

**Camosun College**  
**Department of Chemistry & Geoscience**  
Chemistry 121-03 – Syllabus - Winter 2007  
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**Prerequisites:** Chem 12 and Chem 120

**Lectures:** Thursday 6:30 pm - 9:20 pm

**Labs:** Tuesday 6:30 pm - 9:20 pm

**Office hours:** Tuesday, Thursday 5:30 pm – 6:20 pm

**Textbook:**

- “Chemistry, The Central Science” by Brown, LeMay, & Bursten, 10<sup>th</sup> Ed., 2006
- Solutions Manual & Organic Supplement (for Chem 121) also available.
- Chemistry 121 Lab Manual (Safety glasses mandatory & lab coat recommended)

**Intended Learning Outcomes:**

*At the end of the course the student will be able to:*

1. Utilize the specialized vocabulary and nomenclature based on the IUPAC system of organic compounds to name and draw structures for many simple organic compounds containing the common functional groups.
2. Write chemical reactions to illustrate numerous transformations between organic functional groups.
3. Draw structural and stereoisomers of organic compounds and name stereoisomers based upon the IUPAC system of nomenclature.
4. Demonstrate an understanding of the factors that influence the rate of a chemical reaction, deduce the rate of a chemical reaction from time/concentration data, and utilize rate laws to perform kinetic calculations.
5. Apply the laws of thermodynamics and account for the factors that lead to spontaneous physical and chemical changes.
6. Explain how and why reactions attain equilibrium positions and perform calculations pertaining to equilibrium systems.

7. Describe redox reactions, use electrochemical data to predict the spontaneity of redox reactions, and comprehend the structures of electrochemical cells.
8. Describe various acid-base theories and apply these theories to acid-base reactions in aqueous solution.
9. Perform experiments in the areas of preparative organic, preparative inorganic, physical and analytical chemistry and use the various associated pieces of laboratory equipment.

## Course Material:

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### **1. Organic Chemistry (12-15 hours)\* (Chapter 25 + The Essentials of Organic Chemistry)**

- Hydrocarbons, alkanes, alkenes, alkynes and aromatics.
- Nomenclature. Structural isomerism, stereoisomers, *Z/E* nomenclature.
- Chemical properties of hydrocarbons including mechanisms of addition reactions to alkenes (Markovnikov's rule) and aromatic substitution.
- Functional group chemistry including alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines, amides and alkyl halides. Synthesis, properties, chemical reactivity, and nomenclature.
- Optical isomerism, enantiomers, Cahn, Ingold, Prelog nomenclature.
- Biological compounds, amino acids, proteins, carbohydrates, fats.
- Polymers.

### **2. Kinetics (6 hours) (Chapter 14)**

- Reaction rates, measuring reaction rates, factors influencing reaction rates.
- Rate laws, types of rate laws, determining the form of the rate law, method of initial rates.
- Integrated rate laws, zero order, first order, and second order, half-life.
- Temperature and rate, models for chemical kinetics, collision theory, activated complex theory.
- Arrhenius equation, Arrhenius parameters.
- Reaction mechanisms, rate-determining step, deducing the rate law from the mechanism.
- Catalysis, enzymes, industrial catalysis, ozone layer depletion.

### **3. Chemical Equilibrium (3 hours) (Chapter 15)**

- Equilibrium condition,  $K_c$ ,  $K_p$ , heterogeneous equilibria, reaction quotient, relation between  $K_p$  and  $K_c$
  - Calculating unknown equilibrium concentrations and/or equilibrium constants.
- Le Châtelier's principle, the Haber process.

### **4. Thermochemistry and Chemical Thermodynamics (Chapters 5 and 19) (9 hours)**

- Nature of energy, first law of thermodynamics, enthalpy, enthalpy of reaction.
- Calorimetry, bomb calorimeter.

- Hess's law, enthalpy of formation.
- Fuels.
- Spontaneous processes, reversible and irreversible processes.
- Entropy and the 2nd law, molecular interpretation of entropy.
- Third law of thermodynamics third law entropies, calculating entropy changes.
- Gibbs free energy, standard free energy, Free energy and temperature and equilibrium, free energy and work, driving nonspontaneous processes.

### **5. Acids and Bases (Chapters 16 and 17) (6 hours)**

- Nature of acids and bases, Arrhenius and Brønsted-Lowry models, conjugate acids and bases.
- Autoionization of water, the pH scale, strong and weak acids, strong and weak bases.  $K_a$  and  $K_b$ .
- pH calculations for strong acid and base solution, weak acid and base solutions.
- Relating structure to acid/base strength, acid/base properties of salts.
- Lewis acids and bases, common ion effect, buffers, Henderson-Hasselbalch equation.
- Solubility equilibria, formation of complex ions.

### **6. Electrochemistry (3 hours) (Chapter 20)**

- Review of redox reactions, balancing redox equations
- Galvanic cells, electrical energy, standard electrode potentials, cell emf, free energy and electrical work,
- Nernst equation

\*The organic chemistry will be supplemented by additional notes and problems which will be handed to you at appropriate intervals.

**Note:** You will be given a more detailed summary of the material covered in the course towards the end of the term. Because of time constraints we may not be able to cover all the topics listed above.

## **COURSE CONTENT**

The course includes:

- The scheduled lectures
- Weekly laboratory work (8 labs)
- Two 120-minute term tests.<sup>#</sup>
- A three-hour written final examination at the end of the course on ALL the material in the course.

### **Notes**

<sup>#</sup> Term Test #1 will be on material covered in the first four weeks of the course and is scheduled for Feb 1. Term Test #2 will be on the material covered since Test #1 and is scheduled for lab period of Week 12.

## Tutorials

There will be a tutorial the weeks previous to the tests. It is advised that everyone attend, even if you don't have any questions as other people may have questions which may be useful to you

## Laboratory Work

Experiments are performed on a weekly basis (apart from scheduled tutorials or tests). A report is required for each experiment. Details are given in the lab handout.

## Basis of Student Assessment (Weighting)

The course mark will be derived in the following manner:

Laboratory (8 labs)	25%
Term Test I	20% (2.5h) (Feb 6)*
Term Test II	20% (2.5h) (Mar 27)*
Final (Comprehensive)	35% (3h in April )

\* Test dates to be confirmed first week of classes

- 1) Student is encouraged to attempt both tests. If a Test score is not as high as that of the April final exam it will be dropped automatically and its weight redistributed to the final exam. You may choose not to write one or both tests and have each weight redistributed to the final exam. For the gambler who misses both tests, your final exam will then be 75% of the course grade.
- (2) Student must write each test as scheduled. No one is allowed to write late and there will be no make-up test. No exceptions.

## The Letter grade

The following scale is used:

A+ = 95 - 100%	B = 75 - 79%	D = 50 - 59%
A = 90 - 94%	B- = 70 - 74%	F = 0 - 49%
A- = 85 - 89%	C+ = 65 - 69%	
B+ = 80 - 84%	C = 60 - 64%	

## Notes

1. You must hand in a minimum of 75% of the lab work and score a minimum of 50% on lab marks to be permitted to take the final exam.
2. You must pass both the lecture portion and the laboratory portion in order to pass the course.

## **Recommended Materials or Services to Assist Students to Succeed Throughout the Course**

Articles in the Library Reserve Room for Chem 120 & 121:  
(at least one copy of the followings)

- B-L-B, 10<sup>th</sup> Edition & Solutions to Red Exercises  
Student's Guide, "Math Review Toolkit" & "The Essentials of Organic chemistry" for the 10<sup>th</sup> Ed. are also available.
- B-L-B, 9<sup>th</sup> Edition , Student's Guide, & Solutions to Red Exercises.
- B-L-B, 8<sup>th</sup> Edition , Student's Guide, & Solutions to Red Exercises.
- B-L-B, 7<sup>th</sup> Edition.

## **LEARNING SUPPORT AND SERVICES FOR STUDENTS**

There are a variety of services available for students to assist them throughout their learning. This information is available in the College Calendar, Registrar's Office or the College web site at <http://www.camosun.bc.ca>

## **ACADEMIC CONDUCT POLICY**

There is an Academic Conduct Policy. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, Registration, and on the College web site in the Policy Section.

[www.camosun.bc.ca/divisions/pres/policy/2-education/2-5.html](http://www.camosun.bc.ca/divisions/pres/policy/2-education/2-5.html)