CHM 252 ORGANIC CHEMISTRY II

COURSE DESCRIPTION:

Prerequisites: CHM 251 with a C or better
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 chromotography, 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. a-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. ß-keto acids and decarboxylations
- G. Acetoacetic ester synthesis
- H. Nitriles
- I. Malonic ester syntheses
- J. a,ß-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) a-amino acids
    3) a-amino acid synthesis
H. Nitrogen heterocycles
    1) Pyridine
    2) Pyrrole

X. Carbohydrates I
A. $x\ CO_2 + x\ H_2O$ -----> $C_x(H_2O)_x + x\ O_2$
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. 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:

To be selected by Instructor/Discipline Chair.