

CHM 252
ORGANIC CHEMISTRY II

COURSE DESCRIPTION:

Prerequisites: CHM 251
Corequisites: None

This course continues the systematic study of the theories, principles, and techniques of organic chemistry. Topics include nomenclature, structure, properties, reactions, and mechanisms of aromatics, aldehydes, ketones, carboxylic acids and derivatives, amines and heterocyclics. Multi-step synthesis is emphasized. Upon completion, students should be able to demonstrate an understanding of organic concepts as needed to pursue further study in chemistry and related professional fields. 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. Explain aliphatic nucleophilic substitution reactions.
- b. Explain unimolecular reactions and bimolecular reactions.
- c. Describe chirality, enantiomers and diastereoisomers.
- d. Explain SN1 and SN2 reactions.
- e. Understand aldehydes and ketones.
- f. Identify the oxidation state of organic functional groups.
- g. Describe reduction of carbonyl groups.
- h. Explain Grignard reactions.
- i. Describe carboxylic acids and derivatives.
- j. Explain the correlation between pKa and leaving group ability, and pKa and nucleophilicity.
- k. Describe phenols.
- l. Understand enolates and carbanions.
- m. Understand the reactions of amines.
- n. Explain aldol reactions.
- o. Explain tautomerism.
- p. Describe elimination reactions.
- q. Describe amino acids and proteins
- r. Describe polycyclic and heterocyclic compounds.
- s. Describe carbohydrates and their stereochemistry.
- t. Explain the structure and component molecules of nucleic acids.
- u. Understand the organic mechanisms related to the biogenesis of natural products.
- v. Describe concerted and pericyclic reactions.

OUTLINE OF INSTRUCTION:

- I. Alkyl halides
 - A. Nucleophiles

- B. Bases
 - C. Leaving groups
 - D. Structure and mechanism
 - E. Stereochemistry
- II. Alcohols and ethers
- A. Acids and bases
 - B. Preparations
 - C. Williamson ether synthesis
- III. Aldehydes and ketones
- A. Oxidation reactions
 - B. Preparations
 - C. Alcohols
 - D. Reduction of aldehydes and ketones
 - E. Grignard reactions
 - F. Oxidation state
- IV. Acids and derivatives
- A. pKa and oxidation state
 - B. Leaving groups
 - C. Esters
 - D. Amides
 - E. Anhydrides
- V. Leaving group ability
- A. pKa
 - B. Nucleophilicity
- VI. Electronegativity, resonance & pKa: A qualitative examination of pKa
- A. Water
 - B. Mineral acids
 - C. Alcohols
 - D. Phenols
 - E. Carboxylic acids
- VII. Carbons with a negative charge; carbanions
- A. Grignard reactions
 - B. α -hydrogens
 - C. Aldol condensations
 - D. Keto/enol tautomerism
- VIII. Reactions on carbons with a negative charge
- A. The iodoform test
 - B. Claisen condensations
 - C. Knoevenagel reactions
 - D. Dieckmann reaction
 - E. C/O alkylations, enolates
 - F. β -keto acids and decarboxylations
 - G. Acetoacetic ester synthesis

- H. Nitriles
- I. Malonic ester syntheses
- J. α,β -unsaturated systems
- K. Michael conjugate additions
- L. Elimination reactions

IX. Amines

- A. Bonding
- B. Primary { 1° }, Secondary { 2° }, Tertiary { 3° }
- C. Base character
- D. Stereochemistry
- E. Diazotization
- F. A Synthesis - sulfanilamide
 - 1.) Sulfa drugs
 - 2.) Nitration - electrophilic substitution
 - 3.) Acylation - amide formation
 - 4.) Sulfonation - electrophilic substitution, *o,p* directors
 - 5.) Amide preparation - from an acid chloride
 - 6.) Amide hydrolysis
- G. Introduction to amino acids
 - 1.) Sulfanilic acid
 - 2.) α -amino acids
 - 3.) α -amino acid synthesis
- H. Nitrogen heterocycles
 - 1.) Pyridine
 - 2.) Pyrrole

X. Carbohydrates I

- A. $x \text{CO}_2 + x \text{H}_2\text{O} \rightarrow \text{C}_x(\text{H}_2\text{O})_x + x \text{O}_2$
- B. Kiliani - Fisher synthesis
- C. Polyhydroxy alcohols with an extra aldehyde group
- D. Threose and erythrose
- E. Aldopentoses
- F. Aldohexoses

XI. Carbohydrates II

- A. Fischer projection formulas
- B. optical activity - D-glyceraldehyde
- C. Carbonyl groups
- D. Oxygen heterocycles
- E. Mutarotation
- F. Polysaccharides
- G. Ketohexoses
- H. Reducing and non-reducing sugars

XII. Pyrimidines and Purines

- A. Thymine and cytosine
- B. Adenine and guanine
- C. Ribonucleosides

XIII. Polynucleotides

- A. Phosphoric acid
- B. Esters of phosphoric acid
- C. Ribonucleoside polymers
- D. Deoxyribose
- E. Hydrogen bonding
- F. Watson-Crick base pairing / the double helix
- G. Coding for protein synthesis

XIV. The tertiary structure of proteins

- A. Enzymes
- B. Receptor sites

XV. Terpenes

- A. Acetyl Co-enzyme A
- B. Condensation reactions
- C. Steroids

REQUIRED TEXTBOOK AND MATERIALS:

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

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

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

Darling's model kit with atom visions.

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.