:20pm.

Homework Problems: Approximately ten take-home problem sets relating to material being covered in class will be assigned over the course of the semester. These problems will be graded and will count towards 100 points of your final class grade. Homework problems will be posted on Canvas.

Journal Club Student Presentations: Each student will give a 10-minute presentation on a recent publication concerning the instrumental methods covered in class. Selected publications must be approved by Dr. Hageman two weeks before presentations occur. Dr. Hageman will give an example Journal Club Presentation one week before the first set of student presentations. Presentations should include an introduction to the publication, details about instrumental methods and techniques, and a summary of results.

Missed Exam Policy: Missed exams with a well-documented and acceptable cause can be made up by a student, at the discretion of the instructor. Make-up exams will be scheduled 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 documented by a note from your academic advisor and (3) 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 reason for the absence. Students are expected to notify the instructor in advance of missing an exam; students are required to produce the necessary documentation within one week after missing the exam.

Grading: Grades will be assigned according to the results from the homework problems, Journal Club presentation, three in-class exams, and the final examination using the following point distributions:

Homework Problems 100 points
Journal Club Presentation 50 points
Exam #1 100 points
Exam #2 100 points
Exam #4 100 points
Final Exam (Comprehensive) 100 points
Total 550 Points

Grading Scale (percentage of 550 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.

** Grade cutoffs **may** change to lower percentages (but **not** higher) depending upon the exact class exam averages.

Course Withdrawal: Students may withdraw from Chemistry 5640 as outlined in the current on-line edition of the Utah State University General Catalog (web link for Spring 2017 academic calendar with deadlines: http://www.usu.edu/registrar/).

Additional Provisions: The administration of Chemistry 5640 will adhere strictly to the USU Academic Policies outlined in the current on-line edition of the Utah State University General Catalog. The complete code of Policies and Procedures for Students can also be viewed online at: http://studentconduct.usu.edu/studentcode/index.

Spring Holidays: 2019 Spring holidays occur on Monday, January 21 (Martin Luther King, Jr. Day) and Monday, February 18 (President's Day). These missed classes will not be re-scheduled.

Note about Disabilities:
In accordance with the Americans with Disabilities Act, reasonable accommodation will be provided for all persons with disabilities in order to ensure equal participation in Chemistry 5640. A student who requires an accommodation must contact the Instructor. The disability must be documented by the Disability Resource Center. In cooperation with the Disability Resource Center, reasonable accommodation will be provided for students with Disabilities. Course material may be requested in alternate formats through the Disability Resource Center (phone number 797-2444).

Categories for Primary Course Learning Objectives:
I. Basic Cognitive Background

- Gaining factual knowledge (terminology, classifications, methods, trends)
- Learning fundamental principles, generalizations, or theories

II. Application of Learning

- Learning to apply course materials (to improve rational thinking, problem solving
- and decisions)
- Developing specific skills, competencies and points of view needed by professionals in the field most closely related to this course
- Applying knowledge to current literature in instrumental analysis

Note about course schedule: The attached course 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 all classes.

Instrumental Analysis (Chem 5640) Tentative Course Content Outline

Lecture #	Day	Date	Text Book Ch.	Topic	Notes
1	Mon	7-Jan	1	Introduction to analytical process	
2	Wed	9-Jan	1	Introduction to analytical process	
3	Fri	11-Jan	5	Signals & noise	
4	Mon	14-Jan	5	Signals & noise	
5	Wed	16-Jan	6	Introduction to spectroscopic methods	
6	Fri	18-Jan	6	Introduction to spectroscopic methods	
	Mon	21-Jan		**MLK HOLIDAY**	
7	Wed	23-Jan	7	Components of optical systems	
8	Fri	25-Jan	7	Components of optical systems	
9	Mon	28-Jan	8	Introduction to optical atomic spectroscopy	
10	Wed	30-Jan	8	Introduction to optical atomic spectroscopy	END OF MATERIAL FOR EXAM #1 (10 lectures)
11	Fri	1-Feb	9	Atomic absorption spectroscopy AAS)	
12	Mon	4-Feb	9	Atomic absorption spectroscopy (AAS)	
	Wed	6-Feb		**EXAM #1**	
13	Fri	8-Feb	10	Atomic emission spectroscopy (AES)	DUE: Selected Publications for Student Presentations
14	Mon	11-Feb	11	Atomic mass spectrometry (ICP-MS)	
15	Wed	13-Feb	13	Introduction to UV-Vis spectroscopy	
	Fri	15-Feb	14	Applications of UV-Vis spectroscopy	Dr. Hageman gives example Journal Club Presentation
	Mon	18-Feb		**PRESIDENT'S DAY HOLIDAY**	
16	Wed	20-Feb	14	Applications of UV-Vis spectroscopy	
17	Fri	22-Feb		** Journal Club Student Presentations	
18	Mon	25-Feb	15	Fluorescence, phosphorescence, and chemiluminescence	
19	Wed	27-Feb	15	Fluorescence, phosphorescence, and chemiluminescence	END OF MATERIAL FOR EXAM #2 (9 lectures)
20	Fri	1-Mar	16	IR absorption spectroscopy	
21	Mon	4-Mar	16	IR absorption spectroscopy	
	Wed	6-Mar		**EXAM #2**	
22	Fri	8-Mar	17	Applications of IR spectroscopy	

	Mon	11-Mar		**SPRING BREAK**	
	Wed	13-Mar		**SPRING BREAK**	
	Fri	15-Mar		**SPRING BREAK**	
23	Mon	18-Mar	19	Nuclear Magnetic Resonance (NMR)	Lecture by Dr. Simons
24	Wed	20-Mar	19	Nuclear Magnetic Resonance (NMR)	Lecture by Dr. Simons; DUE: Selected Publications for Student Presentations
25	Fri	22-Mar	19	Nuclear Magnetic Resonance (NMR)	Lecture by Dr. Simons
26	Mon	25-Mar	17	Raman spectroscopy	
27	Wed	27-Mar	20	Mass spectrometry	
28	Fri	29-Mar	20	Mass spectrometry	
29	Mon	1-Apr	20	Mass spectrometry	END OF MATERIAL FOR EXAM #3 (10 lectures)
	Wed	3-Apr		** Journal Club Student Presentations	
30	Fri	5-Apr	26	Fundamentals of chromatographic separations	
31	Mon	8-Apr	26	Fundamentals of chromatographic separations	
32	Wed	10-Apr	26	Fundamentals of chromatographic separations	
33	Fri	12-Apr		**EXAM #3**	
34	Mon	15-Apr	27	GC	
35	Wed	17-Apr	27	GC	
36	Fri	19-Apr	28	HPLC	NO TEST WEEK BEGINS
37	Mon	22-Apr	28	HPLC	
	Tues	23-Apr			LAST DAY of CLASSES
	Wed	24-Apr			
	Thurs	25-Apr			EXAM WEEK starts
	Fri	26-Apr			
	Mon	29-Apr			
	Wed	1-May		**FINAL EXAM, 12:30am-2:20pm**	