Course Name: Organic Chemistry II

Course Number: CHE* E212

Credits: 4

Catalog description: The second part of a two-part sequence designed to present the principles and theories involving the principal groups of carbon compounds. Presents nomenclature, preparation and reactions of alcohols, ethers, conjugated double-bond systems, aromatic compounds, aldehydes, ketones, carboxylic acids, esters, amines, and biomolecules. Explains reaction mechanisms when necessary. The laboratory exercises investigate either the preparation or the reaction of the aforementioned chemical species. Laboratory exercises may also include using modern instrumentation to identify organic compounds. (3 hours lecture / 4 hours laboratory per week)

Prerequisite: CHE 211: Organic Chemistry I with a grade of C- or better (or permission of instructor)

General Education Competencies Satisfied:

Discipline-Specific Attribute Code(s):

☒ **SCI** **Science elective**

Course objectives:

Upon successful completion of this course, the student will:

1. State the conditions, predict products, or write mechanisms for reactions of the following functional groups: alcohols, ethers, epoxides, conjugated systems, aromatics, amines, aldehydes, ketones, and carboxylic acids and their derivatives.
2. Use spectroscopic techniques to characterize organic molecules and subgroups.
3. Plan the synthesis of simple molecules using the reactions learned throughout both the Organic Chemistry I and Organic Chemistry II courses.
4. Perform organic chemistry laboratory experiments both independently and collaboratively, employing proper chemical hygiene, to effectively and ethically collect, interpret, evaluate, and communicate scientific data from those experiments in writing. A greater emphasis is placed on the laboratory report and relationship of the theory to results or experimental design.

Course Content:

Lecture:

1) Alcohols
   a) Reactions
2) Ethers and Epoxides
   a) Structure
   b) Nomenclature
   c) Physical properties
   d) Synthesis
   e) Reactions
3) Spectroscopic Methods for Structure Elucidation
   a) Infrared spectroscopy
      i) Theory
      ii) Spectra of Common Function Groups (*optional* – if already covered in CHE 211: Organic Chemistry I)
      iii) Interpretation of spectra
   b) Mass spectrometry
      i) Theory
      ii) Fragmentation patterns
      iii) Interpretation of spectra
   c) Nuclear Magnetic Resonance (NMR) spectroscopy
      i) Theory
      ii) Proton (^{1}H) spectroscopy
         (1) Chemical Shifts
         (2) Spin-spin splitting
         (3) Integration and proton counting
      iii) Carbon-13 (^{13}C) spectroscopy
         (1) Chemical shifts
         (2) Distortionless Enhancement by Polarization Transfer (DEPT)
      iv) Interpretation of spectra
4) Conjugated Double-Bond Systems
   a) Molecular orbital theory of alkenes, dienes, and conjugated systems
   b) Allylic cations, anions, and radicals
   c) Reactions of conjugated systems
      i) Electrophilic addition
      ii) Diels-Alder cycloaddition reaction
         (1) Stereochemistry
   d) Ultraviolet spectroscopy

    i) Effect of conjugation
5) Aromatic Compounds
    a) Structure
    b) Nomenclature
    c) Physical properties
    d) Synthesis
    e) Reactions
6) Ketones and Aldehydes
    a) Structure
    b) Nomenclature
    c) Physical properties
    d) Synthesis
    e) Reactions
7) Amines
    a) Structure
    b) Nomenclature
    c) Physical properties
    d) Synthesis
    e) Reactions
8) Carboxylic Acids
    a) Structure
    b) Nomenclature
    c) Physical properties
    d) Synthesis
    e) Reactions
9) Carboxylic Acid Derivatives and Nitriles
    a) Structure
    b) Nomenclature
    c) Physical properties
    d) Synthesis
    e) Reactions
10) Biomolecules (may include: carbohydrates, amino acids, peptides, proteins, lipids, nucleic acids)
    a) Structure
    b) Physical properties
    c) Synthesis
    d) Reactions

Laboratory

1) Safety in the Organic Laboratory

2) Alcohol Preparation or Alcohol Reaction
3) Compound Identification using Spectroscopic Methods
4) Electrophilic Aromatic Substitution
5) Multi-Step Synthesis
6) Identification of an Unknown Organic Compound using Physical, Chemical, and Spectroscopic Methods

HCC Safety Standard:

Instruction covering all safety rules and guidelines will be provided by the instructor during the first laboratory session. The safety features of the individual laboratory will also be highlighted by the instructor. Students are expected to read and understand the rules of the HCC Science Laboratory Student Safety Contract. The students will then sign this contract signifying that they have been instructed and understand the requirements for safety pertaining to their course. The student and instructor will each keep a copy of this contract. Students must come to the laboratory prepared for the laboratory activity. Students must abide by the safety rules and guidelines which may include wearing personal protection equipment. Failure to do so may result in removal from the laboratory by the instructor.

Date of Last Revision: 02/02/2020