

# CHM 251

## ORGANIC CHEMISTRY I

### COURSE DESCRIPTION:

Prerequisites: CHM 152

Corequisites: None

This course provides a systematic study of the theories, principles, and techniques of organic chemistry. Topics include nomenclature, structure, properties, reactions, and mechanisms of hydrocarbons, alkyl halides, alcohols, and ethers; further topics include isomerization, stereochemistry, and spectroscopy. Upon completion, students should be able to demonstrate an understanding of the fundamental concepts of covered organic topics as needed in CHM 252. Laboratory experiments, including spectroscopy and chromatography, and computer-based exercises augment and reinforce the basic principles discussed in lecture as well as provide practical examples. *This course has been approved to satisfy the Comprehensive Articulation Agreement for transferability as a pre-major and/or elective course requirement.* Course Hours Per Week: Class, 3. Lab, 3. Semester Hours Credit, 4.

### LEARNING OUTCOMES:

Upon completion of this course, students will be able to:

- a. Describe the electronic structure of the atom.
- b. Explain electronegativity.
- c. Write molecular and structural formulas.
- d. Describe acids and bases.
- e. Identify the potential for hydrogen bonding.
- f. Identify functional groups.
- g. Use organic nomenclature.
- h. Describe alkanes, alkenes, and alkynes.
- i. Describe geometric isomerism in alkenes and cyclic compounds.
- j. Explain the properties of organohalogen compounds.
- k. Describe free radical reactions.
- l. Explain electrophilic addition reactions.
- m. Explain acid catalyzed elimination reactions.
- n. Describe alcohols and ethers.
- o. Explain infrared and nuclear magnetic resonance spectroscopy.
- p. Describe aromatic compounds, alkyl and halo benzenes.
- q. Explain electrophilic aromatic substitution reactions.

### OUTLINE OF INSTRUCTION

- I. Introduction to bonding in organic molecules
  - A. Electrons in atoms
  - B. Atomic and hybrid orbitals
  - C. Tetravalent carbon
  - D. Covalent bonds
  - E. Single bonds

- II. The structure of the simple alkanes
  - A. Hydrocarbons
  - B. Chains and branched chains
  - C. Introduction to nomenclature (*part i*)
  - D. Cycloalkanes
  
- III. Introduction to molecular geometry
  - A. Ethane
  - B. Energy in molecules
  - C. Rotation and conformation
  - D. Intramolecular effects
  - E. *cis* and *trans* isomers
  - F. Physical properties of alkanes
  
- IV. Hydrocarbons, alkenes and alkynes
  - A. Alkenes
  - B. Hybrid bonding in double and triple bonds
  - C. *sp* and *sp*<sup>2</sup> bonds
  - D. *p* - *p* covalent bonding, bonds
  - E. Single bonds:  $\sigma$  bonds
  - F. *s* character, *p* character and the energy of bonding orbitals
  - G. Bond energy
  - H. Unsaturation equivalent
  - I. Introduction to nomenclature (*part ii*)
    - 1.) Alkanes
    - 2.) Branched alkanes
    - 3.) Alkenes
    - 4.) Alkynes
    - 5.) Rings
  
- V. An Introduction to atoms other than carbon and hydrogen
  - A. Heteroatoms
  - B. Electronegativity
  - C. Polarity
  - D. Covalent bonding in alkanes containing heteroatoms
  - E. Intramolecular effects
  - F. Intermolecular effects
  - G. Physical properties
  
- VI. Introduction to acids and bases
  - A. Electronegativity
  - B. Acids
  - C. Bases
  - D. Salts
  - E. Physical properties
  - F. Equilibrium expressions
  
- VII. Making and breaking chemical bonds

- A. *s* character, *p* character and the energy of bonding orbitals
  - B. Combustion
  - C. Bond energy
  - D. Free radical substitution
  - E. Reactive intermediates
- VIII. Addition reactions to orbitals
- A. Acids and bases
  - B. Protons
  - C. Energy changes
  - D. Stereochemistry
  - E. Introduction to electrophilic addition reactions
- IX. Basic nomenclature
- A. Alkanes and branched alkanes
  - B. Alkenes, alkynes
  - C. Rings
  - D. Alcohols
  - E. Halides
  - F. Multiple functionality
- X. Electrophilic addition to bonds
- A. Heterolytic cleavage
  - B. Electrophiles
  - C. Electrophilic attack
  - D. Nucleophiles
  - E. Markownikoff rule
- XI. Unsaturated systems
- A. Electrophilic addition
  - B. Dehydration of alcohols
  - C. Stabilization of intermediates by resonance
- XII. Introduction to stabilized systems
- A. Hydrogenation
  - B. Heat of hydrogenation
  - C. Dienes
  - D. Introduction to resonance
- XIII. Benzene
- A. Cyclohexane
  - B. Cyclohexene
  - C. Bonding
  - D. Stabilization
  - E. Aromaticity
- XIV. Spectroscopy
- A. Infrared spectrum

B. Nuclear magnetic resonance spectra

XV. Electrophilic addition to benzene and aromatic systems

A. Electrophilic addition

B. Substituted benzene rings

C. Electrophilic addition on substituted benzene rings

D. Acids

### **REQUIRED TEXTBOOK AND MATERIALS:**

Carey, F. A. Organic Chemistry. 7<sup>th</sup> ed. Boston: McGraw-Hill Higher Education, 2008.

Hill, R. K. Experiments in Organic Chemistry. 3<sup>rd</sup> ed. Raleigh: Contemporary Publishing Company, 2006.

Hayden, Student Lab Notebook (100 carbonless dupl.. sets). , 2000

Darling's model kit with atom visions.

Safety glasses: Available in lab or at any hardware store.

Scientific calculator.

Lab coat: It is preferred that a student have a personal lab coat.

### **SUGGESTED REFERENCES, PERIODICALS, AND VISUAL AIDS:**

Numerous supplementary texts, programmed materials, and audiovisual packages are available in the Educational Resources Center. These materials may be utilized to reinforce the lecture and lab material or to provide material for independent study by the student.

### **STATEMENT OF STUDENTS WITH DISABILITIES:**

Students who require academic accommodations due to any physical, psychological, or learning disability are encouraged to request assistance from a disability services counselor within the first two weeks of class. Likewise, students who potentially require emergency medical attention due to any chronic health condition are encouraged to disclose this information to a disability services counselor within the first two weeks of class. Counselors can be contacted by calling 536-7207, ext 1418 or by visiting the Student Development Office in the Phail Wynn Jr. Student Services Center, room 1309.