

OUTLINE OF CHEMICAL ENGINEERING 4K3/6K3: Sep 2-Dec 4, 2025

Reactor Design for Heterogeneous Systems

The land on which we learn is on the traditional territories of the Mississauga and Haudenosaunee nations, and within the lands protected by the “Dish with One Spoon” wampum agreement.

Instructor: Dr. P. Mhaskar (he/him/his, JHE-216A; email: mhaskar@mcmaster.ca)

- The outline borrows liberally (and gratefully) elements from Dr. Kim Jones course outline for Che 3BK3.

TA:

Lectures: Please see Avenue/Mosaic

Course Timeline (subject to change)

Sep 3	Chapter 1 Done
Sep 5	Practice + GWS 1
Sep 8	Chapter 2, till slide 14
Sep 10	Chapter 2 complete, introduce Asmt 1, project
Sep 12	Practice + Graded WS 2
Sep 15	Chapter 3 slides, till slide 15
Sep 17	Chapter 3 slides, till slide 35
Sep 19	Practice + Graded WS 3
Sep 22	Chapter 3 slides, till slide 41
Sep 24	Chapter 3 slides, till slide 53
Sep 26	Practice + Graded WS 4
Sep 29	Till end of chapter 3
Oct 1	In-Class Test
Oct 3	Google colab session, Assignment 1
Oct 8	
Oct 10	Till end of chapter 3 +Google Colab
Oct 12	Google Colab Session (run by Aswin Chandrasekar)
Oct 13-19	Practice + Graded WS 5
Oct 22	Chapter 4 till slide 18
Oct 24	Chapter 4, till slide 28
Oct 27	Practice + Graded WS 6
Oct 29	Project help (Run by Aswin Chandrasekar)
Oct 31	
Nov 3	Project help (Run by Aswin Chandrasekar)
Nov 5	Practice + Graded WS 7
Nov 7	Student Created Questions for MT
Nov 10	Chapter 4, till slide 36 Project related
Nov 12	Practice + Graded WS 8
Nov 14	End of Chapter 4
Nov 17	Chapter 5 till slide 13
Nov 19	Practice + Graded WS 9
Nov 21	Chapter 5 till slide 19

Nov 24	Chapter 5 till slide 28
Nov 26	Practice + Graded WS 10
Nov 28	Chapter 5 finish
Dec 1	Project related
Dec 3	Practice + Graded WS 11
	Course Recap 1
	Course Recap 2- end of lectures

Tests: Schedule:

In-Class Test Question Due September 27, 11:59 PM

In-Class Test: October 1st

Mid Term Test Question Due October 27, 11:59 PM

Mid Term Test: October 31, Venue

6:30-8:30 PM

Final Exam Test Questions Due: 1 week before the final exam

You are allowed to bring your device and write the test on your device if it is in airplane mode. All tests will be open book/open notes etc. Also note that at the end of the test, you will be uploading your test to a folder on Avenue (use a device to take pictures and create a PDF).

Notes: The tests and the exam will be open book and open notes. You will be allowed the use of your device (in airplane mode) while writing the exam.

Examination: Final examination, 2.5 hours.

Office hours:

Please reach out by email or through Teams and we'll set up a meeting time that works for both of us. My hope is to meet individually with each of you (briefly at least) at some time through the term. I will do my best to respond within 24 hours (either email or through Teams). Please send me a gentle reminder via **email** if you do not hear back from me within 24 hours. Your teaching assistant is available to help and will share their availability for dedicated office hours.

Participation: If your preferred name is not the same as the name that appears on the university provided roster for the course, please let me know so that I can use your preferred name. I often seek feedback during lectures and incorrect answers (or "I don't know") are valuable feedback! Please let me know if you are deeply uncomfortable being asked questions (due to social anxiety or any other reason).

Activity: Some of the activities I really like are playing chess online on chess.com- my handle is mhaskarP. Others are Badminton and Squash and Tennis. I am an intermediate level player in all these (so somewhere between a complete beginner and the best in the world), and love playing with others who may be in a similar bracket. Let me know if you would like to play one of these.

Calculators: Any calculator may be used in the tests and final exam.

Prerequisites: There are prerequisites for this course. If you haven't done too well in those courses or feel that you may not have grasped those concepts as well as you could, that is ok. I will cover every concept in enough detail that you will be able to succeed in this class. If you are ever feeling overwhelmed or uncertain, please reach out to me. I've had that same sense of being overwhelmed many times during my career, and sometimes found comfort in sharing these with folks I could trust. Let me know if I can be of any assistance.

Grading:	Graded Workshops	10	% of final grade (10 best out of 11)
	Assignments	6	% " " "
	ICT: Create a question:	2	% " " "
	In-Class Test	6	% " " "
	In-Class Redo	3	% " " "
	MT: Create a question:	2	% " " "
	Mid-term	16	% " " "
	Mid-Term Redo	6	% " " "
	Term project	20	% " " "
	FE: Create a question:	3	% " " "
	Final exam	25	% " " "

Your **final exam mark** will be used to calculate any portion of your grade where you earned a lower mark. For example, if you scored a 50% on midterm, but 80% on the final exam, the midterm mark will also be raised to 80%.

The course assessment will include competency-based assessment. The question in the in-class test will be used to assess competency in the course. Thus, you will pass the course only if you display competency in the course material by scoring more than 50% in that question. You will be given three attempts to demonstrate competency. The first being through the in-class test, and two more, with one question each on the mid-term and final exam. The question will be clearly identified in the midterm and the final exam. You only need to demonstrate competency by scoring more than 50 % on at least (any) one of these assessment.

MSAF Policy: You do not need to submit an MSAF for any missed activity. The grade of such an activity will be directly moved to the final exams. That said, if you can, you are highly encouraged to participate in the in-course activities, their difficulty level is often lower than the final exam. Please contact me as soon as possible to discuss what you need to succeed. If you need accommodations (through SAS or otherwise),

please let me know what your needs are so we can best work toward your success together. If you have caregiving responsibilities that may interfere with this class, please contact me and we can try to find flexible solutions.

The Term Project, Assignment, and Creating Questions for the in class test, midterm and final exam is to be done in groups of two (except for graduate students, who need to do it individually). **The graded WS is to be done individually.** For all your assignments and project and tests and exams, you are free/encouraged to use generative AI (tools such as chat GPT), etc, but you are responsible for the answer you submit! You are to use Python for all the programming.

The final percentage grades will be converted to letter grades using the Registrar's recommended procedure. Adjustments to final grades may be done at the discretion of the instructor. No make-up midterms will be given. Marks of missed midterm/tests will be automatically moved to the final exam.

Required Text:

Courseware available on Avenue

Supplementary References:

1. H.S. Fogler, *Elements of Chemical Reaction Engineering*, Prentice-Hall, 4rd Edition, 2006, Chapters 1,10-12, parts of Chapters 13&14.
2. J.M. Smith, *Chemical Engineering Kinetics*, McGraw-Hill (1981), 3rd Edition.
3. O. Levenspiel, *Chemical Reaction Engineering*, 2nd Edition, Wiley (1972). 3rd Edition (1999).

Objectives

Enable the students to develop an understanding of Advanced Reactor Design including Catalytic kinetics, mass transfer limitations, packed and fluidized bed reactors and two phase reactors.

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

As some of you may already be aware, 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 process**.

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](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.

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.