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September, 2017
CHEM ENG 2D04
CHEMICAL ENGINEERING PRINCIPLES I

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INSTRUCTOR: Dr. Phil Wood, JHE 117, 905-525-9140 Ext 24920, woodpe@mcmaster.ca

TEACHING ASSISTANTS: (Duties To be determined)

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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: This course deals with the basic concepts or fundamental principles of chemical engineering. The main one is the idea of conservation of mass but several others will be presented as well. Amongst these principles are: stoichiometry, dimensional analysis, equilibrium, steady and unsteady state, energy balances and others. The min objective though is to learn how to formulate and solve material balance problems in chemical engineering. At the end of this course, you should be able to do perform the following chemical engineering skills:

LEARNING OUTCOMES (numbers in brackets refer to CEAB "Indicators" see the accreditation document on the ChE Department website for an explanation):

   1. Basic engineering calculations [1.2, 1.3]
        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 [2.1, 2.3, 3.2, 5.3]
        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 and bypass, and reactive processes.
        d.   Be able to use spreadsheets to solve material and energy balance problems
   3. Applied physical chemistry [1.2, 1.3]
        a.   Perform pressure-volume-temperature calculations for ideal and non-ideal gases
        b.   Perform vapour-liquid calculations for systems with a single 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 [1.4]
        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 ChE2D4 to future courses:
                i.   Material and energy balances: ChE 2F4, 3G4
                ii.   Thermodynamics, vapour pressure, phase change: ChE 2F4, 3D3, 3G4, 3M4
                iii.   Process systems: ChE 2F4, 3G4, 3P3
                iv.   Calculations and modelling: ChE 2F4, 3G4, 3E4, 3P3

     v. Pressure drop and fluid flow: ChE 2O4
     vi. Reactions, stoichiometry: ChE 3K4
     vii Thermal Energy balances: ChE 2A4

COURSE TIMES:

•	Lectures:	▪ Mon	11:30 – 12:20	HH-109
		▪ Wed	1130 – 12:20	HH-109
		▪ Fri	1:30 - 2:20	HH-109
•	Tutorial	▪ Mon	2:30-1:20	BSB-135
•	Lab (L1):	▪ Tues	08:30-10:20	ETB - 238
•	Lab (L2):	▪ Wed	3:30 – 5:20	JHE-A101

Total hours per week: **6 contact hours per week.**

Instructor and TA led hours will fluctuate. At times, I will run the tutorials, when I feel that you need a bit of extra help. Lecture hours will mainly be for the presentation of new material and going through examples. Tutorials will be times for you to work through problems on your own, with the guidance of the TA and/or me.

TEXTBOOK: R.M. Felder, R.W. Rousseau and L.M. Bullard, *Elementary Principles of Chemical Engineering, 4th Edition,* Wiley, 2015 **F&R**

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

GRADING ASSESSMENT:

Weekly homework assignments:	15%
Term Test #1	15%
Term Test #2	15%
Term Test #3	15%
Final Examination	40%

For all tests and the final exam, you will be able to use your textbook and the McMaster standard calculator. If you opt to purchase an e-book version of your textbook, please note that you will need to borrow a hard copy of the text for the final examination. The final percentage grade will be converted to a letter grade using the standard conversion in the Undergraduate Calendar.

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 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 be submitted on 8.5 by 11 inch paper, and **stapled**.
2. Work must be neatly organized with intermediate calculations shown
3. Use consistent units in your calculations (**always check your units!**)
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 on the *Avenue To Learn* website.

COURSE POLICIES Missed Tests and Final Examination

• If you are absent for a test, the weight of the test will automatically be shifted to the final exam.

Late Homework
All homework **must** be handed in at the beginning of lecture in class, unless other instructions have been given.   Late assignments will not be accepted. Assignments will generally be handed out and due on Mondays.

Email
Email is a great way to get in touch with me if you have a question. I usually respond quickly and if it is a problem that I know that many of you will have, I can send out a mass reply on Avenue.

Office Hours
Scheduled office hours will be determined at the beginning of class and will be posted on Avenue.

CD Resources
Previous editions of the textbook came with a CD. The additional resources previously on the CD are now on-line in a "Companion" website for the text. To access this site use www.wiley.com/college/felder.

• [Visual encyclopaedia](#) of chemical engineering equipment (– throughout the course I will be asking you to look up equipment and explain how it works and this is a good starting point.
• [Tips for Student Success](#) – See particularly the article "A Survival Guide to Chemical Engineering" by one of the text's authors: Lisa Bullard (This document has been put on Avenue)
• Physical property database – Not yet available
• Instructional tutorials –

TENTATIVE COURSE OUTLINE:

1. Introduction to Chem Eng (Chapter 1, F&R)
2. Unit conversions (Ch 1)
3. Engineering Calculations (Ch 2)
4. Process variables: mass, flow, composition, temperature, pressure (Ch 3)
5. Material balances (Ch 4) – This is the most important Chapter in the book for this course!
   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. Energy Balances (Ch 7) – May or may not get much done in this chapter

a. First law of thermodynamics
b. Open systems at steady state
c. Thermodynamic data
d. Calculation procedures
e. Mechanical energy balances

9. Plant Case Study (will likely be given out earlier in the course)

10. Final Examination Review

TEST DATES (Very tentative):

Midterm 1 – October 2nd
Midterm 2 – November 6th
Midterm 3 – November 27th

In all cases, the midterms will be held during the Tutorial slot on Mondays at 2:30.

SENATE AND THE FACULTY OF ENGINEERING POLICIES
"The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons concerned, individuals are reminded that they should contact the Department Chair, the Sexual Harassment Officer or the
Human Rights Consultant, as soon as possible."

"Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and 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 kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically
Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

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."