Course Syllabus

Department: Science & Technology

Date: January 2015

I. Course Prefix and Number: CHM 205

Course Name: Organic Chemistry I – Lecture Only

Credit Hours and Contact Hours: 4 credit hours and 4 (3:0:1) contact hours

Catalog Description including pre- and co-requisites:

A systematic study of the chemistry of carbon compounds emphasizing reactions, mechanisms, and synthesis with a focus on functional groups, addition reactions to alkenes and alkynes, alcohols and ethers, stereochemistry, nomenclature, acid-base chemistry, reaction kinetics and thermodynamics.

Completion of General Chemistry II or equivalent with a grade of C or better is prerequisite.

II. Course Outcomes and Objectives

Student Learning Outcomes:

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

- Demonstrate an understanding of basic principles of organic chemistry and how they relate to everyday experiences.
- Demonstrate problem solving and critical thinking skills
- Apply methods of scientific inquiry.
- Apply problem solving techniques to real-world problems.
- Demonstrate an understanding of the chemical environment and the role that organic molecules play in the natural and the synthetic world.

Relationship to Academic Programs and Curriculum:

This course is required for majors in chemistry, chemical engineering, biology, biotechnology, pharmacology, and other pre-professional programs.

College Learning Outcomes Addressed by the Course:

☐ writing	☐ computer literacy
☐ oral communications	☐ ethics/values
X reading	☐ citizenship
☐ mathematics	☐ global concerns
X critical thinking	☐ information resources

III. Instructional Materials and Methods

Types of Course Materials:

A standard two-semester 200 level organic textbook and workbook.

Methods of Instruction (e.g. Lecture and Seminar …):

Three hours of lecture, with a one hour recitation period for individual as well as group learning activities such as case studies and guided learning activities.

IV. Assessment Measures (Summarize how the college and student learning outcomes will be assessed):

Student learning outcomes will be assessed using a variety of assessment measures:

1. Unit exams, quizzes, and a comprehensive final will assess student knowledge of basic principles of organic chemistry and how they relate to everyday experiences.
2. Class assignments and active learning activities such as case studies and guided learning, will assess mastery of critical thinking, reading, information resources and applying content to solve real world problems.

V. General Outline of Topics Covered:

A. Introduction to the Structure and Properties of Organic Compounds

General Outcome:

- The student should be able to apply information from general chemistry that is relevant to organic chemistry, as well as to recognize the concepts of structure and functional groups in organic chemistry.

Specific Learning Outcomes:

Upon completion of this material the student should be able to:

- Apply the following general chemistry concepts to organic chemistry: chemical bonding, hybrid orbitals, molecular geometry, bond energies, polarity, the relationship between structure and physical properties, and acid/base theories.
- Recognize, draw and identify examples of each of the major functional groups and classes of organic compounds

B. Alkanes, Alkyl Halides and Nucleophilic Substitution Reactions

General Outcome:

- The student should be able to name, detail the structure, properties and reactions of alkanes and alkyl halides and demonstrate an understanding of the characteristics of the nucleophilic substitution reaction.

Specific Learning Outcomes:

Upon completion of this material the student should be able to:

- Name and draw structural formulas of the first 12 straight chain alkanes, branched alkanes and alkyl halides and relate these structures to their physical properties.
- Recognize the relative energies involved in various conformations and single bond rotations.
- Detail the major preparations of alkanes and alkyl halides.
- Detail the mechanism for a free radical substitution reaction and the factors which control it.
- Discuss the differences between the two nucleophilic substitution mechanisms S_N1 versus S_N2.
- Recognize experimental factors which would make either the S_N1 or S_N2 mechanism predominate (e.g., alkyl group structure, nature and concentration of the nucleophile or polarity of the solvent).
- Make predictions of stereochemical fates for chiral alkyl halides undergoing either S_N1 or S_N2 reactions.
- Write detailed mechanisms for S_N1, S_N2, E1 and E2 reactions (including those involving rearrangement).
- Discuss and weigh factors which would make the competing reaction of elimination predominate over either unimolecular or bimolecular substitution such as the nature of the base/nucleophile, the alkyl group structure, the temperature or the solvent polarity.

C. Alkenes, Alkynes, Conjugated Systems, and Elimination Reactions

General Outcome:

- The students should be able to demonstrate an understanding of the structure, nomenclature, physical properties, preparation and major reactions of unsaturated hydrocarbons.

Specific Learning Outcomes:

Upon completion of this material the student should be able to:

- Name unsaturated hydrocarbons and detail the structures and properties of selected alkenes, polyenes and alkynes.
- Outline the preparations of alkenes and alkynes and the mechanisms involved.
- Discuss the structure, stability and reaction of carbocations.
- Discuss the oxidative cleavage, substitution and addition reactions of alkenes (including Diels-Alder), and dienes and alkynes.
- Write equations to demonstrate the acidity of alkynes.
- Define and recognize tautomerism.
- Detail the differences between conjugated, isolated and cumulative double bonds.

D. Stereochemistry

General Outcome:

- The student should be able to describe the importance of the three dimensional structure of molecules and the effect of this on physical and chemical properties..

Specific Learning Outcomes:

Upon completion of this material the student should be able to:

- Recognize which molecules will and which will not exhibit stereoisomerism.
- Explain the workings of a polarimeter and the meanings of optical rotation and plane polarized light and calculate specific rotation.
- Identify meso, chiral and achiral molecules and centers of chirality.
- Define and give examples of the common terms associated with stereochemistry.
- Use the sequence rules to denote R or S configurations and draw stereostructures and Fischer projections for R and S configurations.
- Predict the stereochemistry of the product of reaction of compounds with or without chiral carbons.

E. Alcohols, Ethers and Epoxides; Thiols and Sulfides

General Outcome:

- The student should be able to name alcohols, ethers, thiols, and sulfides. As well as demonstrate an understanding of the major reactions of the alcohols and ethers.

Specific Learning Outcomes:

Upon completion of this material the student should be able to:

- Assign IUPAC and common names to alcohols and ethers.
- Describe mechanisms and equations for the preparation of alcohols and ethers.
- Describe and write equations for reactions involving alcohols
- Describe simple tests by which alcohols may be characterized or classified.
- Describe the special uses of ethers as solvents and list the major hazards associated with their use.
- Describe the reactions of ethers and epoxides, especially with nucleophilic reagents.