

CBE 2224B - CHEMICAL ENGINEERING THERMODYNAMICS**COURSE OUTLINE 2014-2015**

Description. This course provides the basics of the thermodynamics involved in chemical engineering with emphasis on thermodynamics properties of fluids, solution thermodynamics, and reaction equilibria. Emphasis is placed on the application of thermodynamics to practical problems in phase equilibria and on solutions and reaction equilibria in separations and reaction engineering.

Prerequisites. CBE 2214A/B or MME 2204 A/B.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites.

Corequisites: None.

Antirequisites: None.

Contact Hours (per week). 3 lecture hours, 2 tutorial hours, 0.5 course.

Instructor

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Undergraduate Assistant

Ingrid Timusk (TEB 477) Telephone: 519-661-2111 ext: 82131 email: itimusk2@uwo.ca

Reference Texts

- J.M. Smith, H.C. Van Ness and M. M. Abbott, "Introduction to Chemical Engineering Thermodynamics," 7th Ed. McGraw Hill, 2005.
- Richard Elliott and Carl Lira. Introductory Chemical Engineering Thermodynamics. Prentice Hall, 2012.

Course Notes

"Chemical Engineering Thermodynamics" available at the University Book Store. You should get a copy of this.

Laboratory and Laboratory Notes: None.

Units: SI and other engineering units will be used.

General Learning Objectives: At the end of this course students should be able to:

- Describe the behavior of non-ideal fluids over a wide range of temperature and pressure and, apply thermodynamic concepts to phase equilibria of one-component systems.
- Use primary thermodynamic functions (P, V, T, U and S) and auxiliary functions (H, G and A) to define conditions of equilibrium and stability and develop useful thermodynamic relationships using the Maxwell relations
- Apply thermodynamic principles to understand fugacity, partial molar properties, chemical potential, and activity coefficients for non-ideal fluid systems.
- Investigate binary phase equilibria; construct and apply P-x-y and T-x-y phase diagrams using activity coefficient correlations, and perform vapour-liquid equilibrium (VLE) calculations.
- Apply thermodynamic principles to reaction equilibrium between phases and reactions. Calculate the equilibrium constant for chemical reactions. Derive and solve reaction equilibrium expressions for gas-phase, liquid-phase and multi-phase reactions to determine how far a chemical reaction will proceed before equilibrium is reached. Determine the equilibrium point for systems involving multiple reactions, calculation and application of extent of reaction, and stoichiometric number.

Applicable CEAB Attributes. This is the second thermodynamics course offered in Year 2. Students enrolled into this course have already taken the first thermodynamics course that deals with properties of pure substances, the first and second laws of thermodynamics, and thermodynamic cycles and tables. CBE 2224 is primarily chemical thermodynamics and has three essential elements: (i) Volumetric and Thermodynamic properties of fluids, (ii) Phase equilibria, (iii) Reaction equilibria. The course is thus *taught and evaluated* at the **intermediate** level. Special emphasis will be placed on the applications of thermodynamics to practical problems in chemical engineering such as pressure-volume-temperature relationships, vapor-liquid equilibria, and reaction equilibria in both separations and reaction engineering. The course relies on solid understanding of thermodynamic principles and constraints for the treatment of chemical operation units such as distillation, reaction, and storage facilities.

Attribute	Classification	Level
	Introduced/Taught/Evaluated	Beginner/Intermediate/Advanced
Knowledge	Taught	Intermediate
Problem Analysis	Taught and Evaluated	Intermediate
Investigation	Taught and Evaluated	Intermediate

Evaluation

The final course mark will be determined as follows:

Assignments (4 Assignments)	10%
Quizzes (4 quizzes)	10%
Midterm Examination (1)	25%
Final Examination (1)	55%

Assignments. There will be 4 assignments in total. Assignments will be posted on the course website one week before they are due.

Examinations. The midterm will be a **closed book two and half hour** examination. The final will be a **closed book** examination and will take place in the regular examination period.

The midterm examination is set for Friday March 6, 2015 from 5pm to 8pm.

Programmable calculators are permitted during the examinations but memories must be erased before the examination.

Note

1) Students must pass the final examination to pass this course. Students who fail the final examination will be assigned the aggregate mark, or the final examination mark, whichever is less.

2) Quizzes will be given during the tutorial hours (either at the beginning or towards the end of the tutorial session).

3) Assignments are to be handed into CBE 2224b locker (# C461) located in TEB on the specified due date provided by the Instructor. Late assignments will receive a mark of zero (0).

Repeating All Components of the Course

In accordance with Senate and Faculty Policy, students who have failed an Engineering course (i.e. <50%) must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted for grading by the student in subsequent years.

Use of English

In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance

Attendance in all lectures and tutorials is required. Any student who, in the opinion of the instructor, is absent too frequently from classes or laboratory periods in any course, will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular examination in the course.

Cheating

University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning (see Scholastic Offence Policy in the Western Academic Calendar).

Plagiarism

Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. Plagiarism is a major academic offence (see Scholastic Offence Policy in the Western Academic Calendar).

The University of Western Ontario has software for plagiarism checking. Students may be required to submit their work in electronic form for plagiarism checking.

Conduct

Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others.

Sickness and Other Problems

Students should immediately consult with the instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented. The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

Notice

Students are responsible for regularly checking their Western email and notices posted on the course web site.

Consultation

Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

Accreditation (AU) Breakdown

Engineering Science = 75%
Engineering Design = 25%

***INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS
OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED***

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC ACCOMMODATION WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE IF YOU ARE IN FIRST YEAR) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC ACCOMMODATION WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2014 UWO ACADEMIC CALENDAR).

A. GENERAL REGULATIONS & PROCEDURES

1. Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.
2. Bring your request for academic accommodation to the attention of the chair of your (or the Undergraduate Services office if you are in first year) **PRIOR** to the scheduled time of the test or final examination or due date of the assignment. If you are unable to contact the relevant person, leave a message with the appropriate department (or with the Undergraduate Services Office if you are in first year). The address, telephone and fax numbers are given at the end of these instructions. Documentation must be provided as soon as possible.
3. If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

B. TERM TESTS

1. If you are unable to write a term test, inform your instructor and the Chair of your Department (or the Undergraduate Services Office if you are in first year) **PRIOR** to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office and inform the Chair of the Department (or the Undergraduate Services Office if you are in first year).
2. Be prepared to provide supporting documentation to the Chair and the Undergraduate Services Office (see next page for information on documentation).
3. Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair (or the Undergraduate Services Office if you are in first year) is required when rescheduling term tests.

C. FINAL EXAMINATIONS

1. If you are unable to write a final examination, contact the Undergraduate Services Office **PRIOR TO THE SCHEDULED EXAMINATION TIME** to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number (please spell your full name).
2. Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
3. In order to receive permission to write a special examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

N.B. It is the student's responsibility to check the date, time and location of the special examination.

D. LATE ASSIGNMENTS

1. Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
2. Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
3. If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
4.
 - i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.
 - ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

E. SHORT ABSENCES

If you miss a class due to a minor illness or other problems, check your course outlines for information regarding attendance requirements and make sure you are not missing a test or assignment. Cover any readings and arrange to borrow notes from a classmate.

F. EXTENDED ABSENCES

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms Karen Murray in the Undergraduate Services Office if you are in first year.

G. DOCUMENTATION

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office if you are in first year). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.

Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

H. ACADEMIC CONCERNS

You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).

You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.

If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

Calendar References: Check these regulations in your 2014 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness: <http://www.westerncalendar.uwo.ca/2014/pg117.html#>

Academic Accommodations for Students with Disabilities: <http://www.westerncalendar.uwo.ca/2014/pg118.html>

Academic Accommodations for Religious or Holy Days: <http://www.westerncalendar.uwo.ca/2014/pg119.html>

Course Withdrawals: <http://www.westerncalendar.uwo.ca/2014/pg157.html>

Examinations: <http://www.westerncalendar.uwo.ca/2014/pg129.html>

Scheduling of Term Assignments: <http://www.westerncalendar.uwo.ca/2014/pg97.html>

Scholastic Offences: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Student Medical Certificate: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Engineering Academic Regulations: <http://www.westerncalendar.uwo.ca/2014/pg1442.html>

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University.

Drop Deadlines:

First term half course (i.e. "A" or "F"):	November 5, 2014
Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2014
Second term half or second term full course (i.e. "B" or "G"):	March 7, 2015

Undergraduate Services Office:	SEB 2097	telephone: (519) 661-2130	fax: (519) 661-3757
Dept. of Chemical and Biochemical Engineering & Green Process Engineering	TEB 477	telephone: (519) 661-2131	fax: (519) 661-3498
Dept. of Civil and Environmental Engineering:	SEB 3005	telephone: (519) 661-2139	fax: (519) 661-3779
Dept. of Electrical and Computer Engineering, Software Engineering, Mechatronics Engineering	TEB 279	telephone: (519) 661-3758	fax: (519) 850-2436
Dept. of Mechanical and Materials Engineering:	SEB 3002	telephone: (519) 661-4412	fax: (519) 661-3020