

**W.Booth School of Engineering Practice  
&Technology**  
**PROCTECH 3CE3**  
**Chemical Engineering III: Unit and  
Process Design**  
*Fall 2023*



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**ENGINEERING**

### **Instructor Information**

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Kostas Apostolou

**Email:** apostol@mcmaster.ca

**Office:** ETB/213

**Office Hours:**

TBD

Teaching Lectures

Ali Mohsenipour

**Email:** mohsea2@mcmaster.ca

**Office Hours:**

TBD

Teaching Labs

Douglas Ferrier

**Email:** ferried@mcmaster.ca

**Office Hours:**

TBD

Teaching Labs

### **Course Information**

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**Lectures:** 3 hours per week

**Labs:** 2 hours per week

**Course Dates:** 09/05/2023 - 12/06/2023

**Units:** 3.00

**Course Delivery Mode:** In Person

**Course Description:** This course covers simulation and analysis of integrated process units within a chemical process plant. Key topics covered are: process flow diagrams and simulation models, process analysis using simulation model, rudimentary process optimization and plant simulation Three lectures, one lab (two hours); first term  
**Prerequisite(s):** ENGTECH 2MA3, PROCTECH 2EC3, 3CT3 and registration in Level IV of Automation Systems Engineering Technology.

## Instructor-Specific Course Information

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**This course specifically covers:**

Reaction kinetic fundamentals and reactor design. Heat Transfer: one dimensional conduction and convection. Heat exchanger calculations. Fluid flow: laminar and turbulent flow; Bernoulli's equation; pressure drop through pipes. Introduction to process simulation software; construction and interpretation of process flow diagrams. Process optimization through simulation

## Meeting Details

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Week	Topic
1	<u>Introduction</u>
2	<u>Reaction kinetics:</u> Rate of reaction, rate laws, Arrhenius equation
3	<u>Reaction kinetics:</u> Reaction mechanisms, catalysis
4	<u>Chemical Reactor Design:</u> Batch, CSTR balance equations
5	<u>Chemical Reactor Design:</u> Examples
<b><i>Midterm Recess</i></b>	
6	<u>Heat Transfer:</u> One dimensional conduction

	<b>Test 1</b>
7	<u>Heat Transfer:</u> One dimensional conduction & introduction to convection
8	<u>Heat Transfer:</u> Convection & Heat Exchangers fundamentals
9	<u>Heat Transfer:</u> Heat Exchanger equations and design
10	<u>Fluid flow:</u> Introduction: laminar vs turbulent flow. Bernoulli's Equation
11	<u>Fluid flow:</u> Application of Bernoulli's equation <b>Test 2</b>
12	<u>Fluid flow:</u> Pressure drop in pipes
13	<u>Review</u>

<b>List of Experiments</b>	
Week 1	Intro to UniSim Design – Heat Exchanger
Week 2	Reactions – CSTR
Week 3	Reactions – CSTR Case Studies
Week 4	Reaction – PFR
Week 5	Demethanization
Week 6	Biodiesel production
Week 7	Steam Power Plant
Week 8	PID Control
Week 9	PID Control #2
Week 10	PID Control #3 ?
Week 11	Lab Test

**Important Links**

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- [Mosaic](#)
- [Avenue to Learn](#)
- [Student Accessibility Services - Accommodations](#)
- [McMaster University Library](#)
- [eReserves](#)

## Course Learning Outcomes

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For accreditation reasons, these learning outcome statements must be tied back to CEAB graduate attributes (GAs), including those that are measured in this course. If you are unsure how to do this, please contact the Associate Chair Undergraduate in your department.

- Combine mass and energy balances to calculate required flowrates and energy inputs in chemical reactors.
- Integrate mass balances with reaction rate fundamentals for predicting the extent of reactions in CSTR, PFR, and Batch reactors
- Perform one-dimensional conduction and convection calculations.
- Relate liquid height to pressure and perform hydrostatic pressure calculations
- Use the Bernoulli equation and augment it for calculations in pipes
- Execute process analysis using Unisim Design
- Monitor the transient behavior of industrial processes through process simulation software and critique on the interplay of the control aspects of those processes.

## Required Materials and Texts

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Textbook Listing: <https://textbooks.mcmaster.ca>

N/A

## Optional Course Materials

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Textbook Listing: <https://textbooks.mcmaster.ca>

### Elements of Chemical Reaction Engineering

**ISBN:** 9780137459438

**Authors:** H Scott Fogler

**Publisher:** Pearson

**Publication Date:** 2021

**Edition:** 6th

### Fundamentals of Heat and Mass Transfer

**ISBN:** 978-1-119-35388-1

**Authors:** Theodore L. Bergman, Adrienne S. Lavine, Frank P. Incropera, David P. DeWitt

**Publisher:** Wiley

**Publication Date:** December 2018

**Edition:** 8th

### Munson, Young and Okiishi's Fundamentals of Fluid Mechanics

**ISBN:** 978-1-119-54799-0

**Authors:** Philip M. Gerhart, Andrew L. Gerhart, John I. Hochstein

**Publisher:** Wiley

**Publication Date:** December 2018

**Edition:** 8th

## Class Format

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In Person

## Course Evaluation

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Assessment	Weight
Quizzes	10%

Term Test	35%
Labs	25%
Final Examination	30%

## Grading Scale

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Grade	Equivalent Grade Point	Equivalent Percentages
A+	12	90-100
A	11	85-89
A-	10	80-84
B+	9	77-79
B	8	73-76
B-	7	70-72
C+	6	67-69
C	5	63-66
C-	4	60-62
D+	3	57-59
D	2	53-56
D-	1	50-52
F	0	0-49

## Course Schedule

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### Lectures:

Friday 9:30AM - 10:20AM in HSC 1A1

Monday 3:30PM - 5:20PM in ABB 102

### Labs:

All labs are in Mohawk College Fennel Campus room i-216

Monday 8:00AM - 9:50AM or 11:00AM - 12:50PM or

Tuesday 9:00AM - 10:50AM or 12:00PM - 1:50PM or

Thursday 8:00AM - 9:50AM or 11:00AM - 12:50PM or 1:00PM - 2:50PM or 3:00PM -

4:50PM or

Friday 2:00PM - 3:50PM or 5:00PM - 6:50PM

## Laboratory Overview, Operation, and Safety

The Faculty of Engineering is committed to McMaster University's Workplace and Environmental Health and Safety Policy which states: "Students are required by University policy to comply with all University health, safety and environmental programs and policies". It is your responsibility to understand McMaster University's Risk Management system, which is supported by a collection of Risk Management Manuals (RMMs) that contain programs and policies in support of the Risk Management System. The RMMs are available from [https://hr.mcmaster.ca/employees/health\\_safety\\_well-being/our-safety/risk-management-manuals-rmms/](https://hr.mcmaster.ca/employees/health_safety_well-being/our-safety/risk-management-manuals-rmms/).

It is also your responsibility to follow any specific Standard Operating Procedures (SOPs) provided for specific experiments (see course lab manuals) and the laboratory equipment.

Additionally, McMaster University's workplace health and safety guidance related to COVID-19 must always be followed (available from <https://hr.mcmaster.ca/resources/covid19/workplace-health-and-safety-guidance-during-covid-19/>).

## Absences, Missed Work, Illness

### **Exams:**

Absence from a test without an approved MSAF will result in a grade of zero for the test. If an approved MSAF is submitted, the weight of the missed test will be added to the final exam's weight. In case of multiple missed tests with approved MSAFs, the opportunity to write missed test(s) at an alternate date may be offered, at the discretion of the instructor.

### **Quizzes:**

Most quizzes will be on-line asynchronous with a limited number of announced in-class synchronous ones. Absence from any quiz without an approved MSAF will result to a

grade of zero for that quiz. A submitted MSAF for an asynchronous on-line quiz will be accommodated by extending the submission window for that quiz. A submitted MSAF for an in-class synchronous quiz will be accommodated either by distributing the weight of the quiz to the remaining quiz components (which might mean that a student will miss any opportunity to “drop” the worst quiz from his/her grade) or by providing the opportunity to take an equivalent on-line asynchronous quiz.

### **Lab Sessions:**

Labs must complete in the section/time students are registered at. Absence from a lab without an approved MSAF form will result in a grade of zero for the lab. Details for number of labs and lab reports will be outlined during first week of labs. All lab reports are due one week from the day of performing the corresponding experiment, unless otherwise noted. Reports submitted late without an acceptable explanation or prior permission will be penalized by 10% per calendar day.

### **Turnitin.com**

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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. A2L, 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](http://www.mcmaster.ca/academicintegrity).

### **Generative AI: Use Prohibited**

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Students are not permitted to use generative AI in this course. In alignment with [McMaster academic integrity policy](#), it “shall be an offence knowingly to ... submit academic work for assessment that was purchased or acquired from another source”.



This includes work created by generative AI tools. Also state in the policy is the following, “Contract Cheating is the act of “outsourcing of student work to third parties” (Lancaster & Clarke, 2016, p. 639) with or without payment.” Using Generative AI tools is a form of contract cheating. Charges of academic dishonesty will be brought forward to the Office of Academic Integrity.

## **APPROVED ADVISORY STATEMENTS**

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### **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](https://secretariat.mcmaster.ca/university-policies-proceduresguidelines/), 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](http://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](mailto:sas@mcmaster.ca) to make arrangements with a Program Coordinator. For further information, consult McMaster University’s [Academic Accommodation of Students with Disabilities](#) policy.

### **Academic Advising**

For any academic inquires please reach out to the Office of the Associate Dean (Academic) in Engineering located in JHE-Hatch 301.

Details on academic supports and contact information are available from:

<https://www.eng.mcmaster.ca/programs/academic-advising>

### **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.