



**CHEMENG 3BK3
Bio-Reaction Engineering
Fall 2025 Course Outline**

Calendar/Course Description

Kinetics of cellular processes, microbial processes and enzyme reactions including those of immobilized cells and enzymes. Cell culturing. Bioreactor design. Bioprocess development including downstream processing.

Pre-Requisites and Anti-Requisites

Prerequisite(s): Registration in Level IV or above of any Chemical Engineering program or the Integrated Biomedical Engineering & Health Sciences (IBEHS) Program; or permission of the Department

Instructor Office Hours and Contact Information

Dr. Vince Leung
JHE A412
leungv@mcmaster.ca

Office Hours:
By Appointment

Teaching Assistants and Contact Information

TBD



Learning Outcomes

Learning Outcomes

Kinetics of cellular processes, microbial processes and enzyme reactions including those of immobilized cells and enzymes.

Cell culture. bioreactor design, operation, scale-up and control.

Bioprocess development including downstream processing.

Expression systems

Kinetics of cellular processes, microbial processes and enzyme reactions including those of immobilized cells and enzymes.

Cell culture. bioreactor design, operation, scale-up and control.

Course Materials

Course material posted on Avenue

Suggested Textbook:

M.L. Shuler, F. Kargi and M. DeLisa, *Bioprocess Engineering: Basic Concepts*, Third Edition, Prentice Hall, 2017

Course Overview

Week of	Topic	CHAPTERS IN SHULER AND F. KARGI
1. Sept. 1	Introduction, Applied microbiology	Ch. 2
2. Sept. 8	Enzymes	Ch. 3
3. Sept. 15	Gene expression, metabolic regulation	Ch. 4
4. Sept. 22	Cell growth (metabolism)	Ch. 5
5. Sept. 29	Growth kinetics	Ch. 6
6. Oct. 6	Stoichiometry, Bioreactor design and operation	Ch. 7, Ch. 9
7. Oct. 13	Reading Week	
8. Oct. 20	Bioreactor design and operation	Ch. 9
9. Oct. 27	Scale-up and control of bioreactors	Ch. 10
10. Nov. 3	Scale-up and control of bioreactors	Ch. 10
11. Nov. 10	Overview of downstream processes, Choice of expression system	Ch 11, Ch 12
12. Nov. 17	Presentations	
13. Nov. 24	Presentations	
14. Dec. 1	Presentations, Review	

Assessment

Component	Weight
11 Problem Sets	2% each, lowest one dropped (20% total)
In-class Participation	10%
Analysis of ChatGPT Memo of Research Paper	15%
PowerPoint presentation of research paper equations	10%
Midterm Test	15% (Week 8)
Final Exam	30%
Total	100%

Notes:

- The instructor reserves the right to alter the evaluation scheme if necessary.
- Grading will be determined from the instructor's gradesheet not marks listed on Avenue. In the case of discrepancies between the two, the marks on Avenue will be disregarded.

Course Grading

The overall percentage for the course will be converted to a letter grade using the scale recommended by the Office of the Registrar. The instructor reserves the right to adjust marks up or down. Graded reports will be kept in the department for a minimum of one year, in accordance with Senate regulations.

Methods of Communication

Announcements, labs, case studies, and lecture slides will be posted on Avenue to Learn (<http://avenue.mcmaster.ca/>). All assignments will be submitted and graded on Avenue to Learn. The most up-to-date course outline will be posted on Avenue.

The instructor and the teaching assistants will primarily communicate with students via their McMaster email address. If there are any questions, please email the instructor or the teaching assistants at the email addresses provided above.

Lectures

Three 50-minute lecture per week. Lectures will be in-person and recorded using ECHO360. Completion of in-class activities is required for lecture participation marks.

Avenue to Learn

This course uses the university's learning management system, Avenue to Learn, to allow communication between the students and to provide access to grades. Marks posted on Avenue are given for information purposes only – the final grade of the course is determined from the instructor's gradesheet. It is important that students understand how the system is used by the teaching staff to avoid problems throughout the course.

The instructor (and possibly the TAs) will use this medium to communicate announcements and provide grades whenever the assignments/labs etc. are marked. Neither the e-mail nor discussion board features on Avenue are monitored by the teaching staff. The discussion board is intended for students to collaborate on their reports. Report any misuse of the board to the instructor.

Reports/assignments are due in the Avenue dropboxes. All files (except relevant Excel files) must be in LEGIBLE pdf format.

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 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-procedures-guidelines/), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- Plagiarism, e.g., submission of work not one's own or which other credit been obtained.
- Improper collaboration in group work.
- Copying or using unauthorized aids in tests and examinations.

On all work submitted for credit by students at McMaster University, the following pledge is either required or implied:

"I understand and believe the main purpose of McMaster and of a university to be the pursuit of knowledge and scholarship. This pursuit requires my academic integrity; I do not take credit that I have not earned. I believe that academic dishonesty, in whatever form, is ultimately destructive to the values of McMaster, and unfair to those students who pursue their studies honestly. I pledge that I completed this assessment following the guidelines of McMaster's academic integrity policy."

Authenticity / Plagiarism Detection

In this course we will be using a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. Students will be expected to submit their work electronically either directly to Turnitin.com or via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish to submit their work through A2L and/or Turnitin.com must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com or A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., on-line search, other software, etc.). To see the Turnitin.com Policy, please go to the following website: www.mcmaster.ca/academicintegrity.

Academic Accommodations for 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.

Academic Accommodation for Religious, Indigenous, or Spiritual Observations (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 examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

Academic Accommodations for Relief for Missed Academic Work: McMaster Student Absence Form (MSAF)

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "[Requests for Relief for Missed Academic Term Work](#)".

- All MSAFs are to be directed to leungv@mcmaster.ca. Sending to another email address will delay processing.
- It is the prerogative of the instructor of the course to determine the appropriate relief for missed term work in his/her course.
 - In the event an MSAF is applied to an assignment, a 3-day extension will be given.
 - In the event an MSAF is applied to a midterm test, the grade value of the midterm test will be added to the final exam.

Courses with an On-Line Element

In this course, we will be using **Avenue-to-Learn** and **Microsoft Teams**. Students should be aware that, when they access the electronic components of this course, private information such as first and last names, usernames 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 this course 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.

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.

Reference to Research Ethics

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <https://reo.mcmaster.ca/>.

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, A2L and/or McMaster email.

Notice Regarding Possible Course Modification

The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes..

Use of AI Tools in the Course

Students may use generative AI for [editing/translating/outlining/brainstorming/revising/etc.] their work throughout the course so long as the use of generative AI is referenced and cited following citation instructions given in the syllabus. Use of generative AI outside the stated use of [editing/translating/outlining/brainstorming/revising/etc] without citation will constitute academic dishonesty. It is the student's responsibility to be clear on the limitations for use and to be clear on the expectations for citation and reference and to do so appropriately.

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**.