**September, 2020**
**CHEM ENG 2D04**
CHEMICAL ENGINEERING PRINCIPLES I

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**TEACHING ASSISTANTS:**

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**CALENDAR:** Steady-state mass balances in chemical processes and the first law of thermodynamics. The behaviour of gases and liquids, and their physical equilibria. Recycle in steady state operation.

**COURSE OBJECTIVES:** At the end of this course, you should be able to do perform the following chemical engineering skills:

1. **Basic engineering calculations**
    a. Be able to convert quantities from one set of units to another
    b. Define, calculate and estimate properties of materials and compounds
    c. Be able to calculate/estimate important process operation parameters including fluid density, flow rate, chemical compositions expressed as mass or mole fractions, concentrations, fluid pressure and temperature
2. **Material and energy balance calculations**
    a. Draw and label a process flow diagram based on a verbal or qualitative description
    b. Carry out a degree of freedom analysis – i.e. determine which variables can be changed and which are fixed by constraints
    c. Write and solve material and energy balance equations for single and multiple unit processes, which may or may not include recycle(s) and bypass(es), and reactive processes.
    d. Be able to use spreadsheets to solve material and energy balance problems
3. **Applied physical chemistry**
    a. Perform pressure-volume-temperature calculations for ideal and non-ideal gases
    b. Perform vapour-liquid calculations for systems with one condensable component and for ideal multicomponent solutions
    c. Calculate changes in internal energy for process fluids undergoing specified changes in temperature, pressure, phase and chemical composition.
    d. Incorporate these thermodynamic results into process material and energy balance calculations.
4. **Introduction to other chemical engineering topics**
    a. Examine different processes to understand process flow diagrams
    b. Survey types of process equipment and analyze its function, principles of operation, cost, size.

c. Show linkages of topics in ChE2D04 to future courses:
    i. Material and energy balances: ChE 2F04, 3G03
    ii. Thermodynamics, vapour pressure, phase change: ChE 2F04, 3D03, 3G03, 3M04
    iii. Process systems: ChE 2F04, 3G03, 3P03
    iv. Calculations and modelling: ChE 2F04, 3G03, 3E04, 3P03
    v. Pressure drop and fluid flow: ChE 2O04
    vi. Reactions, stoichiometry: ChE 3K04
    vii. Heat balances: ChE 3A04

**COURSE TIMES:**

- Lectures: M 8:30-9:20 Virtual
    - W 8:30-9:20 Virtual
    - F 10:30-11:20 Virtual
    - M 2:30-3:20 Virtual **
- Tutorial (T1): Tu 10:30-12:20 Via Microsoft Teams
- Tutorial (T2): W 2:30-4:20 Via Microsoft Teams

Total hours per week: 6 contact hours per week.
**Note that this lecture hour is typically run on an as needed basis. I will be available during this hour and during the Friday am lecture for consultation and discussion.

Tutorials will be instructor and TA led. Links will be provided to the Teams rooms for the tutorials. The instructor and TAs will also be available as needed for extra help and discussion.

The weekly lecture and problem schedule will be posted on Avenue to Learn on Monday morning. While you should feel free to work through the material at your own pace, you are encouraged to keep this in mind for tests.

**TEXTBOOK:** R.M. Felder and R.W. Rousseau, *Elementary Principles of Chemical Engineering, 3rd Edition,* Wiley, 2000 (Please note that the 4th edition is required) **F&R**

**REFERENCE:** D.M. Himmelblau, *Basic Principles and Calculations in Chemical Engineering, 6th edition*, Prentice-Hall, 1996. **Himm**

**CALCULATOR:** The McMaster Standard Calculator (Casio fx991) may be used on tests and examinations.

**GRADING ASSESSMENT:**

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| Weekly homework assignments: | 20% |
| Weekly tutorial quizzes | 5% |
| Term Test 1 | 10% |
| Term Test 1 remark after group work | 5% |
| Term Test 2 | 10% |
| Term Test 2 remark | 5% |

| | |
|---|---|
| Participation | 15% |
| Final Examination | 30% |

All tests and the final exam will be open book and open notes. While engineering is about collaboration, the expectation is that you will complete the tests on your own. You will then be assigned to a group for discussion of the problems and will have the option to change your answers based on the group discussions. Participation will include group assignments (10%), as well as individual activities that will be posted (5%). The final percentage grade will be converted to a letter grade using the standard conversion in the Undergraduate Calendar.

In three lectures throughout the term, we will give a bonus problem for you to solve and hand in that will be counted as bonus marks towards your term tests and final exams. You will responsible for handing these in during the assigned week. Discussion with your peers, TAs and instructor to solve these problems is encouraged.

**ACADEMIC INTEGRITY:**

Please remember that copying, cloning, or "borrowing" other people's solutions and assignments is cheating – academic dishonesty. Many engineering problems involve working in groups so you are encouraged to work with others. However, you must each hand in your own assignments having solved the problems on your own. The best way to learn the material is to go through the problems and understand what you are doing. Since this course forms the basis of so much of what you will do in Chemical Engineering, it is particularly important to understand the material presented and be able to solve the problems from this course.

**BASIC COURSE PROTOCOL:**

A few basic ground-rules to help you develop good habits for future courses and work:

1. All homework must neatly written or typed and scanned to pdf.
2. Work must be neatly organized with intermediate calculations shown
3. Use consistent units in your calculations
4. If the units of the problem are British units, you must do the calculations in British units. Marks will be taken off for converting to metric and then converting back to British units at the end.
5. Use diagrams to explain your solution, if appropriate
6. Make sure that **you have your name and student number** on the first page.

Solutions to the assignment problems will be available online.

**COURSE POLICIES**

**Missed Term Tests and Final Examination**

- If you are absent for a term test the grade will automatically be shifted to the final exam.

**Assignments**

- There will be 7-8 assignments throughout the term. The lowest grade on the assignments will be dropped.

**Late Homework**
All homework **must** be handed in on time. Late assignments will not be accepted. Assignments will generally be handed out and due on Wednesdays, allowing you to use the tutorial time to help with any problems.

**Email**
Email is a great way to get in touch with us if you have a question. We usually respond quickly and if it is a problem that we know that many of you will have, we can send out a mass reply or post something on Avenue to Learn.

**Office Hours**
As noted, I will be available during the lecture hours on Monday afternoon and Friday morning for consultation. If you need to meet with me outside of this time, please send an email to set something up. TAs will post office hours.

**TENTATIVE COURSE OUTLINE (Weekly schedule to be posted on Avenue to Learn):**

1. Introduction to Chem Eng (Chapter 1, F&R)
2. Unit conversions (Ch 2)
3. Engineering Calculations (Ch 2)
4. Process variables: mass, flow, composition, temperature, pressure (Ch 3)
5. Material balances (Ch 4)
    a. general equations, single units
    b. degrees of freedom
    c. multiple units and recycles
    d. reactive systems
    e. combustion
6. Single phase systems (Ch 5)
    a. Liquids and ideal gases
    b. Non-ideal gases
7. Multiphase systems (Ch 6)
    a. Vapour-liquid equilibrium
    b. Solids- liquids
    c. Two liquid phases
    d. Adsorption
8. Plant Case Study
9. Final Examination Review

**TEST DATES (tentative):**

Term Test 1 – Friday October 9th
Term Test 2 – Friday November 6th
In all cases, the term tests will be held during the lecture slot and will be due at the posted time.

**SENATE AND THE FACULTY OF ENGINEERING POLICIES**

**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. 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