CHEM2011 3.0 "Introduction to Thermodynamics"

Lectures: Mon, Wed, Fri at 8:30 am – 9:30 am (Lassonde Lecture Hall C)

Tutorials: Wed at 1:30 pm – 2:30 pm (Lassonde Lecture Hall C)

Instructor: Dr. Kyle Belozerov

Office: Chemistry Bldg. Room 358

(416)736-2100 ext. 66643

vbelozer@yorku.ca (communication by e-mail is **highly** preferred!).

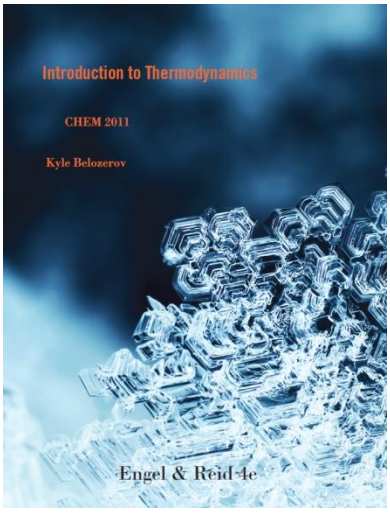
Office hours: Dr. Belozerov will hold office hours on Mon and Fri at 1:00 pm – 2:00 pm (CB358)

Calendar description: This course is an introduction to equilibrium chemical thermodynamics. The three laws of thermodynamics and the thermodynamic state functions are described. Many applications are considered, including the operation of heat engines, phase transformations, thermochemistry and chemical reaction equilibria. Three lecture hours, one tutorial hour. One term. Three credits.

Prerequisites: SC/MATH 1014 3.00, or SC/MATH 1505 6.00 with a minimum grade of B;
SC/CHEM 1001 3.00 or SC/CHEM 1100 4.00.

Course credit exclusions: None.

Textbook: Introduction to Thermodynamics, a Custom textbook for York University based on Thermodynamics, Statistical thermodynamics, and Kinetics, by Thomal Engel and Philip Reid (Pearson)



4th edition (2019). **This is a <u>required</u> textbook**, and all of the references (page numbers, problem numbers, etc) will be based on this edition. The textbook is available at the York Bookstore (ISBN-10:1-323-89848-4 or ISBN-13: 978-1-323-89848-2; see cover on the left).

You can also use the full-length version of the 4th edition of the textbook (ISBN-10: 0-13-480458-9 or ISBN-13: 978-0-13-480458-3).

An earlier edition of the same text (Thermodynamics, Statistical thermodynamics, and Kinetics, by Thomal Engel and Philip Reid (Pearson) 3rd edition (2013) ISBN-10: 0-321-76618-0 or ISBN-13: 978-0-321-76618-2) may be used, however it will be **your responsibility** to match the material in the 4th edition to the material in the 3rd edition.

Course website: The course will be managed through the York Moodle website: https://moodle.yorku.ca/ Make sure you are subscribed with the correct e-mail address as many important course announcements will be posted on Moodle in the course of the semester.

Evaluation:

Midterm 1 (Jan 25, 50 min)	15%
Midterm 2 (Feb 15, 50 min)	15%
Midterm 3 (Mar 15, 50 min)	15%
Lecture activity points (iClicker)	5%
Tutorial activity points (iClicker, worksheets)	5%
5 Pop-quizzes (iClicker in lectures)	5%
Online homework (5 on Moodle)	5%
Final exam (cumulative, 180 min)	35%

Activity points: In order to earn full activity points (10% of course total), you must participate in at least 80% of in-class activities. These activities may include pre- and post-quizzes, iClicker questions during lectures, worksheets in tutorials, etc. Pop-quizzes and midterms do not count toward in-class activities. If you participate in fewer than 80% of activities, your activity points will be proportionately reduced. Your in-class participation will not be graded – you earn points simply for attending and being engaged during classes. You can opt out of participating in in-class activities and pop-quizzes, and then the weight of your activity points will be moved to the final exam, making it worth up to 50% of the final grade. **You must e-mail me your opt-out request no later than 11:59 pm on January 13, 2019.**

Pop-quizzes will be given without prior announcement throughout the semester. Each pop-quiz will be 5 min long and will consist of 5 multiple-choice or short-answer questions. Pop-quizzes may be given at any time during lecture. Pop-quizzes are designed to be answered using iClicker, however, you may write down your answers on a sheet of paper, if your iClicker device is not available. You may opt out of pop-quizzes as described above.

Major topics covered: System, surroundings, laws of thermodynamics, heat, work, energy, equilibrium, reversibility, enthalpy, state functions, path functions, thermochemistry, entropy, Helmholtz energy, Gibbs energy, chemical potential, activities, effect of temperature and pressure on equilibria, phase equilibria, surface tension, basic multivariate calculus (review). These topics and others are covered in Chapters 1 through 6 of the textbook.

At home, read the sections of the textbook that were covered in each lecture (this info is posted on Moodle in lecture slides), and solve the assigned problems (these will be posted on Moodle as we complete each major topic).

Additional study guides, materials, practice problems, and learning objectives will be posted on Moodle throughout the semester, and prior to every test/exam.

Experiential Education and E-Learning: Group work during tutorials; online homework offered through the Moodle course website; in-class participation using iClicker; tests and tutorial worksheets administered using Crowdmark.

Learning Outcomes (LO's) for the course:

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

1) define the system and the surroundings in a variety of experimental contexts, and distinguish between reversible and irreversible thermodynamic processes;

2) calculate heat, work, internal energy, and enthalpy changes in a variety of reversible and irreversible processes;

3) explain the concepts of heat capacity and entropy at the molecular level.

4) articulate the differences between state and path functions, and use the basic rules of multivariate calculus to derive classical relationships between state functions;

5) evaluate the spontaneity of physical and chemical processes by calculating entropy changes in the system and in the surroundings, and by calculating Gibbs and Helmholtz energy changes;

6) explain the concept of the chemical potential and its contribution to Gibbs energy of a reaction;

7) derive the relationship between equilibrium constant and Gibbs energy, and calculate equilibrium pressures and concentrations of reaction components at different temperatures and pressures.

Detailed lesson-level LO's are available on the course Moodle website.

Course policies

1. E-MAIL ETIQUETTE: Use your Yorku email address as other email addresses (e.g., Hotmail) are filtered out by the university's email system and do not always reach their intended recipient. Please do not use the Moodle email function or respond to course announcement emails.

Subject line: your name, student number and a brief indication of topic (e.g., 'Question regarding gene regulation). I receive a lot of email and this practice helps me sort emails efficiently. Emails without the required information will not receive a response.

Please include your NAME at the end of each email.

Due to the size of the class, I will not be able to offer individual tutoring by e-mail. If you need help, please consider attending my office hours.

2. MISSED MIDTERMS/FINAL: No makeup midterms will be offered. If you cannot make it to a midterm, you **DO NOT** need to provide any documentation for your absence. The weight of the missed midterm will be automatically transferred to your final exam. Please be advised that you should carefully think about using this option and how this may affect your final grade. Making the final exam very heavily weighted will put a lot of pressure on you during the finals session.

ALL students who miss the FINAL EXAM MUST submit a deferred standing agreement (DSA) to the Chemistry Undergraduate office (CB124) within 5 business days of the missed exam. The DSA must be accompanied by the documentation supporting the absence. If your DSA is approved, you will be given an opportunity to write the deferred final exam. If your DSA is denied, you will need to petition the course to your home faculty.

3. RE-MARKING REQUESTS: If you believe a written answer on a test was marked incorrectly you must submit a written rationale detailing the suspected error through Moodle (instructions to be given at a later date) within 1 week of receiving a Crowdmark link to your marked paper. I will aim to address all re-marking requests within 1-2 weeks of receiving them. NOTE: re-marking can result in the mark being raised, confirmed, or lowered. To be fair and consistent with regards to the entire class, individual grades are NOT negotiable. We cannot provide 'extra credit' assignments. Marks for assignments and tests are not 'rounded' or 'bell-curved'.

4. ACCOMMODATIONS: Please email me a pdf, a scan, or a photo of your CDS Accommodation letters as soon as possible. Please also notify me of any religious observance conflicts occurring at any point during the term, for which accommodations will be required as soon as possible.

Please note: "Senate policy states that students are expected to monitor their progress in courses, taking into account their personal and academic circumstances, and to make the necessary adjustments to their workload to meet the requirements and deadlines." (from Senate Policy of Students' Responsibilities in the Petition/Appeal Processes).

Students with physical, learning, or psychiatric disabilities who require reasonable accommodations in resources or evaluation methods are encouraged to consult with the Office for Persons with Disabilities (OPD) and ensure that requests for appropriate accommodations are arranged with the Section Instructor early in the term.

5. ACADEMIC INTEGRITY: Students should be familiar with, and follow York University's policies regarding academic integrity. See: https://spark.library.yorku.ca/academic-integrity-what-is-academic-integrity/

6. RECORDING LECTURES: All lectures will be recorded and posted on Moodle.

University policies

1. Academic Honesty and Integrity

York students are required to maintain the highest standards of academic honesty and they are subject to the Senate Policy on Academic Honesty (http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/). The Policy affirms the responsibility of faculty members to foster acceptable standards of academic conduct and of the student to abide by such standards.

There is also an academic integrity website with comprehensive information about academic honesty and how to find resources at York to help improve students' research and writing skills, and cope with University life. Students are expected to review the materials on the Academic Integrity website at - http://www.yorku.ca/academicintegrity/

2. Access/Disability

York University is committed to principles of respect, inclusion and equality of all persons with disabilities across campus. The University provides services for students with disabilities (including physical, medical, learning and psychiatric disabilities) needing accommodation related to teaching and evaluation methods/materials. These services are made available to students in all Faculties and programs at York University.

Student's in need of these services are asked to register with disability services as early as possible to ensure that appropriate academic accommodation can be provided with advance notice. You are encouraged to schedule a time early in the term to meet with each professor to discuss your accommodation needs. Please note that registering with disabilities services and discussing your needs with your professors is necessary to avoid any impediment to receiving the necessary academic accommodations to meet your needs.

Additional information is available at the following websites:

Counselling & Disability Services - http://cds.info.yorku.ca/

York Accessibility Hub - http://accessibilityhub.info.yorku.ca/

3. Ethics Review Process

York students are subject to the York University Policy for the Ethics Review Process for Research Involving Human Participants. In particular, students proposing to undertake research involving human participants (e.g., interviewing the director of a company or government agency, having students complete a questionnaire, etc.) are required to submit an Application for Ethical Approval of Research Involving Human Participants at least one month before you plan to begin the research. If you are in doubt as to whether this requirement applies to you, contact your Course Director immediately.

4. Religious Observance Accommodation

York University is committed to respecting the religious beliefs and practices of all members of the community, and making accommodations for observances of special significance to adherents. Should any of the dates specified in this syllabus for an in-class test or examination pose such a conflict for you, contact the Course Director within the first three weeks of class. Similarly, should an assignment to be completed in a lab, practicum placement, workshop, etc., scheduled later in the term pose such a conflict, contact the Course director immediately. Please note that to arrange an alternative date or time for an examination scheduled in the formal examination periods (December and April/May), students must complete an Examination Accommodation Form, which can be obtained from Student Client Services, Student Services Centre or online at http://www.registrar.yorku.ca/pdf/exam_accommodation.pdf (PDF)

5. Student Conduct in Academic Situations

Students and instructors are expected to maintain a professional relationship characterized by courtesy and mutual respect. Moreover, it is the responsibility of the instructor to maintain an appropriate academic atmosphere in the classroom and other academic settings, and the responsibility of the student to cooperate in that endeavour. Further, the instructor is the best person to decide, in the first instance, whether such an atmosphere is present in the class. The policy and procedures governing disruptive and/or harassing behaviour by students in academic situations is available at - http://secretariat-policies.info.yorku.ca/policies/disruptive-andor-harassing-behaviour-in-academic-situations-senate-policy/