Montgomery County Community College
CHE 262
Organic Chemistry II
4-3-3

COURSE DESCRIPTION:
This course is a continuation of CHE 261and covers the nomenclature, structure, properties and reactions of many important classes of organic compounds including arenes, alcohols, ethers, epoxides, thiols, sulfides, aldehydes, ketones, carboxylic acids, nitriles, carboxylic acid derivatives, amines, carbohydrates, amino acids and lipids. Stereochemistry, reaction mechanisms, syntheses and spectroscopy are stressed. The laboratory demonstrates syntheses discussed during lecture. This course is subject to a course fee. Refer to http://mc3.edu/adm-fin-aid/paying/tuition/course-fees for current rates.

REQUISITE(S):
Previous Course Requirements
CHE 261 - Organic Chemistry I

CO-REQUISITE(S):
None

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

LEARNING OUTCOMES	LEARNING ACTIVITIES	EVALUATION METHODS
1. Name aromatic hydrocarbons; use Huckel Rule to determine aromaticity; and determine structure of aromatic compound by using spectroscopy.	Lectures Class Discussions Problem Solving	Section Exam and Comprehensive Final Exam
2. Discuss the reactions of benzene: bromination, nitration, sulfonation, alkylation, acylation, substitution (electrophilic and nucleophilic), benzyne intermediate, oxidation and reduction.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving Laboratory Activity and Report	Section Exam and Comprehensive Final Exam
3. Name alcohols and phenols, explain properties and their acidity, discuss synthesis (reduction of	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving	Section Exam and Comprehensive Final Exam

carbonyl with Grignard reagent), reactions (oxidation and substitution) and spectroscopy of alcohols and phenols.	Laboratory Activity and Report	
4. Name ethers, epoxides, thiols and sulfides; discuss synthesis (Williamson and alkoxymercuration), reactions (acid cleavage, Claisen Rearrangement and ring opening) and spectroscopy.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving	Section Exam and Comprehensive Final Exam
5. Name and synthesize aldehydes and ketones, discuss reactions (oxidation, nucleophilic addition, Cannizzaro, conjugate nucleophilic addition) and spectroscopy.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving Laboratory Activities and Reports	Section Exam and Comprehensive Final Exam
6. Name carboxylic acids and nitriles, discuss reactions (acidity and reduction) and spectroscopy.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving	Section Exam and Comprehensive Final Exam
7. Name acid halides, acid anhydrides, esters, and amides, discuss synthesis, reactions (nucleophilic acyl substitutions) and spectroscopy.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving Laboratory Activity and Report	Section Exam and Comprehensive Final Exam
8. Discuss Keto-Enol tautomerism, various alpha substitution reactions (halogenation and Hell-Volhard-Zelinski) and enolate ion formation (Haloform reaction).	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving	Section Exam and Comprehensive Final Exam
9. Discuss carbonyl condensation reactions	Lectures Class Discussions	Section Exam and Comprehensive Final Exam

such as: Aldol with dehydration, Claisen and mixed Claisen, Dieckmann, Robinson annulation, and the Michael Reaction.	Emphasis on Reaction Mechanisms Problem Solving Laboratory Activity and Report	
10. Name amines and arylamines and discuss basicity, synthesis, reactions, phase transfer catalysts, and spectroscopy.	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving	Section Exam and Comprehensive Final Exam
11. Identify carbohydrates (Fischer projections and D, L sugars), amino acids (peptides and proteins) and lipids (fats and soap).	Lectures Class Discussions Emphasis on Reaction Mechanisms Problem Solving Laboratory Activity and Report	Section Exam and Comprehensive Final Exam

At the conclusion of each semester/session, assessment of the learning outcomes will be completed by course faculty using the listed evaluation method(s). Aggregated results will be submitted to the Associate Vice President of Academic Affairs. The benchmark for each learning outcome is that *70% of students will meet or exceed outcome criteria*.

SEQUENCE OF TOPICS:

I. Benzene and Aromaticity
   - A. Nomenclature of Aromatic Hydrocarbons
   - B. Structure and Stability of Benzene
   - C. Molecular Orbital Description of Benzene
   - D. Hűckel Rule: Pyridine and Pyrrole
   - E. Polycylclic Aromatic Compounds
   - F. Spectroscopy of Aromatic Compounds

II. Chemistry of Benzene
   - A. Electrophilic Aromatic Substitution
   - B. Halogenation
   - C. Friedel-Crafts Alkylation Reaction
   - D. Acylation Reaction
   - E. Substituted Effects on Substituted Aromatic Rings
   - F. Trisubstituted Benzene and their Synthesis
   - G. Nucleophilic Aromatic Substitution
   - H. Benzyne
   - I. Oxidation and Reduction of Aromatic Rings

III. Alcohols and Phenols
   - A. Nomenclature
   - B. Properties: H-bonding and Acidity and Basicity

C. Synthesis of Alcohols: Reduction of Carbonyl and Use of Grignard Reagent
D. Reactions of Alcohols: Oxidation and Protection
E. Synthesis of Phenols
F. Reactions of Phenols
G. Spectroscopy of Alcohols and PhenolsIV. Ethers and Epoxides
A. Nomenclature
B. Structure and properties
C. Williamson Ether Synthesis
D. Alkoxymercuration of Alkenes
E. Acidic Cleavage of Ethers
F. Claisen Rearrangement of Ethers
G. Epoxides and Ring Opening Reactions
H. Crown Ethers
I. Thiols and Sulfides
J. Spectroscopy of Ethers

V. Aldehydes and Ketones
A. Nomenclature
B. Synthesis
C. Oxidation
D. Nucleophilic Addition of
1. H_2O – Hydration
2. HCN – Cyanohydrin Formation
3. Grignard Reagent or Hydride Reagents – Alcohol Formation
4. Amines – Imine and Enamine Formation
5. Hydrazine – Wolff-Kishner Reaction
6. Alcohols – Acetal Formation
7. Phosphorus Ylides – Wittig Reaction
E. Cannizzaro Reaction
F. Conjugate Nucleophilic Additions to α,β-Unsaturated Aldehydes and Ketones
G. Spectroscopy of Aldehydes and Ketones

VI. Carboxylic Acids and Nitriles
A. Nomenclature
B. Structure and Properties
C. Dissociation of Carboxylic Acids
D. Substituent Effects
1. Acidity
2. Substituted Benzoic Acid
E. Synthesis
F. Reactions: Reduction
G. Nitriles chemistry
H. Spectroscopy of Carboxylic Acids and Nitriles

VII. Carboxylic Acid Derivatives
A. Nomenclature
B. Nuclophilic Acyl Substitution Reactions

C. Acid Halide Chemistry
D. Acid Anhydride Chemistry
E. Amides Chemistry
F. Polyamides and Polyesters
G. Spectroscopy of Carboxylic Acid Derivatives

VIII. Carbonyl Alpha-Substitution Reactions
A. Keto-Enol Tautomerism
B. Reactivity of Enols
C. Alpha Halogenation of Aldehydes and Ketones
D. Alpha Bromination of Carboxylic Acids: Hell-Volhard-Zelinski Reaction
E. Enolate Ion Formation: Acidity of alpha H
F. Haloform Reaction
G. Alkylation of Enolate Ions

IX. Carbonyl Condensation Reactions
A. Aldol Reaction
B. Dehydration of Aldol Products: Synthesis of Enones
C. Mixed Aldol Reactions
D. Intramolecular Aldol Reactions
E. Claisen Condensation Reactions
F. Mixed Claisen and Dieckmann Condensations
G. Michael Reaction
H. Robinson annulation

X. Amines
A. Nomenclature
B. Structure and Properties
C. Basicity of Amines and Substituted Arylamines
D. Synthesis of Amine
E. Reactions of Amines and Arylamines
F. Phase Transfer Catalyst
G. Spectroscopy

XI. Biomolecules
A. Carbohydrates
1. Fischer Projections
2. D, L Sugars
B. Amino Acids
1. Peptides and Proteins
C. Lipids
1. Fats and Oils
2. Soap

SEQUENCE OF EXPERIMENTS:

1. Analysis of MS, IR, NMR Spectra
2. Macroscale Nitration of Methyl Benzoate
3. Diels Alder Reaction: Microscale Cracking of Dicyclopentadiene; cis-Norbornene-5,6-endo-dicarboxylic Anhydride
4. Friedel-Crafts Acylation of Ferrocene Microscale Acetylferrocene

5. Borohydride Reduction of 2-Methylcyclohexanone
6. Grignard Synthesis: Microscale: Phenylmagnesium Bromide and Triphenylmethanol
7. Transfer Hydrogenation of Olive Oil and Br_2 Test for Alkenes. Macroscale
8. Ester Hydrolysis (Saponification): The Synthesis of Soap Macroscale
9. Dibenzalacetone by Aldol Condensation – MacroscaleLEARNING MATERIALS:

McMurry, J. (2024). *Organic Chemistry* (10th ed.). OpenStax.
McMurry, S. (2024). *Study Guide and Student Solutions Manual* (10th ed.). OpenStax.
Williamson, K., Masters, K. (2017). *Macroscale and Microscale Organic Experiments* (7th ed.). Cengage.
Molecular models

Other learning materials may be required and made available directly to the student and/or via the College's Libraries and/or course management system.

COURSE APPROVAL:

Prepared by:	Dr. E. Martins, Assistant Professor of Chemistry	Date: 10/14/2004
Revised by:	Dr. L. McAtee, Assistant Professor of Chemistry	Date: 2/5/2009
VPAA/Provost Compliance Verification:	Dr. John C. Flynn, Jr.	Date: 9/11/2009
Revised by:	Dr. L. McAtee, Assistant Professor of Chemistry	Date: 12/22/2012
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 2/13/2013
Revised by:	Debbie Dalrymple	Date: 6/27/2016
VPAA/Provost or designee Compliance Verification:	Victoria L. Bastecki-Perez, Ed.D.	Date: 6/27/2016
Revised by:	Debbie Dalrymple	Date: 11/5/2024
VPAA or designee Compliance Verification:		Date: 11/13/2024

This course is consistent with Montgomery County Community College's mission. It was developed, approved and will be delivered in full compliance with the policies and procedures established by the College.