CHM 222H: Introduction to Physical Chemistry
Course Syllabus: Fall 2020

I   CONTACTS

INSTRUCTOR
Name: Jeremy Schofield
Email: jeremy.schofield@utoronto.ca
Office: Lash Miller, room 420E
Classes: online using Bb Collaborate and in person.
> o   In person classes at 4 - 5 p.m. on Mondays and Wednesdays in LM 158.
Online student hours: Fridays, 4 – 5 p.m. or by appointment.

TEACHING ASSISTANTS
Tutorial sessions will be **run online only** during the scheduled period (either Tuesdays from 2 – 3 pm or Fridays from 1 – 2 pm) by the teaching assistants. The TAs for the course are:

Name: Margarita Gladkikh
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II   COURSE OVERVIEW

COURSE DESCRIPTION:
Classes will be concerned with presenting a systematic approach to the topic of *thermodynamics*, one of the fundamental pillars of Physical Chemistry.

STUDENT LEARNING OUTCOMES:

By the end of this course, students will be able to:

- Discuss the laws of thermodynamics and how they can be used for chemical systems.
- Apply the laws of thermodynamics to compute changes in observable physical properties for specific processes.
- Apply thermodynamic principles to compute the physical properties of chemical systems in an equilibrium state, such as the determination of phase and chemical composition as a function of the thermodynamic properties that specify the state.

PREREQUISITE COURSES:
This course assumes you have a basic understanding of elementary differential and integral calculus and elementary physics and physical chemistry. The language used to express the principles of thermodynamics is mathematical and involves multi-variable calculus. A modest

level of mathematical sophistication is required for success in the course. The pre-requisites for the course are: CHM 135H, 136H)/151Y, MAT (135H, 136H)/137Y/157Y, PHY (131H, 132H)/(151H, 152H).
In addition, it is recommended that students be concurrently enrolled in a course in multivariable calculus such as MAT 235Y or MAT 237Y.

READINGS:
Required: Adapted ebook *Physical Chemistry*, by Ira Levine
  o Available for purchase from https://create.mheducation.com/shop/ *or*
  o From the U of T Bookstore via the link:
     https://www.campusebookstore.com/integration/AccessCodes/default.aspx?bookseller_id=96&

III   HOW THE COURSE IS ORGANIZED

Course content is organized in content by week. For each week, there will be assigned reading material from the ebook and problems posted on Quercus for discussion in tutorials.

Students enrolled in the online section of the course are expected to follow the live classes online, read the assigned ebook material, and work through the assigned tutorial questions according to the posted dates.

The following is only a *rough* schedule:

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

Dates	Week	Topics	Reading
Sept. 14 – Sept. 20	1	Definitions of thermodynamic systems and properties. Temperature and the zeroth law of thermodynamics.	Chapter 1: Pages 1-32.
Sept. 21 – Sept. 27	2	Energy, calculations of work.	Chapter 2: Pages 37- 46.
Sept. 28 – Oct. 4	3	Work, heat, and the First Law of Thermodynamics. **Online quiz 1:** Wednesday, Sept. 30: 10% of final mark	Chapter 2: Pages 46 – 52.

Oct. 5 – Oct. 11	4	Enthalpy, internal energy, heat capacities at constant volume and constant pressure.	Chapter 2: Pages 52 – 57.
Oct. 12 – Oct. 18	5	Changes in state functions for isothermal, adiabatic, irreversible and reversible processes. **Term Test 1:** Monday, Oct. 19: 25% of final mark	Chapter 2: Pages 58 – 73.
Oct. 19 – Oct. 25	6	Carnot cycle and heat engines: heat, work and efficiency for a cyclic process.	Chapter 3: Pages 78 – 85.
Oct. 26 – Nov. 1	7	Statements of the Second Law of Thermodynamics, calculation of entropy changes. **Online quiz 2**: Monday, Nov. 2: 10% of final mark	Chapter 3: Pages 78 - 97.
Nov. 2 – Nov. 8	8	Spontaneity, Helmholtz and Gibbs free energies.	Chapter 4: Pages 109 – 125.
Nov. 9 – Nov. 13		Reading week	
Nov. 16 - Nov. 22	9	Chemical potential and changes in phase. **Term Test 2:** Wednesday, Nov. 18: 25% of final mark	Chapter 4: Pages 125 – 132.
Nov. 23 – Nov. 29	10	Equilibrium in chemical reactions.	Chapter 5: Pages 140 – 169 Chapter 6: Pages 174 - 190
Nov. 30 – Dec. 6	11	One-component phase equilibria	Chapter 7: Pages 205 - 225

TUTORIAL OBJECTIVES:
Online tutorials will provide the opportunity for students to ask questions and receive feedback on assigned problems. Tutorial problems will be assigned weekly and it is *imperative* for success in the course that each student attempts to solve the assignments on their own. The problem sets not only provide a valuable means of reinforcing concepts introduced in class but also serve as an example of the level of mastery of material expected of them.

IV   EVALUATION/GRADING SCHEME

- **Quizzes:** (two in total, to be completed on Wednesday, September 30, 2020 and on Monday, November 2, 2020) worth 10% each.
- **Term tests:** (two in total, on Monday, October 19 and Wednesday, November 18, 2020) worth 25% each. Term tests will be scheduled to be completed during a 24-hour period and students will be granted a 2-hour window to complete them once started*.
- **Final assessment: (**to be held during final assessment period in December 2020), worth 30% of final mark.

*No resources such as lecture notes or internet allowed.
MARK BREAKDOWN

Student mark will be based on the higher outcome of two different marking schemes:

Quizzes 2 x 10% = 20% total grade Term test 2 x 25% = 50% total grade Final Assessment = 30% total grade	or	Quizzes 2 x 10% = 20% total grade Term test 2 x 20% = 40% total grade Final Assessment = 40% total grade

Note: if an unexpected technical issue occurs with a university system (e.g., Quercus services, network outage) that affects availability or functionality, it may be necessary to revise the timing or weighting of the assessments.

V   COURSE POLICIES

- We will strive to answer all communications such as emails in a 24-hour period.

- The University of Toronto is committed to equity, human rights and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities.

- All work for the course must be submitted using Quercus.

- Normal University procedures should be followed to signal course absences and request make-up tests or exemptions from exams.

VI   TECHNOLOGY REQUIREMENTS

This course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, broken printers, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

VII   INSTITUTIONAL POLICIES AND SUPPORT

ACADEMIC INTEGRITY

On Academic Integrity:
Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters (https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In assignments:
1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:
1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:
1. Falsifying institutional documents or grades.
2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what

constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see https://www.academicintegrity.utoronto.ca/).

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This course, including your participation, will be recorded on video and will be available to students in the course for viewing remotely and after each session.

Course videos and materials belong to your instructor, the University, and/or other sources depending on the specific facts of each situation and are protected by copyright. Do not download, copy, or share any course or student materials or videos without the explicit permission of the instructor.

ACCESSIBILITY NEEDS
Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact Accessibility Services as soon as possible.

ADDITIONAL SERVICES and SUPPORT
The following are some important links to help you with academic and/or technical service and support

- General student services and resources at Student Life
- Full library service through University of Toronto Libraries
- Resources on conducting online research through University Libraries Research
- Resources on academic support from the Academic Success Centre
- Learner support at the Writing Centre
- Information for Technical Support/Quercus Support