X **UNIVERSITY COLLEGE OF THE FRASER VALLEY**

COURSE INFORMATION

DISCIPLINE/DEPARTMENT: Chemistry **IMPLEMENTATION DATE**: Fall 1993

Course Revised Implementation Date: September 2003
Course to be Reviewed: September 2007

Chemistry 311	Intermediate Organic Chemistry I	4
SUBJECT/NUMBER OF COURSE	**DESCRIPTIVE TITLE**	**UCFV CREDITS**

CALENDAR DESCRIPTION: An intermediate level Organic Chemistry course involving a detailed study of condensation reactions, dienes and heterocyclic compounds. The approach will be by reaction mechanism and synthesis. The spectroscopic techniques first introduced in Chem 212 are examined in more detail, both in theory and in practice. The laboratory component of the course involves the synthesis of a variety of compounds and qualitative analysis by both spectroscopic and chemical means.

RATIONALE: With Chem 312 or Chemistry 411 this course satisfies organic chemistry requirements towards a Bachelor of General Science degree with a minor in Chemistry.

COURSE PREREQUISITES: One of, CHEM 211 or CHEM 213; and one of: CHEM 212 or CHEM 214.

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? **9** **Yes** **:** **No**

AUTHORIZATION SIGNATURES:

Course Designer(s): Peter W. Slade/Arthur M. Last **Chairperson**: T. Cooper
Curriculum Committee

Department Head: A. Last **Dean**: K. Wayne Welsh

PAC: Approval in Principle _____ **(Date)** **PAC: Final Approval**: December 4, 2002 **(Date)**

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SYNONYMOUS COURSES:

(a) replaces previous Chem 311 which included labs
(course #)

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

SUPPLIES/MATERIALS:

TEXTBOOKS, REFERENCES, MATERIALS (List reading resources elsewhere)

TEXTS: Organic Chemistry, 3rd edition, L.G. Wade Jr., (Prentice-Hall), 1995
Aromatic Heterocyclic Chemistry, D.T. Davies (Oxford University Press), 1993

REFERENCES: Organic Chemistry, 4th edition, John McMurry (Brooks/Cole), 1995
Organic Chemistry, K. Peter C. Vollhardt (W.H. Freeman), 1987
Advanced Organic Chemistry, 4th edition, Jerry March (John Wiley)

OBJECTIVES:

Students enrolling in this course will be pursuing careers in chemistry or hoping to achieve a minor in either or both.

It is intended that students will be able to:

1. Acquire a deeper understanding of 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. Extrapolate the information obtained in class sessions into the laboratory.
4. Demonstrate 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 flexible, yet will be based on the following:

Laboratory (reports and techniques)	25%
Mid-term examinations (2)	25%
Problem assignments, class participation, other tests	5%
Final examination	30%

COURSE CONTENT:

Mass Spectroscopy: Wade ch. 11; McM ch. 12 (6 hours)

Mass spectroscopy - general methodology. Identification of fragment ions and radical fragments in the fragmentation of alkanes, alcohols, alkenes and alkyl halides.

Nuclear Magnetic Spectroscopy: Wade ch. 12; McM ch. 13 (10 hours)

Review of proton magnetic spectroscopy, more complex splitting patterns; calculation of J coupling constants, long-range coupling; ^{13}C n.m.r. spectroscopy; n.m.r. spectra of larger molecules.

Conjugated Dienes and Ultra-violet Spectroscopy: Wade ch. 15 and Appendix 3; McM ch. 14 (8 hours)

Preparation and stability of conjugated dienes; molecular orbital description of 1,3-butadiene; electrophilic addition (1,2 & 1,4 addition); Diels-Alder cycloaddition reactions; other conjugated systems. Ultra-violet spectrum of 1,3-butadiene. Ultra-violet spectroscopy of other conjugated systems. Woodward-Hofmann and Woodward-Fieser rules.

Carbonyl Condensation Reactions: Wade ch. 22; McM. ch. 23 (8 hours)

Review of aldol condensation reactions (from 212); Claisen condensation reaction, Dieckmann reaction; Michael reaction, Perkin reaction, Stork enamine reaction, carbonyl condensation reactions in syntheses, Wittig reaction, Robinson annulation; and in biological systems.

Heterocyclic Compounds: Wade ch. 16; McM 29; Davies (6 hours)

Structures of five membered rings: pyrrole, furan, thiophene; electrophilic substitution. Structures of six-membered rings: pyridine - electrophilic and nucleophilic substitution. Fused heterocycles.

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LABORATORY EXPERIMENTS:

To be selected by instructor from:

1. A Diels-Alder reaction: cyclopentadiene + maleic anhydride --->endobicyclo [2:2:1] hept-5-en-2,3-dicarboxylic anhydride. Students run an n.m.r. spectrum.

2. A Diels-Alder reaction continued: adduct from 1 + bromine --->exo cis 2,3-dibromo-endo-bicyclo [2:2:1] heptan-5,6-dicarboxylic anhydride. Students run infra-red and n.m.r. spectra.

3. Qualitative Analysis (single unknowns): Sodium fusion tests, functional group tests and full identity by derivative and/or by i.r and n.m.r. spectroscopy (perhaps 2 or 3 of this type). {2 weeks}

4. Robinson Annulation experiment (ref.: J. Chem Ed. 65, 637, July 1988).

5. Polarimetry: resolution of (±) sec-butylamine or (±) α-phenylethylamine.

6. Heterocyclic compound: synthesis of 4-methyl-6-hydroxypyrimidine.

7. Synthesis of Lidocaine - a local anaesthetic (ref. SFU Chem 255). 2,6-dimethylaniline + chloroacetyl chloride ---> α-chloro-2,6-dimethylacetanilide. Then latter + diethylamine ---> lidocaine. Students run infra-red and n.m.r. spectra. {2 weeks}

8. Fats and Oils: (ref. SFU Chem 255).
   (Saponification of a fat or oil,
   Iodine number determination)
   Fatty acid esterification and subsequent GC analysis.

9. Mass Spectoscopy lab. (assistance from SFU regarding analyses until own instrument obtained).

10. A project involving multi-step synthesis (of compounds to be decided later), analyzing products by i.r. and n.m.r. spectroscopy {2 weeks}

11. Condensation reaction: Synthesis of Ethyl Acetoacetate. (Purification by column chromatography).