OUTLINE OF CHEMICAL ENGINEERING 3P04: JAN-APRIL, 2026
PROCESS CONTROL

Instructor: Dr. C.L.E. Swartz (JHE-360; email: swartzc@mcmaster.ca)

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Office Hours: Drop in, and by appointment.

Tests: Provisional schedule:
Test 1: Wed Feb 11, 4:30PM-5:20PM
Test 2: Wed Mar 18, 4:30PM-5:20PM
Dates to be confirmed.

Examination: Final examination, 2.5 hours.

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

Grading:

Assignments	15 %	of final grade
Mid-term 1	12.5%	" " "
Mid-term 2	12.5%	" " "
Lab	5%	
Term project	15 %	" " "
Final exam	40 %	" " "

There will be approximately 5 "regular" assignments, with about 5-6 questions each, with due dates about 2 weeks apart. There will also be 5 in-class tutorials that take the form of a hands-on workshop or guided problem-solving. The "regular assignments" (i.e. take-home assignments) will contribute 10% toward the final course grade, and the "in-class assignments" will contribute 5%.

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.

Recommended Text: Either of

1. D.E. Seborg, T.F. Edgar, D.A. Mellichamp, and F.J. Doyle, *Process Dynamics and Control*, 3rd Edn., Wiley, 2011.(***Highly recommended. Any edition of this book is good***)
2. T.E. Marlin, *Process Control: Designing Processes and Control Systems for Dynamic Performance*, McGraw-Hill, 2000. ***The book is free, and available at http://www.pc-education.mcmaster.ca/Book_Links.htm***

Supplementary References:

3. B.A. Ogunnaike and W.H. Ray, *Process Dynamics, Modeling and Control*, Oxford, 1994.
4. C.A. Smith and A. B. Corripio, *Principles and Practice of Automatic Control*, Wiley, 1985.
5. G. Stephanopoulos, *Chemical Process Control: An Introduction to Theory and Practice*, Prentice Hall, 1984.

Provisional Course Outline

1. **Process Dynamics**
   - Development of mathematical models
   - Laplace transforms
   - Transfer functions
   - Linearization
   - Open-loop response of first, second and higher-order systems
   - Process identification

2. **Feedback Control Fundamentals & Closed-Loop Analysis**
   - P, PI and PID controllers
   - Block diagrams
   - Routh-Hurwitz stability criterion
   - Instrumentation hardware & representation

3. **Feedback Controller Design**
   - Direct synthesis
   - PID tuning methods

4. **Advanced Control Systems**
   - Feedforward control
   - Cascade control

5. **Control of Multi-Input, Multi-Output Systems**
   - Model development
   - Interaction, Loop pairing - Relative Gain Array
   - Decoupling
   - Stability

6. **Digital Control – an Introduction**
   - Sampled-data systems
   - Digital PID controller

7. **Control of Process Plants**
   - Process automation hierarchy
   - Introduction to model predictive control (MPC)

Objective

The course is geared to address the following: Given a process and operational objectives, design a control system which is (i) stable, (ii) has good performance characteristics, and (iii) is robust. This requires knowledge of dynamic behavior of processes (process modeling, solution of dynamic equations, characterization of dynamic behavior); control systems; stability and techniques for assessing it; performance criteria and how they are affected by controller parameters. Students will also be exposed to the Matlab Simulink simulation package, which is a convenient environment for analyzing process dynamics and feedback systems, and for evaluating the performance of control system designs.

ADVISORY/POLICY STATEMENTS

Use of AI tools in the course.
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.

Inclusive Environment Statement
We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class.
We will gladly honour your request to address you by an alternate name or gender pronoun. Please advise of this preference early in the semester so that we may make appropriate changes to our records.

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, 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
This course may use 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 swartzc@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.

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.

ATTRIBUTES

Course outcomes	Corresponding CEAB indicator
Understand that processes do not operate at steady state all the time	
Use mathematical equations to describe changing process dynamics	• Ability to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem
Use the PID controller, and know how to tune the parameters in the control loop	• Competence in Specialized Engineering Knowledge • Recognizes and follows an engineering design process
Determine if a system is stable or unstable, and understand factors that influence closed-loop stability	• Ability to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem
Use of the process reaction curve technique to identify a dynamic process model	• Competence in Specialized Engineering Knowledge • Recognizes and follows an engineering design process
Know when to select and how to implement cascade and feedforward controllers	• Competence in Specialized Engineering Knowledge • Ability to identify a range of suitable engineering fundamentals (including mathematical techniques) that would be potentially useful for analyzing a technical problem • Recognizes and follows an engineering design process
Implement multiloop controllers and understand pairing	• Competence in Specialized Engineering Knowledge • Recognizes and follows an engineering design process
Use of Simulink to simulate dynamic response of control systems	• The ability to use modern/state of the art tools

The above outcomes and indicators are for your information. Graduating from an accredited institution has many advantages. Please read more about it here: http://www.engineerscanada.ca/accreditation