UNIVERSITY COLLEGE OF THE FRASER VALLEY

COURSE INFORMATION

DISCIPLINE/DEPARTMENT: Chemistry **IMPLEMENTATION DATE**: Fall 1976

Course Revised Implementation Date: September 2002
Course to be Reviewed: September 2006

Chemistry 211	Organic Chemistry I	4
SUBJECT/NUMBER OF COURSE	**DESCRIPTIVE TITLE**	**UCFV CREDITS**

CALENDAR DESCRIPTION: Organic Chemistry I provides students with an introduction to the subject through a study of the characteristic reactions of the common functional groups. In this way, the chemistry of the alkanes, alkenes, alkynes, alkyl halides, alcohols and ethers is discussed. Particular emphasis is placed on the study of reaction mechanisms, and the importance of stereochemistry is stressed throughout the course. The laboratory component of the course complements the lecture material and introduces students to some of the basic techniques that are employed in modern chemistry laboratories.

RATIONALE: With Chem 212, this course satisfies organic chemistry requirements for students pursuing careers in chemistry, biology, biochemistry, home economics, forestry, pre-medicine and pharmaceutical science.

COURSE PREREQUISITES: Chem 111 and 112

COURSE COREQUISITES: None

HOURS PER TERM FOR EACH STUDENT	**Lecture**	**46**	**hrs**	**Student Directed Learning**		**hrs**
	Laboratory	**32**	**hrs**	**Other - specify:**		
	Seminar		**hrs**	**Exams**	**6**	**hrs**
	Field Experience		**hrs**	**TOTAL**	**84**	**HRS**

MAXIMUM ENROLMENT: 24

Is transfer credit requested? ☒ **Yes** ☐ **No**

AUTHORIZATION SIGNATURES:

Course Designer(s): _____ **Chairperson**: **Curriculum Committee**

Department Head: Noham Weinberg **Dean**: Jackie Snodgrass

PAC: Approval in Principle _____ **(Date)** **PAC: Final Approval**: October 24, 2001 **(Date)**

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Chemistry 211
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SYNONYMOUS COURSES:

(a) replaces N/A
(course #)

(b) cannot take N/A for further credit
(course #)

SUPPLIES/MATERIALS:

Laboratory supplies required.

TEXTBOOKS, REFERENCES, MATERIALS (List reading resources elsewhere)

TEXTS: **Organic Chemistry, 4th edition, John McMurry (Brooks/Cole)**
UCFV Laboratory Manual for Chemistry 211 and 212

REFERENCES: **Organic Chemistry, 3rd edition, L.G. Wade Jr. (Prentice-Hall)**
Organic Chemistry, 6th edition, Morrison and Boyd (Allyn and Bacon)
Organic Chemistry, 3rd edition, Fessenden & Fessenden (Brooks/Cole)
Organic Chemistry, 5th edition, T.W.G. Solomons (John Wiley & Sons)

OBJECTIVES:

Students enrolling in this course will be pursuing careers in chemistry or biology notably, but also other careers requiring a strong background in chemistry.

GENERAL: **Students will understand the fundamental principles of organic chemistry.**

SPECIFIC: It is intended that students will be able to:

1. Understand the basic principles underlying organic chemistry and apply them to new situations using a systematic and logical approach (e.g., in reaction syntheses).
2. Perform laboratory syntheses and analyses with care, precision, and confidence.
3. Relate the information obtained in laboratory experimentation to the theoretical presentations in class sessions.
4. Appreciate the connection between organic syntheses and biological systems, where applicable.

METHODS:

Presentation of the course will be by inter-related class (theory), seminar, and laboratory sessions. Class sessions will promote active student participation to ensure continual mutual feedback in order to reinforce the learning process. Films and audio-visual aids will be used where appropriate. Problem assignments will be continually given. Some selected problems will be collected and marked.

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STUDENT EVALUATION PROCEDURE:

This will be conducted under a flexible system guided by the following:

Laboratory (reports and techniques)	25%
Mid-term examinations (2)	40%
Class participation and instructor's assessment	5%
Final examination	30%

COURSE CONTENT: All references are to McMurry (McM)

Introduction and Review: McM. ch. 1, ch. 2 (omit 2.9)

A general review of some fundamental concepts. Bonding in organic compounds (sp^3, sp^2, sp hybrid orbitals, delocalized orbitals). Bond polarity, molecular polarity, intermolecular forces (dipole-dipole, H-bonding, van der Waals) solubility. Acidity and basicity.

Alkanes and Cycloalkanes: McM. ch. 3, 4, 5.3, 10.3, 10.4

Alkanes: homologous series, nomenclature, structural isomerism. Conformations, torsional strain, steric strain, conformational analysis. Reactions of alkanes: combustion, free radical chlorination and bromination: reactivity and selectivity, free radical stability.

Cycloalkanes: nomenclature, stability of cycloalkanes, C_3-C_6: Baeyer ring strain theory, H data, orbital aspects, factors affecting stability. Conformations, particularly of cyclohexane and substituted cyclohexane, axial/equatorial positions, stereoisomerism, diaxial interactions, conformational analysis.

Alkenes: McM. 5.1, 5.4, 5.5, ch. 6 (not 6.2)

a a) Structure and Synthesis: nomenclature, structures, isomers and their relative stabilities. Synthesis by elimination reactions: (i) dehydrohalogenation with related stereochemistry; (ii) dehydration with carbocation rearrangements. Synthesis by partial hydrogenation.

b) Reactions: Electrophilic addition and oxidation reactions (H_2, X_2, HX, H_2O, ROH, B_2H_6, $KMnO_4$, O_3, epoxidation). Reaction mechanisms for hydrogenation, halogenation--Markovnikov and free radical, hydration, halohydrin, hydroboration, oxidation, epoxidation with stereochemical implications. Applications of reactions to multi-step syntheses.

Alkynes: McM. ch. 8

Nomenclature, structures, and isomerism. Preparation by elimination. Reactions: electrophilic addition, oxidation as for alkenes; and substitution using terminal alkynes: S_N2 vs. E2 aspects. Acidity of terminal alkynes. Use of alkynes with alkenes in multi-step syntheses.

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COURSE CONTENT: (contd.)

Stereoisomerism: McM. ch. 9, 27.5 (resolution of amino acids)

Structural and stereoisomerism - a review. Chirality, enantiomerism, optical activity (including allenes), racemic modification, configuration (R, S nomenclature). Compounds with two chiral centres, meso, threo, erythro forms. Three dimensional and Fischer structures. Stereochemistry of syn/anti addition to alkenes. Reactions of chiral molecules, retention, inversion, racemization of configuration. Relating configurations and resolution.

Alkyl Halides and Substitution/Elimination: McM. ch. 10 (10.1-10.2, 10.7-10.10), ch. 11 (Sub. & Elim.)

Nomenclature, preparations. Nucleophilic substitution reactions (S_N1, S_N2), mechanisms, influence of R, Nu, L, solvent and temperature; stereochemical aspects; solvolysis. Elimination reactions (E1, E2), mechanisms, influence of R, Nu, L, solvent and temperature; stereochemical aspects; Zaitsev and Hofmann products. Substitution v. Elimination summary.

Alcohols: McM 10.8 (Grignards) and ch. 17 (except 17.12)

Nomenclature and physical properties. Preparation: S_N2 attack, hydration, hydroboration, oxymercuration-demercuration, reduction of carbonyls, Grignard synthesis, diol formation. Reactions: contrast of C-O and O-H bond strengths, dehydration, PX_3, tosylate, oxidation. Synthesis problems (Grignards). Use of alcohols in multi-step syntheses.

Ethers: McM 18.1-18.7

Nomenclature and structures. Preparation: substitution by alkoxy ions, Williamson synthesis, alkoxymercuration. Reactions - cleavage by acid, use as solvents.

LABORATORY EXPERIMENTS

To be selected from:

1. Distillation and the Purity of Liquids (Refractive Index)
2. The Purity of Solids: Melting Point and Mixed Melting Point
3. Purification of Solids by Crystallization
4. Extraction
5. Qualitative Organic Analysis: Sodium Fusion and Functional Group Tests
6. Nucleophilic Substitution: Effect of Leaving Group on Adamantyl Halide Solvolysis
7. Synthesis of an Alkene (Cyclohexene, by Dehydration of Cyclohexanol)
8. Synthesis of an Alkyl Halide (1-Bromobutane from n-Butanol)
9. Gas Chromatography: Analysis of a Mixture of Alkenes
10. Synthesis of an Alcohol (Triphenyl Methanol, via Grignard Reagent)