CHEM 4080 – Advanced Analytical Separation Methods
Fall 2023

Professor: Dr. Trevor VandenBoer   Email: profvdb@yorku.ca
Lecture: CC211 T/R 11:30-12:45   Office hours: CB344, Zoom, Wednesdays 11:00
                                              (or by appointment)

Prerequisites: CHEM 2021, CHEM 2080, and CHEM 3080

<u>Other Course Information</u>

- Lectures will be delivered in-person and audio only will be recorded using Zoom (unless otherwise indicated). These recordings will only be available to students enrolled in the course.

- Students are strongly encouraged to attend and participate in discussions during class. If you do not attend, understand that there is no guarantee the sound will be recorded.

- Office hours will be conducted through Zoom (link below). Students will require their YU Passport login and are encouraged to turn on their camera during office hours.

- Office hour: https://yorku.zoom.us/j/99033060266?pwd=ZzliQnN2OXJoa2hqd2hoclZQZE5kUT09

Structure of Course Evaluation	Marks
Assignments (2 x 8 each)	16
Midterm	10
Dry Lab	8
Participation	3
Encounters	2
Term paper	28
Annotated bibliography	*4*
Final paper	*24*
Final exam	33
Total:	100

<u>Dates for Course Evaluation</u>
please note that all dates are tentative

Tuesday, October 3, 2023	Assignment 1 due date
Thursday, October 19, 2023	Term paper topic choice
Friday, October 20, 2023	Encounter 1 due date
Tuesday, October 24, 2023	Midterm (in-class)
*Thursday, October 26, 2023	Walking Trip to Dalton Pharma Analytical Labs
Tuesday, November 14, 2023	Term paper annotated bibliography due
Tuesday, November 21, 2023	Assignment 2 due date
Thursday, November 30, 2023	Dry lab due date
Tuesday, December 5, 2023	Term paper due date
Tuesday, December 5, 2023	Encounter 2 due date

<u>Evaluation Details</u>
The grading scheme for the course conforms to the 9-point grading system used in undergraduate programs at York (e.g., A+ = 9, A = 8, B+ - 7, C+ = 5, etc.). For more information, please see the Senate Policy on Common Grading Scheme for Undergraduate Faculties (https://secretariat-policies.info.yorku.ca/policies/common-grading-scheme-for-undergraduate-faculties/).

Assignments:
- Assignments will involve critiques of separations and methods from the literature.
- All assignments will be submitted through CrowdMark.
- Assignments are due at 11:30 am on the date indicated. Late assignments will be accepted with a penalty of 10 % for work received after class on the due date and an additional 10 % per calendar day up to 3 days after the due date. Students who are unable to complete assignments due to illness or other reason will have the value of the assignment added to the weight of the final exam.

Dry lab:
- Students will explore separation conditions using a software-based HPLC instrument and use the simulator to answer questions.
- The dry lab is due at 11:30 am on the date indicated. Late work will be accepted with a penalty of 10 % for work received after class on the due date and an additional 10 % per calendar day up to 3 days after the due date. Students who are unable to complete the dry lab due to illness or other reason will have the value of the assignment added to the weight of the final exam.

Participation
- Participation will be assessed using iClicker REEF.
- iClicker marks are gained based on <u>participation only</u>.
- Clicker questions will be provided in an "assignment" format and can be completed live or while reviewing the lecture afterwards. Due dates for participation will accompany these assignments.
- York has free subscription to iClicker REEF, so do not make any purchase even if prompted.
- Ensure your correct student number is associated with your iClicker account. Failure to do so may mean that your participation is not counted.
- Clicker questions can be completed up to 2 weeks after the corresponding lecture (or until the end of classes, whichever comes first).
- To find Clicker questions, search for CHEM 4080/5080. Clicker questions will be found under the "assignments" menu.

Encounters
- Analytical chemistry and effective separations underlie many things in our daily lives. Students will submit brief reflections of ~250-500 words on 2 encounters in their lives that have changed through their learning in this course. These submissions must clearly demonstrate a link to course materials and concepts.

Term paper
- Each student will choose a unique analyte/matrix combination. Using literature references, students will contrast and critique existing methods and select and defend the "best" method to analyze for their analyte/matrix. Analyte/matrix combinations will be selected from a list or alternative ideas submitted for approval to Dr. VandenBoer.
- An annotated bibliography of relevant literature will be submitted prior to the term paper.
- Term paper and annotated bibliography are due at 11:30 am on the date indicated. Late work will be accepted with a penalty of 10 % for work received after class on the due date and an additional 10 % per calendar day.

Recommended References
1. Harris and Lucy. Quantitative Chemical Analysis, 10th Ed. or any other edition of the textbook.
2. Skoog. Principles of Instrumental Analysis, 7th Ed. or any other edition of the textbook

<u>Other Course Information</u> (also see Appendix B, posted on eClass)

Email Etiquette
- Students must use their YorkU email address.
- Emails must include the course code in the subject line.
- Use professional language in emails, including a salutation and a signature that includes your full name and student number.

Awareness
Students must make themselves aware of York University policies on Academic Honesty/Integrity, Access/Disability, Student Conduct, Religious Observance and other matters. A periodically updated Information Sheet summarizing this information can be downloaded* and printed, as well as the Registrar's Office issues a list of Religious Observance Days.‡

* http://secretariat.info.yorku.ca/files/CourseInformationForStudentsAugust20121.pdf
‡ http://registrar.yorku.ca/enrol/dates/religious-accommodation-guidelines-2018-2019

Accessibility and Religious Accommodations
- Students registered with Accessibility Services must submit accommodation letters via email to Dr. VandenBoer by September 30, 2023.
- Any religious observance conflicts occurring at any point during the term should be communicated by email to Dr. VandenBoer by September 30, 2023.
  - https://www.yorku.ca/secretariat/policies/policies/academic-accommodation-for-students-religious-observances-policy-guidelines-and-procedures/
- Note: "Senate policy states that students are expected to monitor their progress in courses, taking into account their personal and academic circumstances, and to make the necessary adjustments to their workload to meet the requirements and deadlines." (from Senate Policy of Students' Responsibilities in the Petition/Appeal Processes). The drop deadline is November 8, 2023.

Academic Honesty
- Any student who breaches York's Academic Honesty Policy will be reported. Some offences include:
  - Plagiarism.
  - Students who misrepresent themselves during iClicker activity, a quiz, or examination or provide documentation for absence from any of these that is not legitimate.
  - Students who submit any material for remarking that has been modified in any manner to misrepresent the original assessment.
- Information regarding the consequences for academic dishonesty at York University can be found in the "Academic dishonesty consequences" document on eClass.
- Students are strongly encouraged to familiarize themselves with these policies. Ignorance of the policies is not an acceptable excuse. https://spark.library.yorku.ca/academic-integrity-what-is-academic-integrity/

Course Goals

Develop a comprehensive understanding of the principles of analytical separations, enabling students to:

    i.   Develop separation methods for use in the laboratory.

    ii.   Critically evaluate separation methods described in the scientific literature.

Course Content Overview

Unit 1. Introduction to separations and method development
- A. The analytical process
- B. Defining a good method
- C. Essentials in preventing method error: QA/QC
- D. General considerations in selecting an analytical method
- E. Common detection methods

Unit 2. Chemical properties for understanding separations
- A. Acidity and basicity
- B. Partitioning

Unit 3. Sample preparation
- A. Extraction basics
- B. Preparing liquid samples
- C. Preparing solid samples
- D. Preparing gas samples
- E. Incorporating QA/QC in sample preparation
- F. Preparing biological samples

Unit 4. Separation theory
- A. Separation basics
- B. Optimizing resolution
- C. Solid phase extraction

Unit 5. Partition based analytical separations
- A. Gas chromatography
- B. Liquid chromatography
- C. Ion chromatography
- D. Size-exclusion chromatography
- E. Affinity chromatography

Unit 6. Mobility based separations
- A. Ion mobility spectrometry
- B. Capillary electrophoresis

Unit 7. Sampling
- A. Sampling strategy
- B. Sample collection
- C. Incorporating QA/QC

Unit 8. Special topics in analytical separations (as time allows)