

Division: ACADEMIC DATE: September 12, 1994

 B: Department: SCIENCE & MATHEMATICS New Course: \_\_\_\_\_

 Revision of Course  
 Information form: X

 DATED: May 1984

C: <u>CHEM 420</u> Subject & Course No.	D: <u>ORGANIC CHEMISTRY - PART 2</u> Descriptive Title	E: <u>5</u> Semester Credit
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**F: Calendar Description**

This is part two of a general organic chemistry course which continues from CHEM 320. The course examines the fundamental aspects of modern organic chemistry as illustrated by the structure, properties, synthesis nomenclature and reactions of aldehydes, ketones, carboxylic acids and their derivatives, phenols, amines, fats and carbohydrates and proteins. Reaction mechanisms and NMR spectroscopy are also covered.

**Summary of Revisions:**

 (Enter date & section)  
 Ex: Section C,E,F, &R

D, F, H, N, O, P

**G: Type of Instruction: Hours Per Week/**
**Per Semester**

Lecture	<u>4</u>	Hrs.
Laboratory	<u>3</u>	Hrs.
Lecture Seminar	_____	Hrs.
Clinical Experience	_____	Hrs.
Field Experience	_____	Hrs.
Practicum	_____	Hrs.
Shop	_____	Hrs.
Studio	_____	Hrs.
Student Directed Learning	_____	Hrs.
Other	_____	Hrs.

**TOTAL 7 HOURS**
**H: Course Prerequisites:**  
 CHEM 320, C or better

**I: Course Corequisites:**
**J: Course for which this course  
 is a pre-requisite**
**K: Maximum Class Size:**  
 36

**M: Transfer Credit:**

 Requested \_\_\_\_\_  
 Granted X

 Specify Course Equivalents or  
 Unassigned Credit as Appropriate

U.B.C. CHEM 230(6)(with CHEM 320)

S.F.U. CHEM 250(3) + 255(2)

U. Vic. CHEM 232(1.5)

 OTHER: Open University-CHEM 241(3)+  
 CHEM 246(1) + CHEM(1)

  
 COURSE DESIGNER(S)

  
 DIRECTOR/CHAIRPERSON

  
 DIVISIONAL DEAN

  
 REGISTRAR

**N: Textbooks and materials to be purchased by students  
(Use Bibliographic Form):**

1. Solomons T.W.G. Organic Chemistry 4th Edition (Also used in CHEM 320)  
John Wiley and Sons Inc.
2. CHEM 420 - Laboratory Outline (Douglas College/Current Year)

**Reference Texts:**

Vollhardt and Schore, Organic Chemistry 2nd Edition W.H. Freeman and Co.

Fessenden and Fessenden, Organic Chemistry 5th Edition Brooks-Cole

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**Complete Form with Entries Under the Following Headings:**

**O. Course Objectives; P. Course Content; Q. Method of Instruction;**

**R. Course Evaluation**

**O. Course Objectives:**

**General Objective:**

The student will be able to relate the importance of Organic Chemistry, not only as a science in itself, but also its relevance to other sciences with particular emphasis to the Biological Sciences.

**SPECIFIC OBJECTIVES:**

1. The student will be able to study the various functional groups listed in the Course Outline and do conversion problems involving these.
2. The student will be able to recognize the main reaction mechanisms of Organic Chemistry and thus be able to relate structure to property and reactions.
3. The student will be able to deduce the structure of simple compounds with the aid of spectroscopic data.
4. In general, the student will be able to answer questions on nomenclature, structure, properties, reactions and stereochemistry as they relate to the classes of compounds detailed in the Course Outline.
5. The student will study the fundamental chemistry of fats and waxes and be able to do simple synthetic and degradative problems.
6. The student will study the fundamental chemistry of sugars and carbohydrates, and be able to do simple degradative and synthetic problems.
7. The student will be introduced to the study of peptides and proteins and be able to do simple synthetic and degradative problems involving proteins, peptides and amino acids.
8. The student, using modern Organic techniques will perform experiments in the laboratory which will:
  - a) emphasize the importance of the practical aspects of Organic Chemistry
  - b) illustrate many of the fundamental techniques of Organic Chemistry
  - c) illustrate reactions discussed in class
  - d) illustrate the use of instrumentation to identify new products synthesized in the laboratory

**P. COURSE OUTLINE**

1. **FREE RADICAL REACTIONS**  
Review of Free Radical Reactions, Markovnikov and Anti-Markovnikov Addition of Hydrogen Bromide.
2. **CONJUGATED UNSATURATED SYSTEMS**  
Allylic Substitutions, The Allyl Radical, The Allyl Cation Resonance, Benzylic Radicals, Nucleophilic substitution Reactions, Alkadienes and Poly-unsaturated Systems, 1,4-Additions, Diels-Alder reaction.
3. **SPECTROSCOPIC METHODS OF STRUCTURE DETERMINATION**  
Electromagnetic Spectrum, Review I.R. and U.V., Proton Nuclear Magnetic Resonance, Nuclear Spin, Shielding and Deshielding of Protons, Chemical Shift, Equivalent and Nonequivalent protons, Spin-Spin Coupling, Coupling constant.
4. **AROMATIC COMPOUNDS**  
Aromaticity, Kekule Structures, Resonance, Molecular Orbital picture of Benzene, Nomenclature of Benzene Derivatives, Electrophilic Aromatic Substitution, Activating and Deactivating groups, Orientation in di- and tri- substitution, Halogenation and Oxidation of the side chain.
5. **PHENOLS AND ARYL HALIDES**  
Structure and Nomenclature, Properties and Synthesis of Phenols, Acidity, Reactions of phenolic O-H group, and of the Benzene ring, Claisen Rearrangement, Reimer-Tiemann reaction, Kolbe Reaction, Aryl Halides.
6. **ALDEHYDES & KETONES**  
Nomenclature, Synthesis, Reactions of Carbonyl Compounds, Additions of water, Alcohols, Ammonia and Derivatives, Hydrogen Cyanide and Sodium hydrogen sulfate, Reformatsky Reaction, Oxidation Analysis of Aldehydes and Ketones, Acidity of  $\alpha$ -Hydrogens, Enolate Ions, Aldol Reaction, Reformatsky Reaction, Malonic Ester and Acetoacetic Ester Synthesis, Additions to  $\alpha,\beta$  - Unsaturated Carbonyl Compounds.
7. **CARBOXYLIC ACIDS AND THEIR DERIVATIVES**  
Nomenclature and Properties, Preparation and Reactions of Carboxylic Acids, Acid Chlorides, Acid Anhydride, Esters, Amides, Halo Acids, Decarboxylation of Acids.
8. **AMINES**  
Nomenclature, Basicity, Preparation and Reactions of Amines, Reaction with Nitrous Acid, Replacement reactions of Diazonium salts Sandmeyer reaction, Analysis of Amines, Eliminations involving Ammonium Compounds.
9. **CARBOHYDRATES**  
Monosaccharides, Mutarotation and Glycoside Formation, Oxidation and Reduction reactions of Monosaccharides, Osazones, Disaccharides, Polysaccharides.
10. **LIPIDS**  
Introduction, Fatty Acids, Hydrolysis, Soap, Micelles, and Detergents, Terpenes, Waxes, Metabolism of Fats, Phospholipids.
11. **AMINO ACIDS AND PROTEINS**  
Amino Acids, Synthesis of alpha Amino Acids, Analysis, Amino Acid Sequence of Proteins, Polypeptides, Isoelectric Point, Protein and Peptide Synthesis.

**Q. METHOD OF INSTRUCTION**

The course will be presented using lectures, assigned readings, problem sessions and class discussions. Films and other audio-visual aids, handouts and programmed material will be used where appropriate. The laboratory course will be used to illustrate the practical aspects of the course material. Close coordination will be maintained between laboratory and classroom work whenever possible.

**R. EVALUATION**

Students performance in the course will be evaluated in the following way:

- |    |   |     |
|----|---|-----|
| 1. | Laboratory work   | 30% |
|    | a) Pre-lab write ups, prelab quizzes                                    |     |
|    | Lab notebook 18%  |     |
|    | b) Product Analyses, Final lab quizz 12%                                |     |
| 2. | Examinations  | 70% |
|    | a) A final comprehensive examination: 30%                               |     |
|    | b) A minimum of three in class tests given throughout the semester: 40% |     |

**LABORATORY OUTLINE**

1. Preparation and Purification of the Cyclopentadiene-Maleic Anhydride Adduct.
2. Introduction to N.M.R. (lecture). Analysis of an unknown from N.M.R. and I.R. Spectra.
3. Demonstration of the Operation of the Varian EM-360A N.M.R. Spectrometer.
4. Multi-step Synthesis; Limonene, limonene nitrosochloride, carvoxime and carvone. All products to be tested as directed in the manual and completed by the end of the 4th laboratory session. (4 laboratory periods).
5. Reaction Kinetics of the Oxidation of Alcohols.
6. Separation and Identification of Methyl Esters of Fatty Acids by Gas Chromatography. (2 laboratory periods).
7. Carbohydrates: Hydrolysis of Sucrose and Synthesis of Osazones. Measurement of Optical Rotation of Various Sugars using Polarimeter.
8. Chemical Reactions of Amino Acids.
9. Final Laboratory Quiz. Emphasis will be on techniques practised during the course.