CHEM G220: ORGANIC CHEMISTRY A

Item	Value
Curriculum Committee Approval Date	11/03/2020
Top Code	190500 - Chemistry, General
Units	5 Total Units
Hours	162 Total Hours (Lecture Hours 54; Lab Hours 108)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	Yes
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)
Local General Education (GE)	• GWC Physical Universe*** (GB1)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5A Physical Science (5A) • Cal-GETC 5C Laboratory Activity (5C)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5A Physical Science (5A) • IGETC 5C Laboratory Activity (5C)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B1 Physical Science (B1) • CSU B3 Laboratory Activity (B3)

Course Description

This course is the first in a two-semester organic chemistry sequence. It involves a study of the compounds of carbon and their reactions with an emphasis on structure/reactivity relationships and mechanisms. The laboratory emphasizes standard organic chemistry techniques, investigations, and spectroscopic methods for identification. PREREQUISITE: CHEM G185. Transfer Credit: CSU; UC. C-ID: CHEM 150, 160S. **C-ID:** CHEM 150, 160S.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Use names and structures for organic molecules containing alkyl, cycloalkyl, alkyl halide, alkene, alkyne, alcohol, and ether functional groups.
3. Analyze the shape and energy of organic molecules using stereochemistry and various structural representations.
4. Predict the products, specify the reagents needed, and draw electron-pushing mechanisms for organic reactions studied in this course.
5. Explain how to synthesize a given compound by outlining the forward steps and reagents that are required using reactions learned in this course.
6. Conduct standard organic chemistry techniques, such as melting point, distillation, extraction, recrystallization, gas chromatography, polarimetry and thin-layer chromatography.
7. Draw conclusions from data obtained in lab, such as the identity of an unknown and the purity of compounds.
8. Interpret infrared (IR) and nuclear magnetic resonance (NMR) spectra.
9. Demonstrate laboratory protocols, such as practicing safety and keeping a laboratory notebook.

Course Objectives

- 1. Apply principles of electron configuration, Lewis structural theory, and Valence Shell Electron Pair Repulsion (VSEPR) theory, to predict the structure, bonding, and three-dimensional shape of organic species from the chemical formula.
- 2. Use IUPAC nomenclature rules to systematically name a chemical structure or draw a chemical structure from a name for alkanes, alkyl halides, alkenes, alkynes, alcohols, and ethers.
- 3. Predict the products, including stereo- and regioisomers, and provide appropriate reagents for common reactions, including substitution, elimination, addition, oxidation, free-radical, and reduction reactions.
- 4. Generate a mechanism that explains the regiochemistry and stereochemistry of reactions including nucleophilic substitution, elimination, alkene and alkyne additions, and free-radical halogenation.
- 5. Use learned reactions to create multi-step syntheses.
- 6. Use and explain the common techniques used in the organic chemistry laboratory, such as melting point, recrystallization, extraction, distillation, thin-layer chromatography, and both infrared and nuclear magnetic resonance spectroscopy.
- 7. Execute simple experiments using common organic chemistry laboratory techniques.
- 8. Keep a laboratory notebook and use it to write lab reports.

Lecture Content

Review of Bonding Lewis structural theory Valence Shell Electron Pair Repulsion Theory (VSEPR) Orbital hybridization Bond angles and molecular shape Resonance structures Review of Acid/Base Chemistry Bronsted-Lowry and Lewis acids and bases pKa Energy diagrams Bond and molecule polarity Identify Functional Groups of Organic Compounds Nomenclature Alkanes Cycloalkanes Alkenes Alkynes Alcohols Ethers Alkyl halides Structure of Alkanes and Cycloalkanes Conformations of alkanes and cycloalkanes Newman projections Structure and Reactions of Alkenes and Alkynes Degree of unsaturation cis/trans and E/Z isomers Addition reactions, including mechanisms Carbocation stability and rearrangement Formation and use of acetylide ions Stereochemistry R/S naming of stereocenters Enantiomers, diastereomers, and meso compounds Fischer projections Substitution and Elimination Reactions Bimolecular nucleophilic substition (SN2) reactions, including mechanism and stereochemistry Unimolecular nucleophilic substitution reactions (SN1), including mechanism, stereochemistry and rearrangements Bimolecular elimination reactions (E2), including mechanism, regiochemistry, stereochemistry and conformational requirements Unimolecular elimination reactions (E1), including mechanism, regiochemistry, stereochemistry and rearrangements Competit ion between SN2/E2/SN1/E1 Factors affecting product distribution in substitution and elimination reactions Synthesis of alkenes and alkynes Conversion of alcohols to alkyl halides, sulfonates, alkenes Free Radical Reactions Stability of carbon radicals Mechanism of free radical halogenation of alkanes Product distribution

of free radical halogenation Free radical addition and substitution reactions Oxidation and Reduction Reactions Hydrogenation Hydride reduction Grignard reduction Formation and reactions of epoxides Alkene cleavage by oxidizing agents Oxidation of alcohols Multi-step Synthesis Retrosynthetic analysis Formation of new carbon-carbon bonds Functional group interconversions

Lab Content

Laboratory safety Use and disposal of hazardous materials Introduction to laboratory theory and techniques employed in the separation, purification, and identification of organic compounds Melting point Boiling point Recrystallization Filtration Distillation Extraction Polarimetry Thin-layer chromatography Gas Chromatography Infrared spectroscopy Nuclear Magnetic Resonance (NMR) spectroscopy Maintenance of a laboratory notebook.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Instructional Techniques

A variety of techniques are used such as direct lecture, group problem solving, clicker questions and other active learning techniques.

Reading Assignments

Textbook readings

Writing Assignments

Lab reports may include: Analysis of experimental data; synthesis of ideas; analysis of spectra or chromatograms; presentation of a well-written, logical argument based on facts given or observed.

Out-of-class Assignments

Working problems in workbook and textbook, supplemental problem sets

Demonstration of Critical Thinking

Problem solving, essay, mechanism and synthesis questions on quizzes and exams. Designing laboratory procedures. Laboratory writeups requiring analysis of data and the drawing of conclusions from those data.

Required Writing, Problem Solving, Skills Demonstration

Analysis of experimental data. Synthesis of ideas. Using concepts such as transition states and effect of reactant structure and reaction conditions to predict reaction products. Presentation of a well-written, logical argument based on facts given or observed. Prediction of mechanisms based on acidity arguments and other similar reactions. Use of learned reactions to synthesize moderately complex organic compounds.

Eligible Disciplines

Chemistry: Masters degree in chemistry OR bachelors degree in chemistry or biochemistry AND masters degree in biochemistry, chemical engineering, chemical physics, physics, molecular biology, or geochemistry OR the equivalent. Masters degree required.

Textbooks Resources

1. Required Mohrig, J.; Hammond, C.; and Schatz, P.. Techniques in Organic Chemistry, 4th ed. Freeman Publishing Company (Classic text), 2014 Rationale: Classic text 2. Required Klein, D.. Organic Chemistry, 3rd ed. Wiley, 2017

Manuals Resources

1. Speakman, T. J., Dutz, K. M.. Chemistry 220: A Laboratory Manual for Students at Golden West College, Golden West College , 06-01-2020

Other Resources

1. Safety glasses or goggles 2. Laboratory notebook