University of Toronto Mississauga

Separations, Chromatography and Microfluidics (CHM1105H5S)

Course Syllabus

Winter 2019

Course Instructor (Graduate): Ulrich Krull
E-mail: ulrich.krull@utoronto.ca
Office: DV3216

Course Lecturer: Abootaleb Sedighi
E-mail: taleb.sedighi@utoronto.ca
Lecture: Mon & Wed 12:00pm – 1:00pm
Tutorial: Fridays 9:00am – 10:00am

Reference Books: (recommended)

"Chromatography and Separation Science", Satinder Ahuja, Academic Press Publishing, New York, 2003.

"Principles of Instrumental Analysis" (any recent edition), Skoog *et al.*, Thomson Brooks/Cole

Marking Scheme

Term Test: February 11, 2019	15% of Course Mark
Tutorial Presentation:	15% of Course Mark
Term Paper (electronic submission): due by April 5, 2019	40% of Course Mark
Final Examination at same time/location as CHM416 exam in April exam period:	30% of Course Mark
	Total: 100%

Course Topics

1. General introduction to separation science
    - Equilibrium as the driving force for separative displacement (phase equilibria, chemical equilibria)
    - Separations driven by external forces (electric field, gravity)
    - Separations based on molecular and particle size exclusion methods

2. Extraction principles and techniques
    - Distribution isotherms (adsorption, absorption, partition)
    - Molecular interactions and solvent power scale
    - Continuous extraction
    - Countercurrent extraction
    - Solid phase extraction/microextraction
    - Supercritical fluid extraction
    - Osmosis, dialysis
    - Flotation

3. Chromatographic methods
    - Classification of chromatographic methods and their separation characteristics
    - Basic chromatography theory

4. Paper and thin-layer chromatography

5. Gas chromatography (theory, instrumentation, detectors, interfaces to MS)

6. Liquid chromatography (theory, instrumentation, detectors, interfaces to MS)

7. Electric field driven separations
    - Electrophoresis
    - Microfluidics
    - Electroosmotic flow

Students are responsible for all topics covered, even if they are unable to attend a lecture or tutorial session. In such an event, students are encouraged to read through the materials posted on Quercus, read the related chapters of the reference books, get in touch with your classmates and/or visit the Course Instructor to ensure that you are prepared for any test, presentation or exam questions related to the topic in question.

Midterm Test

The Midterm Test (Feb 11) will be 50 minutes in length and takes place during a regularly scheduled lecture period, starting at 12:10 pm. Pens and a ruler are the only aids permitted. No calculators, MP3 players, iPods, iPads, cell phones, smart phones, tablet computers, or other

electronic devices will be permitted. These items should be left at home, or left at the front of the classroom and turned off. A penalty may be imposed if any of these items are found on or within reach of a student during the writing of the Midterm Test. The Midterm Test can be written in pencil; however, re-marking of tests written in pencil is not permitted.

Tutorials
CHM1105S students will attend the CHM416S tutorials on all dates unless otherwise arranged.

Final Exam
The Final Exam will be three hours in length, cumulative, and scheduled during the final examination period of the winter term.

Term Paper
The topic that you choose for your term paper (the same as that you will present in class) should be researched and written in the form of a critical review, expressing the present state of the field and your views and opinions about where the field is heading based on your readings. The length of the essay should be about 10,000 words (i.e. 40 pages of concise text, double spaced). References will primarily be to the research literature, and should focus on advances that have taken place in the past 3-5 years.

The topic area for the term paper is to be related to separations/extraction/fluidics, and is flexible for selection by students so that they can pursue their personal interests.

Please send me an Email by Wednesday January 21 that confirms the topic that you intend to write about. The date for your presentation will be conveyed by January 29.

Presentations

The topic selected for your presentation will also serve as the topic of your term paper. Presentations are scheduled for Fridays 9:10-10am, during regular tutorial session times. Presentations will be individual, will have a thirty (30) minute allocation of time, and should include an overview of the relevant theory, technology/instrumentation, applications and future directions. The audience should walk away with a clear message of what, why and how. Your presentation should be instructional, the level should target an advanced undergraduate class, and the content should convey the unique potential of your topic as an analytical methodology.