CHEM G225: ORGANIC CHEMISTRY B

Item	Value
Curriculum Committee Approval Date	12/03/2024
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
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
Local General Education (GE)	• Area 5 Natural Sciences (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 second in a two-semester organic chemistry sequence. It involves a continuation of the study of the compounds of carbon and their reactions with an emphasis on structure/reactivity relationships and mechanisms, including chemistry of carbonyl compounds, aromatic compounds and molecules of biological importance. The laboratory includes reactions and workup design, separation and identification of an unknown mixture, multistep synthesis and additional spectroscopy. PREREQUISITE: CHEM G220. Transfer Credit: CSU; UC. C-ID: CHEM 160S. **C-ID:** CHEM 160S.

Course Level Student Learning Outcome(s)

1. Course Outcomes
2. Use the names and structures for organic molecules containing ether, aromatic, carbonyl, nitrile, and
3. Predict the products and specify the reagents needed with stereochemistry and regiochemistry for reactions studied in this course.
4. Draw electron-pushing arrows for organic reactions based on electronic properties and structure.
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. Develop laboratory procedures, such as separating and identifying an unknown mixture or evaluating reaction conditions.
7. Perform synthetic transformations in the lab, obtaining purified products in reasonable yield and purity.
8. Analyze UV-Visible, nuclear magnetic resonance (NMR), infrared (IR), and mass spectra (MS) to determine the structure of organic compounds.

Course Objectives

- 1. Use standard nomenclature rules to name a chemical structure or draw a chemical structure from a name for aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives, esters, and amines.
- 2. Predict the products and provide the appropriate reagents for common reactions of functional groups including epoxides, dienes, aromatics, aldehydes, ketones, carboxylic acids and their derivatives, and amines.
- 3. Generate a reaction mechanism that explains the regiochemistry and stereochemistry for reactions of epoxides, dienes, aromatic rings, aldehydes, ketones, carboxylic acids and their derivatives, and amines.
- 4. Use learned reactions to create multi-step syntheses.
- 5. Analyze structures to understand the basic mechanics surrounding carbohydrates, amino acids, and synthetic polymers.
- 6. Carry out synthetic transformations of organic molecules, including multi-step syntheses.
- 7. Devise procedures for separation, purification and identification of organic compounds.
- 8. Design and carry out experiments.
- 9. Keep a laboratory notebook and use the data therein to write laboratory reports.

Lecture Content

Nomenclature Aromatic compounds Aldehydes Ketones Carboxylic acids and their derivatives Esters Anhydrides Acid halides Amides Carbohydrates Molecular Orbital Theory Conjugated systems Aromatic and anti-aromatic systems Diels-Alder reaction Electrophilic Aromatic Substitution Mechanism via sigma complex Effect of substituents on rate of reaction Effect of substitutents on regiochemistry Friedel-Crafts alkylation and acylation Nucleophilic Aromatic Substitution Addition-elimination mechanism (SNAr) Elimination-addition (benzyne) mechanism Diazonium salts and their reactions Synthesis of Aromatic Compounds Nucleophilic Addition Reactions with Aldehydes and Ketones Addition of alcohols Acetals and hemiacetals Addition of organometallic reagents Addition of amines Imines and enamines Hydrolysis reactions Acetals as protecting groups Wittig reaction Baeyer-Villager oxidation Acyl Substitution Reactions of Carboxylic Acids and their Derivatives Formation of acid chlorides, anhydrides, esters, amides, and nitriles Reduction reactions of carboxylic acids and their derivatives Reactions at the Alpha-Carbon of Carbonyl Compounds Acidity of hydrogens at the alpha carbon Formation of enols and enolates alpha-Halogenation alpha-Alkylation Aldol reactions Claisen condensation Conjugate add ition reactions Michael addition Stork enamine synthesis Robinson annulation Amines Basicity Reactions of amines Synthesis of amines Cross-Coupling Reactions Carbohydrates Classification Haworth projections Nucleotides Amino Acids Nomenclature Acid-

base properties Peptide bonds Organic Polymers Addition polymers Condensation polymers

Lab Content

1. Laboratory safety 2. Review of techniques from first-semester Organic Chemistry3. New techniques a. Column chromatography b. UV/Visible spectroscopy c. Mass spectrometry4. Development of experimental design5. Synthetic transformations, including multistep syntheses6. 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)

Reading Assignments

TextbooksInstructor prepared handouts

Writing Assignments

Laboratory reports, which include: analysis of experimental data; synthesis of ideas; 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.

Out-of-class Assignments

Textbook problems, problem sets on handouts

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 drawing sound conclusions from that data.

Required Writing, Problem Solving, Skills Demonstration

Analysis of experimental data. Synthesis of ideas. Apply concepts such as transition states, molecular orbital theory, 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: Master's degree in chemistry OR bachelor's degree in chemistry or biochemistry AND master's degree in biochemistry, chemical engineering, chemical physics, physics, molecular biology, or geochemistry OR the equivalent. Master's degree required.

Textbooks Resources

1. Required McMurry, J. Organic Chemistry, 10th ed. OpenStax (OER), 2023 Rationale: none 2. Required Nichols, L. Organic Chemistry Lab Techniques, ed. LibreTexts (OER), 2024 Rationale: none

Manuals Resources

1. Speakman, T. J., Dutz, K. M. Chemistry 225: A Laboratory Manual for Students at Golden West College, Golden West College , 06-01-2024

Other Resources

1. Safety glasses or goggles 2. Laboratory notebook