CHEMICAL ENGINEERING PRINCIPLES II
CHEM ENG 2F04
Winter 2026

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CALENDAR DESCRIPTION: Combined mass and energy balances in the steady and unsteady state. The second law of thermodynamics, physical/chemical equilibria and sustainability.

COURSE OBJECTIVE: This course stresses the fundamentals of material and energy balances as applied to Chemical Engineering problems and continues the use of fundamentals, problem-solving, and degree of freedom analysis. This includes the study of mechanical energy balances, steam tables, balances with chemical reactions, the first and second laws of thermodynamics, and energy cycles.

LECTURES AND TUTORIALS:

• Lectures: 3-4 h/wk;	Mo, We, Th	10:30AM - 11:20AM	BSB B135
	Mo*	15:30 -16:20	MDCL 1309
• Tutorials:	L01, Tu	16:30 - 18:20	BSB 120
	L02, Mo	12:30 - 14:20	BSB B103

*Note that this is specified in your schedules as a tutorial, but it will usually consist of a lecture and/or problem-solving by the course instructor or the TA. The slots labelled as "labs" in your schedules will be sessions with the TA and/or the instructor to solve problems and provide guidance on assignments. These will occur most weeks, but not all. You will be informed at least 24 hours in advance if they are not going to take place.

Lectures and tutorials will be recorded with Echo 360/MS Teams. Office hours for test preparation will be offered (TBA) virtually on MS Teams.

Avenue will be the main platform used to communicate with the class. Class announcements, posting of assignments and other class materials will be done through Avenue.

TEXTBOOKS:

R.M. Felder and R.W. Rousseau, L. G. Bullard Elementary Principles of Chemical Processes, 4rd Ed, Wiley, 2016.

Either one of:

1. J.M. Smith, H.C. Van Ness, and M.M. Abbott, Introduction to Chemical Engineering Thermodynamics, **7th Ed**., McGraw-Hill, 2004.
2. J.M. Smith, H.C. Van Ness, M.M. Abbott and M. Swihart, Introduction to Chemical Engineering Thermodynamics, **8th Ed**., McGraw-Hill, 2018.

GRADING ASSESSMENT:

A.) Assignments and tutorials make up a total 5% of your final grade.

Assignments (4-6) 2.5% (graded for completeness only). Assignments are due no later than at 23:59 (EDT) of the date on which the assignments are due. Assignments are to be submitted electronically through Avenue. Full credit is given for completion. Assignments will not be graded for correctness.

Tutorials 2.5% (given for attendance to the tutorials).

B.) I use the highest possible of the following two ways to assign the test-based grade (95% of your Final Grade):

1. Based on three 150-minute midterm tests, each weighted at 31.67%. If you are satisfied with this grade, you do not have to write the final exam and the average score of the midterms will account for 95% of your final grade.

2. If you write the final exam and your score on it is higher than the average of the three midterms, then your score on the final exam will account for 95% of your total final grade. In the case you write the three midterms AND the final, I will take the highest of the two – the average of the three midterms or the grade in the final.

Missed midterms: In cases where you do not write one or more midterms, the weight of that midterm is transferred to the final. In other words, missing a midterm will require you to write the final.

The final grade is converted to the 12-point scale recommended by the Registrar. Final marks may be raised, at the discretion of the instructor. If a student misses a midterm, the weight of that test is transferred to the final exam.

POLICY ON MISSED WORK: Missed work (late assignments, missed tests etc.) will receive a grade of zero. No late assignments will be accepted. If a "McMaster Student Absence Form" (MSAF) is submitted, then the grade associated with the missed work will be shifted to the final examination. ALL MSAF forms MUST reference the exact work missed (i.e., "Assignment 5", not just "This week's Tutorial").

TEST/EXAMINATION FORMAT: All tests and the final exam will be open **course** textbooks and open notes. Any evidence of copying or collaboration with other people will be treated as a case of academic dishonesty. Tests will be administered in person.

SCHEDULE: **Dates – Tentative for Now**

Test #	Date	Comments
1	Week of Feb 2-6	Specific Test Time TBA
2	Week of March 2-6	
3	Week of March 27 - April 1	
Final Exam	April	

ACADEMIC HONESTY

You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. The academic credentials you earn are rooted in principles of honesty and academic integrity.

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. It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at http://www.mcmaster.ca/academicintegrity.

- Plagiarism, improper collaboration, copying unauthorized tests or aids, and other academic dishonesty will not be tolerated. Your first offence will be reported to the Office of Academic Integrity.
- The default penalty for academic dishonesty is a zero on the test/exam, even if the dishonesty occurred on just one portion or question of that test/exam. However, if Academic Integrity chooses to hold a hearing, they will determine the penalty.

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.

- **P**rofessionalism
- **R**esponsibility
- **O**wnership
- **C**uriosity
- **E**mpathy
- **S**elflessness
- **S**ervice

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**.

OUTLINE OF TOPICS:

	Topic	Main Text	Supplementary Text
1.	Energy Balances: First Law Review	F&R Ch. 7	S&VN Chs. 1, 2, 3
	- Closed and Open Systems		
	- Thermodynamic State and Reference State		
	- Mechanical Energy Balance		
2.	Balances on Non-Reactive Processes:	F&R Ch. 8	S&VN Ch. 4
	- Reversible Processes		(to p. 132)
	- Heat Capacities		
	- Psychometric Charts		
3.	Mixing Processes:	F&R Ch. 8.5	S&VN Ch. 12.4
	- Heats of Solution		
	- Mixing and Solutions		
4.	Reactive Processes:	F&R Ch. 9	S&VN Ch. 4
	- Formation		(pp. 135-150)
	- Combustion		
	- Solutions		
5.	Second Law, Entropy, & Third Law:	S&VN Ch. 5	
	- Reversible Processes	(not 5.11)	
	- Heat Engine		
	- Mathematics of 2nd Law		
	- Ideal and Lost Work		
	- 3rd Law		
6.	Energy Cycles:	S&VN Ch. 8 & 9 (selected Ch. 7)	
	- Carnot Cycle	8.1 (and 5.2)	
	- Rankine Cycle	8.1	
	- Refrigeration	9.1-9.3, 9.5	

COURSE OUTLINE – APPROVED ADVISORY STATEMENTS

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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 DETECTION

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.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use on-line elements (e.g. e-mail, Avenue to Learn (A2L), 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

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".

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, A2L and/or McMaster email.

COURSE LEARNING OBJECTIVES AND ACCREDITATION LEARNING OUTCOMES

Course Learning Objectives:

By the end of this course, students should be able to:

- L0.1. State the first law of thermodynamics, the definitions of work and thermal efficiency and contrast the difference between various forms of energy.
- L0.2. Quantify the amount of energy exchanged in various processes due to heat and work.
- L0.3 Calculate the amount of work done to/by a system following a variety of paths
- L0.4. Apply the first law of thermodynamics to determine heating and cooling requirements for open/closed/isolated systems containing non-reactive and reactive species.
- L0.5. State the definition of entropy (mathematically), apply it to calculate the change in entropy for a system, surroundings and the universe as a process takes place and evaluate the feasibility of processes using the calculations.
- L0.6. For a given process, calculate the ideal work and loss work by combining the first and second laws of thermodynamics. Evaluate the efficiency of converting heat into work.
- L0.7. Sketch pressure-volume and enthalpy-entropy diagrams that describe the cycles in Carnot and Rankine engines. Calculate the thermal efficiency and work obtained from each type of engine given sets of operational conditions.

Accreditation Learning Outcomes:

The Learning Outcomes defined in this section are measured for Accreditation purposes only and will not be directly taken into consideration in determining a student's actual grade in the course. CHEMENG 2F04 will measure the following graduate attribute indicators through the indicated learning outcomes below.

CEAB Indicators	**Learning Objectives**
1.2 Competence in Natural Sciences	L0.1, L0.2, L0.3, L0.5
1.3 Competence in Engineering Fundamentals	L0.1, L0.2, L0.4, L0.7
1.4 Competence in Specialized Engineering knowledge	L0.6, L0.7
2.1 Identifies and states reasonable assumptions and suitable engineering fundamentals, before proposing a solution path to a problem	L0.4, L0.5, L06
2.2 Proposes problem solutions supported by substantiated reasoning, recognizing the limitations of the solutions	L0.4, L0.5, L06

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