

Prof:	William Ogilvie Room 403, D'Iorio Hall		
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Web Site:	The web site can be accessed through Blackboard		
Discussion:	A discussion group is available on the course website for <u>any aspect</u> of the course (lab, lectures, assignments).		
Office Hours:	Contact me by email to arrange an appointment.		
Prerequisite:	CHM1311 or CHM1301 or Grade 12U chemistry or OAC Chemistry or equivalent.		
Lectures:	Wednesdays 13:00-14:30 Fridays 11:30-13:00		
DGD's:	Mondays 17:30 – 19:00 Wednesdays 16:00 - 17:30 Thursdays 16:00 - 17:30 Thursdays 17:30 – 19:00		
Labs:	Information on the labs can be found on the lab website on brightspace.		
Assessment:	Quiz (optional):	Friday January 22	
	Mid Term 1:	Friday February 5	10% - 20%
	Mid Term 2:	Friday March 12	10% - 20%
	Lab:		15%
	Final Exam:		45 - 65 % (Cumulative. Will include questions related to the lab)
		Total:	100%
	Bonus:		+ 1 %

All tests and exams in this course will be proctored. On-line tests and exams will be proctored using the Respondus browser in Monitor mode and/or Zoom. Please see the videos on the course website for more information. Tests and exams are closed book. No electronic devices other than a calculator may be used.

Absence from a mid-term without an approved exemption will result in a grade of 0. You must attend, and hand in reports for, at least 6 out of 7 experiments to receive a grade for the course. You must PASS BOTH the lecture section and laboratory section in order to pass the course.

Assignments: *Do it yourself.* Answers will be posted approximately 1 week after each assignment becomes available.

Text: *Organic Chemistry, Mechanistic Patterns* by Ogilvie, Ackroyd, Browning, Deslongchamps, Lee & Sauer ISBN 978-0-17-650026-9 (print) 978-0-17-672902-8 (ebook)

The text is recommended. If you buy one get the bundle with the solutions guide and online access.

Molecular models are required. Darling Molecular Models are best. These are available from the book-store.

Course Outline

Nomenclature: *Do it yourself.* You are responsible for naming chains up to 12 carbons long for all classes of compound covered (alkanes, alkenes, alkynes, alcohols, thiols, halides, amines, aldehydes, ketones, ethers, cyclic and acyclic molecules). A guide to nomenclature is available on the course web site. Chapter 2 in the text covers the basics of nomenclature. You can expect nomenclature questions on all MT's and exams.

Part A: Structure

- 1) Organic Molecular structure
 - a. "Organic" periodic table, electronegativity and periodic trends, covalent bonds
 - b. Drawing organic structures: Lewis & compressed structures, formal charge method, polarity, resonance
 - c. Atomic and molecular orbitals, molecular orbital theory, bonding and antibonding orbitals
 - d. Orbital shapes and hybridization. Bond angles and structure, σ and π bonds, geometries, relative energies
 - e. Dipoles, Van der Waals forces, H-bonding. Molecular structure and bulk properties
- 2) Alkanes
 - a. Properties, line structures, σ bond rotation, conformations, energy potential diagrams, Newman projections
 - b. Cycloalkanes, ring strain, conformations, configurations, syn/anti and cis/trans nomenclature.
 - c. Chair conformation, axial and equatorial bonds, chair interconversions.
 - d. Stereochemistry, configuration and R/S nomenclature, enantiomers, diastereomers and meso compounds,
 - e. Zig-zag structures, syn/anti nomenclature, resolution, optical activity, enantiomeric excess.

Part B: Simple Reactivity

- 1) Acids and bases
 - a. Acid/base reactions, acidity of organic compounds, inductive effects, resonance, periodic trends. Use of pKa values
 - b. Functional groups, arrow notation, reaction co-ordinate diagrams.
- 2) π Bonds as electrophiles
 - a. Polarity of π bonds. Carbonyl compounds. Effects of resonance. Concept of mechanism, nucleophiles, electrophiles.
 - b. Reduction of carbonyl groups. Additions "across" π bonds. Sodium borohydride and lithium aluminum hydride.
 - c. Imines. Acid catalysis. Sodium cyanoborohydride.
 - d. Cyanohydrin formation. Reversal of the reaction. Acid and base catalysis
 - e. Grignard reagents. Preparation. Polarity. Acid/base reactions. Carbonyl displacements.
 - f. Organo-lithiums. Acid/base reactions. Carbonyl displacements. Alkynyl and vinyl nucleophiles.
 - g. Hydrate formation. Equilibrium with carbonyl forms. Hemi-acetal formation. Intramolecular reactions and ring formation.
 - h. Acid and base catalysis in carbonyl additions. Oxonium ions. Additions to oxoniums.
 - i. Microscopic reversibility. Molecular orbitals and reactivity

Part C: π Bonds and Reactivity

- 1) π Bonds as nucleophiles
 - a. Markovnikov additions. Hydration. Oxy-mercuration. Regioselectivity
 - b. Anti-Markovnikov additions. Hydroboration. Stereochemistry.
 - c. Radical hydrohalogenation. Chain reactions and initiation.
 - d. Epoxide formation. Concerted mechanisms. Stereochemistry.
 - e. Halogenation. Stereochemistry. Halohydrin formation. Regiochemistry.
- 2) Aromatic compounds as nucleophiles
 - a. Aromaticity. Huckle rule. Antiaromatic compounds. Ions and heterocycles.
 - b. Allyl groups and resonance. Allyl cation and anion.
 - c. Electrophilic aromatic substitution. Directing groups. Electrophiles. Heterocycles.
 - d. Manipulations of directing groups. Reductions. Hydrolysis.
 - e. Multi-step synthesis. Retrosynthetic analysis. Disconnections.