Camosun College
Department of Chemistry and Geoscience

Chemistry 121 - Course Outline - Winter 2004

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Prerequisites: Chem 12 and Chem 120

Lectures: Monday (F 200): 11:30 am to 12:20 pm, Wednesday (F 210):11:30 am to 12:20 pm , Friday (F 210): 11:30 am to 12:20 pm.

Labs: Monday, 2:30 to 5:20 pm (F 356/ F 358)

Office Hours: Monday: 1.30 pm to 2:30 pm, Tuesday: 11.30 am to 12.30 pm and 1.30 pm to 2:30 pm, Wednesday: 12.30 pm to1:30 pm, and Friday: 10:30 am to 11:30 am.

Textbook*:* *CHEMISTRY, the Central Science* 9th Edition, *Brown, Lemay, and Bursten*. *The Essentials of Organic Chemistry, George, Field, and Hambley.*

Course Material:

1. Organic Chemistry (14 lectures)* (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 substition.
- 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 lectures) (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 catlysis, ozone layer depletion.

3. Chemical Equilibrium (3 lectures)
- 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 Chatelier's principle, the Haber process.

4. Thermochemistry and Chemical Thermodynamics (Chapters 5 and 19) (9 lectures)

- 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 lectures)

- Nature of acids and bases, Arrhenius and Bronsted-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 lectures) (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:
a) The scheduled lectures
b) Weekly laboratory work (1 lab per week)
c) Biweekly problem sets[1]
d) Two 120-minute term tests.[2]
e) A three-hour written final examination at the end of the course on **ALL** the material in the course.

Notes

1. These are picked from the questions found after each chapter. These problem sets **will not be marked** but it is essential that you do them to keep pace with the material. This is especially

important in an accelerated course such as this. Solutions will be posted outside my office and in a folder in F 358 at regular intervals during the term.

2. **Term Test #1** will be on material covered in the first five weeks of the course and is scheduled for the lab period of **Week 6**. **Term Test #2** will be on material covered from **Week 6** to **Week 11** and is scheduled for lab period of **Week 12**.

Laboratory Work

Experiments are performed on a weekly basis (apart from week 1 and week 14(except when a test is scheduled). A report is required for each experiment. Details are given in the lab handout.

Course Mark

The course mark will be derived in the following manner:

Term Tests(@20%)	40 %
Final	35 %
Laboratory	25 %

NOTE: If it is advantageous to the student the theory mark will be solely derived from the final examination.

The Letter grade

The following scale is used:

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

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.

Intended Learning Outcomes

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.