CHEMICAL ENGINEERING PRINCIPLES II
CHEM ENG 2F04
Winter 2017

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CALENDAR DESCRIPTION: Combined mass and energy balances in the steady and unsteady state. The second law of thermodynamics and physical chemical equilibria. Introduction to process simulation packages.

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, computers, and degree of freedom analysis. This includes the study of mechanical energy balances, steam tables, balances with chemical reaction, the first and second laws of thermodynamics, energy cycles, and unsteady state balances.

COURSE LOADING:

• Lectures: 4 h/wk;	M, W, Th	13:30-14:20	MDCL 1309
	Tu*	11:30-13:20	HH 109
• Tutorials:	L(01), Fr	14:30-16:20	JHE 264
	L(02), M	15:30-17:20	ETB 235

*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 tutorials labeled as "labs" in your schedules will be sessions with the TA and/or the instructor to solve problems and provide guidance on assignments.

***COURSE POLICY ON ASSIGMENTS, TESTS AND FINAL EXAM: Each student must** hand in his/her own solutions. Solutions that are identical or close to identical will be penalized **(usually zero and the infraction will be reported to the Academic Integrity office, McMaster)**. Your **name and student number must be on the top of each page** – else no mark will be given. Assignments are **due at the beginning** of the class period. Late assignments will not be accepted.

TEXTBOOKS:

R.M. Felder and R.W. Rousseau, Elementary Principles of Chemical Processes, 3rd Ed., Wiley, 2000 or 3rd Ed., 2005.

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

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	
7.	Unsteady State Processes:	F&R Ch. 11	
	- Differential Balances		
	- Material and Energy Balances		

GRADING ASSESSMENT:

A.) Assignments and Tutorials Makes 5% of your Final Grade:

Assignments (4-6) 2.5% (graded for completeness only)

Tutorials 2.5% (attendance for mandatory tutorials – announced by instructor)

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 110 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 of 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.

TEST/EXAMINATION FORMAT: All tests and final exam will be open **course** textbooks, and open notes. Tests will cover material up to one week before the test. It is necessary for the student to bring drawing materials to the tests and exam. Tests not written in pen will not be considered for re-marking (except addition of grades). Any evidence of copying or use of unauthorized aids (including cell phones, PDA, Blackberry, etc.) will be treated as a case of academic dishonesty.

SCHEDULE: **Dates – Tentative for Now**

Test #	Duration	Date	Comments
1	110 min	Week of Feb 6-10	Specific Test Time and Room TBA
2	110 min	Week of March 6-10	
3	110 min	Week of March 27- March 31	
Final Exam	3 hours	April	

POLICY ON MISSED WORK: Missed work (late assignments, missed tests etc) will receive a grade of zero. 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 6", not just "This weeks Tutorial").

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:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained. *
2. Improper collaboration in group work. *
3. Copying or using unauthorized aids in tests and examinations. *

COURSE OUTCOMES AND CEAB INDICATORS

Learning Outcomes	Corresponding CEAB Indicators
Be able to state the First Law and to define heat, work, thermal efficiency and the difference between various forms of energy	Competence in Natural Sciences Competence in Engineering Fundamentals
Be able to identify and describe energy exchange processes (in terms of various forms of energy, heat and work)	Competence in Natural Sciences Competence in Engineering Fundamentals
Write and simplify the first law of thermodynamics for any open, closed or isolated systems	Competence in Engineering Fundamentals
Calculate the amount of work done to/by a system following a variety of paths	Competence in Mathematics
Using the first law of thermodynamics, be able to perform energy balances for open/closed/isolated with non-reactive and reactive species	Competence in Mathematics Competence in Natural Sciences Competence in Engineering Fundamentals
Be able to define entropy (mathematically) and to calculate the change in entropy for a system, surroundings and the Universe as a process takes place.	Competence in Mathematics Competence in Natural Sciences Competence in Engineering Fundamentals
Be able to use the second law of thermodynamic to assess the feasibility of processes	Competence in Mathematics Competence in Engineering Fundamentals Obtains experience with open-ended problems.
Be able to define and calculate ideal work and loss work for a process	Competence in Mathematics Competence in Specialized Engineering Knowledge
Be able to explain the functioning of a Carnot Engine and of a Rankine Engine and calculate thermal efficiency and work - given operating conditions	Competence in Natural Sciences Competence in Engineering Fundamentals Competence in Specialized Engineering Knowledge
Be able to perform material and energy balances on systems at unsteady-state. For simple systems, be able to solve the differential equations to obtain analytical solutions that describe the behavior of the system as a function of time	Competence in Mathematics Competence in Natural Sciences Competence in Engineering Fundamentals Obtains experience with open-ended problems.

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