

CHM 416H: Separation Science Fall 2021 Course Syllabus

Course Staff:

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Lectures and Office Hours: Lectures will be given on Tuesdays and Thursdays from 3:00 – 4:00 PM Eastern Time Zone in Lash Miller Room 157, beginning on Sept. 9th and ending on Dec. 7th. Office hours will be given on Tuesdays and Thursdays the hour that immediately follows each lecture (i.e., 4:00 – 5:00 PM, Eastern Time Zone) or by appointment. Office hours will be in Lash Miller Room 629.

Course Description: This course provides theoretical and practical background useful for engaging in cutting-edge chemical separations in chemistry, biology, medicine, engineering, research, and industry. The course covers general separations concepts and principles, with an emphasis on liquid chromatography and its various modes, including partition chromatography, ion chromatography, enantiomer chromatography, size exclusion chromatography, and affinity chromatography. Other topics include materials and instrumentation, gas chromatography, supercritical fluid chromatography, electrophoresis and related techniques, and a host of miscellaneous separation (e.g., TLC, FFF, CF) and extraction (e.g., LLE, SPE, SPME) modalities.

Student Learning Outcomes: By the end of this course, you will be familiar with each of the modes of separation science that are used in the modern research laboratory. You will have explored the theory behind each of these modes, and will be ready to apply this experience in practical settings, whether they be in the academic research laboratory, the industrial quality control/assessment laboratory, or anywhere in between.

Required Texts:

- *Principles of Instrumental Analysis*, Skoog, Holler and Crouch, 6th Edition (Thomson & Brooks/Cole) or 7th Edition (CENGAGE Learning)
- *Introduction to Modern Liquid Chromatography*, Snyder, Kirkland, Dolan, 3rd Edition (Wiley) – available electronically at the library

Prerequisite Courses: This course assumes you have a basic familiarity with analytical chemistry techniques for instrumental analysis. For students at the St. George campus, this typically means successful completion of CHM317H, but exceptions may be granted by the instructor.

Topics and Lecture Notes:

1. General Separations Concepts and Principles
2. Liquid Chromatography Instrumentation
3. Liquid Chromatography Modes
4. Gas & Supercritical Fluid Chromatography
5. Capillary & Gel Electrophoresis
6. Miscellaneous Techniques (TLC, LLE, SPE, FFF, and others)

The six topics listed above correspond to six lecture notes files. Each -file will be posted to the course website prior to the corresponding lectures. Each group of two topics constitutes a "module" that will be addressed chronologically throughout the semester – specifically, module 1 (topics 1-2) in Sept-Oct, module 2 (topics 3-4) Oct-Nov, and module 3 (topics 5-6) in Nov-Dec. Each module is associated with a problem set, a virtual laboratory exercise, and a term test.

Course Website: The course website can be found by logging in to your Quercus account at <https://q.utoronto.ca>. You are advised to check the course website often, as content will be updated regularly. Content to be posted on the course website is summarized below:

- Syllabus and Course Schedule
- Lecture Notes
- Problem Sets and Keys
- Old Tests and Keys
- Virtual Lab Assignments
- Term Tests and Keys

Marking Scheme: Your mark in this course will come from three tests (90%) and from your average score on virtual laboratory exercises (10%). The dates for these assignments are given in the table below. ***There will be no "make-ups," so record these dates and times now and plan to participate accordingly.*** Each test will cover the material in one of the three units in the course, and thus has (nominally) the same 'weight' or 'importance.' But because anyone can have a bad day (and can make a bad mark on that day), your final mark will be calculated as 40% - test with your highest score, 40% - test with your second-highest score, 10% - test with your lowest score, plus 10% - lab participation. For example, if you score a 90, a 70, and a 50 on the tests and have an average of 90 for the virtual lab assessments, your final mark will be a 78.

Assignment	Date and Time (all times Eastern)
Term Test 1	Thursday, October 7, 6:00 – 8:00 PM, place TBD
Term Test 2	Thursday, November 4, 6:00 – 8:00 PM, place TBD
Term Test 3	Time and place TBD (after final lecture)
Virtual Laboratory Exercises	Due online on October 5, November 2, and December 7, 5:00 PM

Term Tests: There are three term tests, each corresponding to one of the course modules, which will be administered and completed in person. The first two tests have been scheduled for October 7 and November 4 from 6:00 – 8:00 PM Eastern Time Zone (place TBD); the third has not been scheduled but will occur after the final virtual lecture on December 7. Failure to participate in term tests will result in a grade of 'zero'; the only acceptable excuse is an illness or other medical emergency, as addressed below.

Virtual Laboratory Exercises: On quercus, you will find three virtual laboratory exercise files, each corresponding to one of the course modules. The first two exercises use the "HPLC Simulator" software package (<http://www.multidlc.org/hplcsim/hplcsim.html>), and the third uses the "PeakMaster" software package (<https://web.natur.cuni.cz/~gas/peakmaster.html>). You are welcome to complete the virtual lab exercises at any time until they are due on October 5, 5:00 PM Eastern Time Zone (exercise 1), November 2, 5:00 PM Eastern Time Zone (exercise 2), and December 7, 5:00 PM Eastern Time Zone (exercise 3). If you do not submit by the designated dates and times, your mark will be 'zero.' Note that the exercises are designed to be relatively straightforward, and a source of "easy" high marks. Don't miss out on them!

Problem Sets and Old Tests: On quercus, you will find three problem sets, each corresponding to one of the course modules. The problem sets will not be collected or marked, but working them is highly recommended to prepare for the tests. Likewise, a set of old tests and keys has been posted, which may also be useful for preparation, but note that the format for the tests in previous years (esp. those that were given online) will be quite different than the format that will be used this year.

Absences: You are advised to attend all of the, but attendance will not be marked or collected. On the other hand, completion of the virtual lab exercises and participation in the term tests is mandatory; absences are only excusable because of illness or other medical emergency. In such a case, **before the date/time that the assignment is due**, you must (i) contact the instructor by email or other means, and (ii) declare the condition using the "Absence Declaration Tool" on ACORN (<https://www.acorn.utoronto.ca/>) which is found in the "Profile and Settings" menu.

Academic Integrity: You are encouraged to discuss course content and to work problem-sets and old tests with your classmates. But the assignments that will be graded (including the virtual laboratory exercises and term tests) in this course should be completed by you and you alone, according to the university's policies on academic integrity.

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>) outlines the behaviours that constitute

academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement
2. Submitting your own work in more than one course without the permission of the instructor
3. Making up sources or facts
4. Obtaining or providing unauthorized assistance on any assignment

On tests and exams:

1. Using or possessing unauthorized aids
2. Looking at someone else's answers during an exam or test
3. Misrepresenting your identity

In academic work:

1. Falsifying institutional documents or grades
2. Falsifying or altering any documentation required by the University

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <https://www.academicintegrity.utoronto.ca/>).