Chemical Engineering 4M03
Industrial Separation Processes
COURSE OUTLINE – FALL 2023

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	Office hours:	Tuesdays from 10am-11am	
TEACHING ASSISTANTS:			Office hours (in JHE 345)
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OFFICIAL DESCRIPTION: Overview of industrial separation processes, liquid-liquid extraction, adsorption, filtration, membrane separations, and separations applicable to the water and energy industries.

PREREQUISITES: CHEM ENG 2O04, CHEMENG 3A04, and CHEMENG 3M04

We will use "Avenue to Learn" (AVENUE) extensively in this course including:
- Posting of course materials (e.g. lecture notes, assignments)
- Posting of course announcements (e.g. guest speakers)
- Submitting your homework assignments and tutorial activities
- Grading activities

Thus you are expected to check the course Avenue page quite regularly.

COURSE OUTLINE*:
1. Overview of separation processes; including:
    a. Economic significance
    b. Guidelines for sequencing of separation processes
    c. Use of process simulators
2. Characterization of molecules, macromolecules, particles, and microorganisms
3. Liquid-Liquid Extraction
4. Membrane-based processes (Reverse Osmosis, Nanofiltration, Ultrafiltration, & Microfiltration)
5. Sorption processes (Adsorption & Ion Exchange)
6. Sedimentation & Centrifugation
    (including coagulation and flocculation)

*Order of topics is subject to change at the discretion of the instructor.

REQUIRED MATERIALS:

There is no official course textbook. Instead, an extensive list of references (many of which will be posted on Avenue) for each topic will be given.

Below I've posted a few links to some great e-books related to certain topics in the course outline that are available through the McMaster library:
- Richard W. Baker, Membrane Technology and Applications, John Wiley & Sons https://ebookcentral.proquest.com/lib/mcmu/reader.action?docID=977928

- Richard G. Holdich, Albert Rushton, and Anthony S. Ward, Solid-Liquid Filtration and Separation Technology : An Introduction, John Wiley & Sons, https://ebookcentral.proquest.com/lib/mcmu/detail.action?docID=481346

When we get into the topic of membrane-based processes, you will be tasked with using DuPont's WAVE Design software to design water treatment systems and analyze their feasibility and performance. You can download a free copy of the full software at https://www.dupont.com/water/resources/design-software.html; some key details for you to know:

1. You will be required to first create an account on the DuPont website.
2. WAVE is only supported on Windows computers and so if you are using a Mac then you will need to run a dedicated Windows partition.

WHAT YOU MUST BE ABLE TO DEMONSTRATE BY THE END OF THE COURSE: This course will bring together multiple aspects from other Chemical Engineering courses: fluid flow, heat transfer, mass transfer, mass and energy balance calculations. We will also be introducing concepts of process analysis and operations, which tie in with the ChE 4N04 and ChE 4W04 courses. The other courses you have taken at McMaster, such as physics, will be heavily used to derive the principles underlying various separation processes. Your math courses will be used to solve the equations we derive. Be prepared to go back to these course notes during assignments, and when preparing for class.

GRADING:
The following shows the contribution of components to the final grade:

Component	Weight	Notes
Assignments	30%	There will be 5 assignments; some will be done individually, and some can be completed in groups of 2.
Tutorial Participation	15%	For a select number of tutorials, you will be asked to upload a completed copy of your work from the tutorial activities to Avenue shortly after the session.
Midterm	15%	See post on "Avenue to Learn" for date, time, & location.
Final Exam	40%	2.5 hours; to be scheduled by the Registrar's office.

Policies regarding grading:

- No sharing of ANY work may be done between groups for assignments. This includes handwritten documents and electronic files of any type. Reusing solutions from previous years will be considered plagiarism.
- Please ensure that you have read the University's academic integrity policy (part of which is reproduced below).
- The assignments and midterm are completely optional – thus no MSAFs are needed and no makeups are allowed. For any evaluation you choose not to complete, the associated weight will simply be added to the final exam. No notice (*i.e.* email to the instructor) is needed if you choose not to complete the midterm and/or an assignment(s).
- For those assignments that can be completed in groups of no more than 2 members.
  - You and your partner will receive the greatest benefit if you each do all the questions yourselves. Arrange to meet and review your solutions, discussing various approaches.
  - You are defeating the purpose of the group-based assignment if you simply divide the assignment into sections, one for each group member. This is definitely not recommended,

because you are losing out on the learning opportunity of seeing your mistakes and your partner's mistakes, and learning from them.
    - Assemble and post to AVENUE a single submission (in PDF format) with both names & student numbers clearly identified at the top of the first page. The grade assigned for each submission will be given to both members of the group.
- Assignments must be handed in by 7:00pm on the scheduled due date. Late assignments may be accepted at the discretion of the instructor but only if a request is made no later than 12:00pm on the scheduled due date.
- Any paper-based materials (textbooks, notes, etc.) and the McMaster-approved calculator are allowed during the midterm and the final exam.
- The final percentage grades will be converted to letter grades using the Registrar's recommended procedure; grade adjustments are at the discretion of the instructor.

LECTURE RECORDINGS: I strongly recommend that you attend the lectures in person, however I am keenly aware that due to many factors (e.g. COVID, job interviews) that it is not always possible. Thus, all the lectures will be recorded (but not livestreamed) via ECHO360 lecture capture (no guarantees on quality or reliability).

The P.R.O.C.E.S.S.

The department of Chemical Engineering has a storied history of education. In addition to teaching and learning, the department is proud of our graduates not only for their academic success, but their more intrinsic traits that make them respected members of the engineering community.
Recently, several high-ranking graduates from the McMaster Chemical Engineering Program employed in various industries (oil/gas, financials, etc.) were interviewed to ask what traits they look for when hiring for engineering positions. Using this information, the department would like to present to you the PROCESS: a code of conduct that we hope will guide our students throughout this program and their careers to come.

- Professionalism
- Responsibility
- Ownership
- Curiosity
- Empathy
- Selflessness
- Service

It is up to YOU to interpret these traits and apply them to your time at McMaster and your career as you see fit. These traits will not be assessed for grades but will be strongly encouraged throughout your time at McMaster**. We hope that you identify with these character traits and what they mean to you, and that you trust the P.R.O.C.E.S.S.**

APPROVED ADVISORY STATEMENTS

Academic Integrity

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity. **It is your responsibility to understand what constitutes academic dishonesty.**

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

Authenticity / Plagiarism

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. Avenue to Learn, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

Courses with an On-line Element

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn, LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

Online Proctoring

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

Conduct Expectations

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the Code of Student Rights & Responsibilities (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

Academic Accommodation of Students with Disabilities

Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a

Program Coordinator. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

Requests for Relief for Missed Academic Term Work

In the event of an absence for medical or other reasons, students should review and follow the Policy on Requests for Relief for Missed Academic Term Work.

Academic Accommodation for Religious, Indigenous, or Spiritual Observances (RISO)

Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students should submit their request to their Faculty Office **normally within 10 working days** of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Copyright and Recording

Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, **including lectures** by University instructors.

The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

Extreme Circumstances

The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, Avenue to Learn and/or McMaster email.