CHEMISTRY Survey of Physical Chemistry

COURSE CONTENT: (Top)

The **lecture recordings** are available under MyCourses.

Text book references: please note this is the **ONLY** place to find the official course content.

Chapter 2: The First Law of Thermodynamics

Everything except: 2.7 real gases

Problems: all in chapter 2 except:

- questions with *
- questions using $C = C(T)$
- Real gas questions 2.62-2.72.

Chapter 3: The Second Law of Thermodynamics

Everything except in section 3.5 skip Cryogenics: the Approach to Absolute Zero

You are responsible for Absolute Entropies.

Skip section 3.8 and 3.9

In Section 3.9, read up to, not include, Refrigeration and Liquefaction.

Problems: 3-1 to 3-55 excluding * problems.

Chapter 4 Chemical Equilibrium

Sections 4.1 to 4.4 (not 4.5, 4.6) do 4.7, 4.8 (but see my class notes which are simpler); do 4.9

Problems: 4.1 to 4.49 excluding * problems.

Chapter 5 Phases and Solutions

Sections 5.1 and 5.2, up to Eq.(5.10) and stop before The Clausius Clapeyron Equation

Problems: 5.1 to 5.4

Chapter 9 Chemical Kinetics

Sections 9.1 to 9.4, skip 9.5. do sections 9.6 to 9.8; of section 9.9 (up to page 9-40); skip section 9.10.

Chapter 10 Chemical mechanisms

Intro, 10.1 to 10.5, only Enzyme Catalysis in 10.9

Problems

Chapter 9
Rate Constants and Order of Reaction 9.1 - 9.21
Temperature Dependence 9.25 - 9.32, 9.34, 9.36 - 9.37
Collision Theory and Transition State Theory 9.38 - 9.41, 9.44 - 9.51

Chapter 10
Composite Mechanisms and Rate Equations 10.1 - 10.8, 10.10, 10.12, 10.15
Catalysis 10.24, 10.27 - 10.34
Enzyme-Catalyzed Reactions 10.35 - 10.36, 10.39, 10.44 - 10.45

General Information (Top)

Prof. Bryan C. Sanctuary
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Credits: 3

Format: 3 lectures.

Time/Location: MWF 012:35 a.m.1:25 p.m. - winter 2017 in OM 112 10:30-11:30 starting January 5th, 2017

Prerequisites: CHEM-110 or CHEM-111 and CHEM-120 or CHEM-121 or equivalent.

Tutorial times: Wednesday, 13:30 to 14:30 in Burnside 1B39

This course is intended for students in biological science programs requiring only one course in physical chemistry. Not open to students who have taken or are taking CHEM-204 or CHEM-213.

Syllabus: The fundamentals of thermodynamics and chemical kinetics with applications to the behaviour of bio-molecular systems. Thermodynamic and kinetic control of biological processes.

Course Text: Course Text: *Physical Chemistry* by Laidler, Meiser and Sanctuary, along with solution manual, available only as an eBook from

http://mchmultimedia.com/product-category/ebook/

Note: you only need to purchase the first half of the book: chapters 1 to 10

Solution manual is bundled with the eBook.

Grading: Quizzes (15%) Midterm (35% of total) and Final exam (50%).

Exam locations: (I will tell you which room later by family name)

Midterm exam: Tuesday, February 17, 2017 Adams AUD, from 19:30 – 21:30.

Tutorial: The tutorial will review topics covered that week, and work out relevant problems.

Time and location TBA

The Final Examination covers whole course

McGill Policy statements: (Top)

"McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures (see www.mcgill.ca/students/srr/honest/ for more information).

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Course outline (Top)

Fall Term

CHEMISTRY 203: OUTLINE

Lecture notes will be uploaded as we proceed.

Please preview the material before coming to class. I will assign problems from the solution manual in class. Do problems assigned because exams will be based on similar problems. In the tutorials a certain number of representative problems will be done.

The intention is to spend approximately one month each on the following topics:

First Law of Thermodynamics;
Second Law of Thermodynamics;
Chemical Kinetics.

The First Law of Thermodynamics: (First month) (Top)

LMS Chapter 2 (note you can right-click a page of LMS and zoom if text too small.

First six lectures or so: The following general concepts should be understood and applied.

- Temperature
- Heat and work
- Conservation of energy
- State functions
- Internal energy
- Types of work—and maximum work
- Enthalpy
- Endothermic and exothermic processes
- Reversible and irreversible paths
- Heat capacity
- Thermochemistry
- Balanced equations
- Standard states
- Hess' Law
- Calorimetry
- Heats of formation
- Bond energies
- Ideal gases at constant pressure (isobaric), constant temperature (isothermal), constant heat (adiabatic) and constant volume (isochoric)
- (We will skip the Joule-Thompson effect in section 2.7.)
- Van der Waal's equation

The Second Law of Thermodynamics: (Second month): (Top)

About twelve lectures or so: will discuss Chapter 3. The following general concepts should be understood and applied.

- Carnot cycle and the steam engine
- Reversible isothermal expansion
- Reversible adiabatic expansion
- Reversible isothermal compression
- Reversible adiabatic compression
- Efficiency of a reversible heat engine
- Definition of entropy
- Irreversible processes
- Entropy and disorder

- Entropy of fusion
- Entropy of vaporization
- Entropy changes in chemical reactions
- Entropy of mixing
- Conditions for equilibrium
- The Gibbs energy
- The Helmholtz energy
- Available non-PV work
- Thermodynamic equation of state
- Heat engines and heat pumps
- Equilibrium
- Phase diagrams

Chemical kinetics: (Third month): (Top)

We will spend about 6 lectures of chapter 9.

- Rates of reaction
- Empirical rate laws
- Order of reactions
- Rate constants
- Zeroth, first and second order rate laws
- Half lives
- Opposing reactions
- Molecularity
- Catalysts
- The Arrhenius equation
- Activation energy
- Reaction coordinates
- Energy potential surfaces
- The pre-exponential factor
- Transition state theory
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We will spend about six lectures on Chapter 10

- Composite reactions
- Simultaneous reactions
- Opposing reactions
- Consecutive reactions
- Steady state approximation
- Rate and equilibrium constants
- Microscopic reversibility
- Free-radical reactions
- Chain reactions
- Photochemical reactions
- Acid base catalysis
- Enzyme catalysis