

Chem 7640 - Special Topics: Chromatography

Instructor: Bob Brown

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Office Hours: Tu 3:00-4:00 PM, W 3:00-4:00 PM and by appointment

General Course Overview

Prerequisites: Although there are no formal prerequisites for this class, student will preferably have taken (or are taking concurrently) most of the following undergraduate courses or their equivalent: instrumental analysis (Chem 5640/5650), quantitative analysis (Chem 3600/3610) and physical chemistry (Chem 3060/3070).

This course is intended for chemistry graduate (Ph.D., MS) and advanced undergraduate students or for graduate students from a science discipline who meet the course prerequisites. The class will be structured with both formal lectures on the material covered in the attached syllabus as well as a less formal aspect where students will be encouraged to discuss aspects of separation science as it relates to their research problems or general interest areas. There will be no formal textbook for the class. Students will be given access to a printed copy of the text: "Principles and Practice of Modern Chromatographic Methods" by Robbards, Haddard and Jackson to supplement class lecture material. Also, an electronic version of the text: "Chromatographic Methods" 5th ed. by A. Braithwaite and F. Smith will be provided via the classes Canvas web site. Beyond the discussion of the basic ideas that are fundamental to all separation processes, the remaining material to be covered in the class will attempt to be geared, as much as possible, to specific interests of students in the class, within the framework of the attached course outline. The course is primarily concerned with chromatographic separation methods for organic compounds, but the basic theory of separation processes is important for all separation techniques. This course should prepare the student for implementing chromatographic separations processes in their individual research areas as well as providing a solid fundamental background in separations for future use in academics or industry.

Grading

Grading will be based upon successful completion of the following:

- (a) Two graded take home assignments (occurring about week 3 and 6 of the second 7-week semester). Specific dates will be announced in class.
- (b) A class project as the final exam to be chosen from either:
 - (i) An in class oral presentations (20-30 minutes) on an instructor approved topic related to chromatographic method of interest to you.

Or

- (ii) A written (typed) report on an approved (by the instructor) separations topic (typically 10-12 double space pages using a 12-point font).
- (c) Class participation (i.e., regular attendance and interaction).

Course Withdrawal: Students may withdraw from Chemistry 7640 as outlined in the most recent Utah State University General Catalog and the most recently revised semester calendar.

Additional Final Provisions: The administration of Chemistry 7640 will adhere strictly to the regulations outlined in the most recent Utah State University Fall Schedule of Classes. Missed exams will be handled on a case-by-case basis and may require written documentation of a medical or family emergency, at my discretion.

Course Learning Objectives:

- 1) Gain an understanding of the basic molecular aspects of separation processes.
- 2) Be able to characterize similarities and differences in operating aspects of various chromatographic processes.
- 3) Gain an improved understanding of the basic physical flow processes that allow chromatographic separations to be performed.
- 4) Understand the importance of diffusion and mass transport to chromatographic separations and gain an understanding of these fundamental physical processes.
- 5) Explore and learn why multi-contact processes such as chromatographic methods allow much more complicated separations to be performed.
- 6) Gain an understanding of various chromatographic processes and why they are important in modern chemistry and biochemistry.

Tentative Course Outline

- (1) Separation Equilibria
 - (a) Simple Thermodynamics Applied To Separations
 - (b) Molecular Aspects of Equilibrium Separations
- (2) Diffusion and Mass Transport
 - (a) Diffusion
 - (b) Mass Transport Through Interfaces
 - (c) Fluid Flow
- (3) Chromatographic Theory
 - (a) Retention and Equilibrium
 - (b) Band Spreading
 - (c) Resolution
 - (d) Multi-component Separations
- (4) Chromatographic Detectors and Instrumentation
- (5) Discussion of Specific Chromatographic Methods
(Dependent on specific student interest)
 - (a) Gas Chromatography
 - (i) Capillary vs. Packed Columns
 - (ii) Stationary Phases

- (b) Liquid Chromatography
 - (i) Normal vs. Reversed Phase
 - (ii) Stationary Phase Types
 - (iii) Columns - particle packed vs. monolithic - why no capillary columns in LC?
 - (iv) HPLC vs. UPLC
- (c) Ion Exchange Chromatography
- (d) Size Exclusion Chromatography - aqueous vs. organic based columns
- (e) Gas Chromatography - selected applications
- (f) Liquid Chromatography - selected applications

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 Chem. 7610. Any student that 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.