MONTGOMERY COLLEGE

DEPARTMENT OF CHEMISTRY

Common Course Outline

CHEM 204 – Organic Chemistry II

Course Description

Continuation of **CHEM 203** Organic Chemistry I with emphasis on aromatic compounds, alcohols, ethers, amines, and carbonyl compounds. Laboratory work reinforces organic synthesis techniques including isolation, purification, and structure determination using analytical methods.

Prerequisites: *A grade of C or better in CHEM 203 within the last five years, or consent of department chair, course coordinator, or designated member of Chemistry faculty.*

Credits: 5 semester hours; three hours lecture, one hour discussion, four hours laboratory per week

Course scheduling

Sections offered at all campuses every Fall and Spring semesters. Offered in Summer I and II sessions at Rockville campus and offered in Summer II session at Takoma Park campus.

Broad Course Outcomes

Upon successful completion of this course, a student will be able to:

- Recognize, name and represent organic compounds and functional groups
- Describe relationships between structure, chemical reactivity and physical properties
- Analyze three-dimensional conformations and configurations of organic structures
- Investigate chemical properties of organic molecules through reactions and synthesis
- Illustrate and investigate organic reactions through kinetics and reaction mechanisms
- Safely work in an organic laboratory environment including the proper waste disposal
- Synthesize, isolate and purify liquid and solid organic products by appropriate methods including recrystallization (solids) and distillation (liquids)
- Characterize organic compounds by physical and chemical properties and analytical methods including IR and NMR spectroscopy.

Specific Course Objectives

Upon successful completion of this course, a student will be able to:

- Identify free radicals and their mechanisms
- Identify conjugated compounds and understand the underlying MO theory.
- Predict products of a Diels-Alder reaction
- Identify aromatic, non-aromatic and anti-aromatic compounds. Understand the underlying MO theory and the effects aromaticity have on various properties such as acidity, basicity and reactivity.
- Predict products of electrophilic aromatic substitution reactions
- Design syntheses of products using electrophilic aromatic substitution reactions
- Identify various functional groups having a carbonyl group. Identify whether they can do a nucleophilic addition or nucleophilic acyl substitution

- Identify various reactions and effectively use them in the synthesis of larger organic molecules like natural products or drugs.
- Perform various reactions learnt in lecture in lab.
- Separate, purify and characterize the products in each case
- Purify compounds by column chromatography
- Use mass spectroscopy in addition to IR and NMR spectroscopy

Major Lecture Topics

Free Radical Reactions; Conjugated Systems and UV-Visible Spectroscopy; Aromatic Compounds; Electrophilic Aromatic Substitution; Carbonyl Chemistry; Nucleophilic Addition; Nucleophilic Acyl Substitution; Enolate Chemistry; Carboxylic Acids; Amines

Major Laboratory Topics

Purification of liquid products by distillation; Purification of solid products by recrystallization; Separation techniques: gas chromatography, thin-layer chromatography, column chromatography; Liquid-liquid extraction; Drying agents, Microwave synthesis; Synthesis of natural products, Analysis and structural determination of liquid and solid organic products by IR spectroscopy, ^{1}H and ^{13}C NMR spectroscopy. Application of organic synthesis reactions such as Diels-Alder reaction; Electrophilic Aromatic Substitution; Fischer Esterification; Wittig reaction, Aldol condensation.

Course Requirements

Grading procedures will be determined by the individual faculty instructor of each section, but will include the following minimum criteria:

Lecture component (75% of overall course grade)

- Minimum of three examinations
- Homework, quizzes, other assignments or projects as assigned by the instructor
- Comprehensive lecture final exam – American Chemical Society Organic Chemistry Examination

Laboratory component (25% of overall course grade)

- Laboratory safety assessment
- Pre-laboratory assignments
- Post-laboratory assignments/reports
- Laboratory final examination

Attendance in laboratory is mandatory. Unexcused absence of three or more lab meetings will result in automatic failure. Students must pass lecture and lab components separately to receive a passing final course grade.

Grading Policy

The following letter grade policy will be used to determine final course grade.

A 100 - 90% **B** 89 - 80% **C** 79 - 70% **D** 69 - 60% **F** < 60%

Required Course Materials

- Textbook – *Organic Chemistry*, Smith, 5th Ed. McGraw-Hill Publisher
- Laboratory safety goggles
- Laboratory notebook

Textbook Chapter Coverage

- Chapter 15 Radical Reactions
- Chapter 16 Conjugation, Resonance and Dienes
- Chapter 17 Benzene and Aromatic Compounds
- Chapter 18 Reaction of Aromatic Compounds
- Chapter 19 Carboxylic Acids and the Acidity of the O-H bond
- Chapter 20 Introduction to Carbonyl Chemistry; Organometallic Reagents; Oxidation and Reduction
- Chapter 21 Aldehydes and Ketones – Nucleophilic Addition
- Chapter 22 Carboxylic Acids and Their Derivatives – Nucleophilic Acyl Substitution
- Chapter 23 Substitution Reactions of Carbonyl Compounds at the α Carbon
- Chapter 24 Carbonyl Condensation Reactions

Additional chapters and sections may be included at the discretion of the individual faculty instructor.

Example Laboratory Experiments (subject to change)

1. Safety in the Chemical Laboratory / Review of IR and ^{1}H NMR Spectroscopy
2. Determination of an Unknown Liquid by IR and ^{1}H NMR Spectroscopy
3. Radical Chlorination of 1-Chlorobutane
4. Diels-Alder Cycloaddition
5. Nitration of a Mono-substituted Aromatic Compound
6. A "Greener" Wittig Reaction: Microwave Synthesis of an Alkene
7. Separation of Wittig Alkene Products by Column Chromatography
8. Grignard Synthesis of a Carboxylic Acid
9. Introduction to Mass Spectrometry
10. Microwave Assisted Fischer Esterification
11. Synthesis of Acetaminophen (Tylenol)
12. Synthesis of Azo Dyes
13. Aldol Condensation Reaction

MC Student Code of Conduct and Academic Honesty

Montgomery College Syllabus Information

chemistry@montgomerycollege.edu