Course Name: Organic Chemistry I

Course Number: CHE* E211

Credits: 4

Catalog description: The first part of a two-part sequence designed to present the principles and theories involving the principal groups of carbon compounds. Topics include nomenclature, stereochemistry, and conformational analysis of organic molecules, and the preparation, reactions and mechanisms of alkanes, alkyl halides, alkenes, alkynes, and alcohols. The laboratory activities feature the basic reaction, purification, and separation techniques utilized in organic chemistry, and activities integrated with the theory of the functional groups covered in lecture. (three hours of lecture and four hours of laboratory per week)

Prerequisite: CHE 122: General Chemistry II with a grade of C- or better (or instructor's permission)

General Education Competencies Satisfied:

Discipline-Specific Attribute Code(s):

☒ **SCI** **Science elective**

Course objectives:

Upon successful completion of this course, the student will:

1. Classify and name organic compounds based on their functional groups.
2. Apply IUPAC (International Union of Pure and Applied Chemistry nomenclature rules to recognize correct chemical names, formulas, and structures.
3. Use general functional group reactions to predict the either the products or reagents and conditions of an organic chemical reaction.
4. Recognize and use organic chemical reaction mechanisms and their energy diagrams to correctly predict reaction products.
5. Relate stereochemistry of reactants to reaction type in order to predict synthetic pathways as well as products.
6. Perform laboratory procedures related to stereochemistry, recrystallization, distillation, chromatography, synthesis, isomerization, and physical characterization.
7. 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.

Course Content:

Lecture:

1) Introduction to Organic Chemistry and Review of General Chemistry
   a) Origins of Organic Chemistry
   b) Principles of Atomic Structure (review)
   c) Electronic structure (review)
      i) electron configurations and orbital diagrams
   d) Ionic and Covalent Bonding (review)
   e) Formulas and Structural Representations
      i) Molecular and Empirical formulas
      ii) Condensed structures
      iii) Bond-Line (skeletal) structures
      iv) Three-Dimensional Perspective in bond-line structures
   f) Polar/Nonpolar Bonds and Molecules (review)
   g) Resonance
      i) Drawing resonance structures
      ii) Major/minor resonance contributors
   h) Acids and Bases (review)
      i) Arrhenius theory
      ii) Brönsted-Lowry theory
      iii) Lewis theory
      iv) pH and pK_a
      v) Relative acidity based on
         (1) Structure
         (2) Bonding
         (3) Resonance
2) Structure and Properties of Organic Molecules
   a) Hybridization and molecular shapes
   b) Molecular orbital theory
   c) Bond rotation
   d) Isomers – introduction
   e) Hydrocarbons - introduction
   f) Other organic functional groups
      i) Infrared Spectroscopy – functional group IR spectroscopy peaks (*optional* – if not covered here it must be covered in CHE 212: Organic Chemistry II)
   g) Intermolecular forces
      i) Types

   ii) Effect on solubility and melting/boiling points
3) Alkanes
   a) structure
   b) nomenclature
   c) physical properties
   d) conformations
   e) cycloalkanes – monosubstituted, disubstituted, fused
      i) ring strain
      ii) conformations
      iii) cis/trans isomerism
   f) uses and sources of alkanes
   g) reactions of alkanes
4) Introduction to Organic Reactions
   a) Types of organic reactions
   b) Reaction mechanism notation and symbols
   c) Equilibrium
   d) Thermodynamics
   e) Homolytic and Heterolytic Bond cleavage
   f) Reaction energy diagrams
      i) Transition states
      ii) Reactive intermediates
         (1) Carbocations
         (2) Radicals
         (3) Carbanions
5) Free-radical halogenation of alkanes
   a) Reaction
   b) Mechanism
   c) Reactivity and selectivity
6) Stereochemistry
   a) Chirality
   b) Stereochemical centers
   c) Fischer projections
   d) Absolute configuration and the (R) and (S) system
   e) Meso compounds
   f) Optical activity and racemic mixtures
   g) Separation of enantiomers
7) Alkyl halides
   a) Structure and physical properties
   b) Nomenclature
   c) Synthesis of alkyl halides

   d) Reactions of alkyl halides
      i) Substitution
         (1) Stability of Carbocations
         (2) Rearrangements of carbocations
      ii) Elimination
         (1) Zaitsev's rule
      iii) Elimination vs. Substitution
         (1) SN1, SN2, E1, E2
8) Alkenes
   a) Structure
   b) Nomenclature
   c) Physical properties
   d) Degrees of unsaturation
   e) Stereoisomerism
   f) Stability
   g) Synthesis
   h) Reactions
9) Alkynes
   a) Structure
   b) Nomenclature
   c) Physical properties
   d) Synthesis
   e) Reactions
10) Alcohols
   a) Structure
   b) Nomenclature
   c) Physical properties
   d) Acidity
   e) Synthesis
11) Introduction to Retrosynthesis

Laboratory

1) Safety and Introduction to the Organic Chemistry Laboratory
2) Melting points of pure compounds and mixtures
3) Thin-layer Chromatography
4) Adsorption Column Chromatography
5) Distillation
6) Solvent Extraction
7) Isolating a Compound from a Natural Substance
8) Nucleophilic Substitution

9) Alkene Preparation or Alkene Reaction

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.

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