Syllabus for Instrumental Analysis (Chem 5640)  
Spring 2021

Class Times: 12:30 PM - 1:20 PM MWF  
Synchronous Lectures will take place via zoom

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Office Hours: Email for an appointment

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.).

This course requires all-inclusive digital materials that are provided to you at a lower price than traditional printed materials. These materials are paid for through an “Auto Access Digital Materials” charge placed on your student account when you registered for the course. To access the materials, visit the Canvas course site. For more details, including dates, deadlines, and opt-out info, visit your student Auto Access Portal: https://portal.verba.io/usu/login

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 mid-semester exams will be held at normal class times via Proctorio. 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. Mid-semester 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. The final examination for the course is currently scheduled for Wednesday, May 5 from 12:30pm to 2:20pm.

Pop Quizzes: Pop quizzes will be given randomly during selected lectures. The purpose of the pop quizzes is to encourage you to keep up with studying and reading material.

Take-Home Problems: Take-home problem sets relating to material being covered in class will be assigned regularly throughout the semester. These problems will be graded and will count as part of your final class grade.

Absentee and Covid Policy:
- Lecture attendance and participation is mandatory. Some lectures will include pop quizzes - if you miss a lecture containing a pop quiz, you will not have another opportunity to take the pop quiz.
- Covid quarantine: If you are in quarantine due to covid exposure, you are still required to attend lectures via zoom and complete assignments on time. Dr. Hageman will be informed by the COVID CARE team if you are in quarantine. DON’T FORGET TO CONTACT the COVID CARE IF YOU NEED TO QUARANTINE (https://www.usu.edu/covid-19/if-you-are-sick/care-team).
- Covid illness: If you are ill and/or need to isolate due to covid exposure, Dr. Hageman will be informed by from the COVID CARE team about your situation. DON’T FORGET TO CONTACT the COVID CARE IF YOU NEED TO ISOLATE (https://www.usu.edu/covid-19/if-you-are-sick/care-team). If you are too ill to attend a lecture or complete an assignment on time, you must contact Dr. Hageman at the earliest date possible to take a missed pop quiz and/or to request an extension on an assignment deadline.
- If you are unable to attend a lecture due to a non-covid illness or for another reason, you must contact Dr. Hageman at the earliest date possible to take a missed pop quiz and/or to request an extension on an assignment deadline.

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. If you need to schedule another time for another time, you must contact Dr. Hageman at the earliest date possible.
Grading: Grades will be assigned according to the following scheme using results from the take-home problems, pop quizzes, three mid-term exams, and the final examination.

Take Home Problems - 15%
Pop Quizzes - 5%
Exam I - 20%
Exam II - 20%
Exam III - 20%
Final Exam (Comprehensive) - 20%

Grading Scale
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 online edition of the Utah State University General Catalog (web link for Spring 2017 academic calendar with deadlines: http://www.usu.edu/registrar/).

USU Academic Policies: 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 be found at: http://www.usu.edu/provost/faculty-life/syllabus.cfm.

Spring Holidays and Schedule Changes:
- Monday, February 15 is a University Holiday (President’s Day).
- There is no class on Friday, March 12.
- The Friday class schedule on April 9 will be held on Thursday, April 8.

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

**Course Content:**
I. Measurement Principles and Electronics  
   a. Introduction to the analytical process, Chapter 1  
   b. Signals and noise, Chapter 5
II. Basics of Spectroscopy  
   a. Introduction to Spectroscopic Methods, Chapter 6  
   b. Components of Optical Systems, Chapter 7
III. Atomic Spectroscopy  
   a. Introduction to Optical Atomic Spectroscopy, Chapter 8  
   b. Atomic Absorption spectroscopy, Chapter 9  
   c. Atomic Emission Spectroscopy, Chapter 10
IV. Molecular Spectroscopy – Electronic transitions  
   a. Introduction to UV-Vis molecular spectroscopy, Chapter 13  
   b. Applications of UV-Vis spectroscopy, Chapter 14  
   c. Fluorescence, phosphorescence and chemiluminescence, Chapter 15
V. Molecular Spectroscopy – Vibrational excitation  
   a. IR absorption spectroscopy, Chapter 16  
   b. Applications of Infrared Spectrometry, Chapter 17  
   c. Raman spectroscopy, Chapter 18
VI. Molecular Spectroscopy – Nuclear transitions  
   a. NMR, Chapter 19
VII. Additional Instrumental Methods for Organic Structural Analysis  
   a. Mass Spectrometry, Chapter 20
VIII. Separation Science  
   a. Fundamentals of chromatographic separations, Chapter 26  
   b. Gas chromatography, Chapter 27  
   c. High performance liquid chromatography, Chapter 28