

Date Adopted: July 1, 1998
Date Reviewed: December 1, 1999
Date Revised: 1999, 2007, 2011



Alabama
Department of
Postsecondary Education

Representing Alabama's Public Two-Year College System

Jefferson State Community College

**CHM 222
Organic Chemistry II**

I. CHM 222 Organic Chemistry II

Credit Hours: 4 Contact Hours: Lecture - 3 Lab - 3

II. Prerequisite
CHM 221

III. Course Description

This course is the second in a two-semester sequence. Topics in this course include nomenclature, structure, physical and chemical properties, synthesis, and typical reactions for aliphatic, alicyclic, aromatic, and biological compounds, polymers and their derivatives, with special emphasis on reaction mechanisms, spectroscopy, and stereochemistry. Laboratory is required and will include the synthesis and confirmation of representative organic compounds with emphasis on basic techniques.

IV. Textbook:

Organic Chemistry, 8th ed. McMurry, Brooks/Cole.

V. General Course Competencies

After completing CHM 222, Organic Chemistry II, the student will be able to

- A. describe the characteristics, structurally, chemically and spectroscopically of alcohols, ethers and related compounds.

- B. demonstrate an understanding of reactions involving aldehydes, ketones, carboxylic acids and their derivatives including nomenclature, synthesis and mechanisms.
- C. demonstrate an understanding of reactions involving amines, carbonyl alpha-substitution and condensation reactions including nomenclature, synthesis and mechanisms.
- D. demonstrate an understanding of carbohydrates, amino acids and peptides.
- E. demonstrate an understanding of lipids and nucleic acids.
- F. discuss the topics related to polymers and pericyclic reactions.

VI. Course Objectives

The student will be required to demonstrate that he has attained each general course competency by performing the objectives listed under each competency.

- A. Describe the characteristics, structurally, chemically and spectroscopically of alcohols, ethers and related compounds.
 - 1. Name and draw structures of alcohols, phenols, ethers, thiols and sulfides.
 - 2. Explain the properties and acidity of alcohols and phenols.
 - 3. Prepare all of the types of compounds studied.
 - 4. Predict the products of reactions involving alcohols, phenols and ethers.
 - 5. Formulate mechanisms for reactions involving alcohols, phenols and ethers.
 - 6. Identify alcohols, phenols and ethers by spectroscopic techniques.
- B. Demonstrate an understanding of reactions involving aldehydes, ketones, carboxylic acids and their derivatives including nomenclature, synthesis and mechanisms.
 - 1. Name and draw aldehydes, ketones, carboxylic acids and their derivatives.
 - 2. Propose a synthesis for each type of compound listed above.
 - 3. Explain the reactivity difference between aldehydes and ketones and between carboxylic acids and their derivatives.
 - 4. Calculate dissociation constants of carboxylic acids, and predict the relative acidities of substituted carboxylic acids.
 - 5. Formulate mechanisms for reactions related to the reactions studied.
 - 6. Predict the products of the reactions for all functional groups studied.
 - 7. Use the spectroscopic techniques to identify these compounds.
 - 8. Draw representative segments of step-growth polymers.
- C. Demonstrate an understanding of reactions involving amines, carbonyl alpha-substitution and condensation reactions including nomenclature, synthesis and mechanisms.
 - 1. Draw keto-enol tautomers of carbonyl compounds, identify acidic hydrogens, and draw the resonance forms of enolates.

2. Formulate the mechanisms of acid- and base-catalyzed enolization and of other α -substitution reactions.
3. Predict the products of α -substitution reaction in synthesis.
4. Use α -substitution reaction in synthesis.
5. Predict the products of carbonyl condensation reactions.
6. Formulate the mechanisms of carbonyl condensation reactions.
7. Use carbonyl condensation reactions in synthesis.
8. Name and draw amines, and classify amines as primary, secondary, tertiary, quaternary, arylamines or heterocyclic amines.
9. Predict the basicity of alkylamines, arylamines and heterocyclic amines.
10. Propose the synthesis of alkylamines and arylamines by several routes.
11. Predict the products of reactions involving alkylamines and arylamines.
12. Propose mechanisms for reactions involving alkylamines and arylamines.
13. Identify amines by spectroscopic techniques.

D. Demonstrate an understanding of carbohydrates, amino acids and peptides.

1. Classify carbohydrates as aldoses, ketoses, D or L sugars, monosaccharides, or polysaccharides.
2. Draw monosaccharides as Fischer projections or chair conformations.
3. Predict the products of reactions of monosaccharides and disaccharides.
4. Deduce the structures of monosaccharides and disaccharides.
5. Formulate mechanisms of reactions involving carbohydrates.
6. Identify the common amino acids and draw them with correct stereochemistry in dipolar form
7. Explain the acid-base behavior of amino acids.
8. Synthesize amino acids.
9. Draw the structure of simple peptides.
10. Deduce the structure of peptides and proteins.
11. Outline the synthesis of peptides.
12. Explain the classification of proteins and the levels of structure of proteins.
13. Draw structures of reaction products of amino acids and peptides.

E. Demonstrate an understanding of lipids and nucleic acids.

1. Draw the structures of fats, oils, steroids and other lipids.
2. Determine the structure of a fat.
3. Predict the products of reactions of fats and steroids.
4. Locate the isoprene units in terpenes.
5. Understand the mechanism of terpene and steroid biosynthesis.
6. Draw the structures and conformations of steroids and other fused-ring systems.
7. Draw orbital pictures of heterocycles and explain their acid-base properties.
8. Explain orientation and reactivity in heterocyclic reactions, and predict the products of reactions involving heterocycles.
9. Formulate mechanisms of reactions involving heterocycles.

10. Draw purines, pyrimidines, nucleosides, nucleotides, and representative segments of DNA and their complements.
 11. List the base sequence that codes for a given amino acid or peptide.
 12. Explain the basic concepts of metabolism, and understand the energy relationships of biochemical reactions.
 13. Answer questions relating to the metabolic pathways of carbohydrates, fatty acids and amino acids.
 14. Formulate mechanisms for metabolic pathways similar to those in the text.
- F. Discuss the topics related to polymers and pericyclic reactions.
1. Understand the principles of molecular orbitals, and locate the HOMO and LUMO of conjugated π systems.
 2. Predict the stereochemistry of thermal and photochemical electrocyclic reactions.
 3. Know the stereochemistry requirements for cycloaddition reactions, and predict the products of cycloadditions.
 4. Classify sigmatropic reactions by order and predict their products.
 5. Know the selection rules for pericyclic reactions.
 6. Locate the monomer units of a polymer; predict the structure of a polymer, given its monomer units.
 7. Formulate the mechanisms of radical, cationic, anionic, and step-growth polymerizations..
 8. Understand the stereochemistry of polymerization, and draw structures of atactic, isotactic, and syndiotactic polymers.
 9. Understand copolymerization, graft polymerization and block polymerization.

VII. CLASS ACTIVITIES

- A. Lecture
1. Lecture
 2. Discussion
 3. Problem solving
- B. Laboratory
1. Demonstrations
 2. Problem solving
 3. Experimentation

VIII. CRITERIA FOR EVALUATION

- A. The student will have demonstrated attainment of the general course competencies if he accumulates a total of 70 percent of the points possible from the following criteria.
- B. Participation in class activities

- C. Class Homework
- D. Written examinations
- E. Final examinations

Organic Chemistry II Laboratory

- A. The student will complete a multi-step synthesis project in which an assigned compound is prepared.
- B. The student will give a presentation in which the student describes the chemical principles involved in the multi-step synthesis project.
- C. The student will identify a general unknown using functional group characterization tests and instrumental techniques.

IX. Attendance

Students are expected to attend all classes for which they are registered. Students who are unable to attend class regularly, regardless of the reason or circumstance, should withdraw from that class before poor attendance interferes with the student's ability to achieve the objectives required in the course. Withdrawal from class can affect eligibility for federal financial aid.

X. Statement on Discrimination/Harassment

The College and the Alabama State Board of Education are committed to providing both employment and educational environments free of harassment or discrimination related to an individual's race, color, gender, religion, national origin, age, or disability. Such harassment is a violation of State Board of Education policy. Any practice or behavior that constitutes harassment or discrimination will not be tolerated.

XI. Americans with Disabilities

The Rehabilitation Act of 1973 (Section 504) and the Americans with Disabilities Act of 1990 state that qualified students with disabilities who meet the essential functions and academic requirements are entitled to reasonable accommodations. It is the student's responsibility to provide appropriate disability documentation to the College. The ADA Accommodations office is located in FSC 300 (205-856-7731).