UNION
UNIVERSITY

COURSE SYLLABUS

I. BASIC INFORMATION

Department of Chemistry
CHE 314
Organic Chemistry I
Three (3) semester hours credit

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II. SCOPE OF COURSE

This course introduces the student to the branch of chemistry that includes the study of the chemistry of life. It builds on the fundamental principles learned in general chemistry, thus it is required that students, at a minimum, before enrolling in CHE 314, successfully complete an academic year of general chemistry at the college level (eight semester hours or its equivalent). Ideally, a student will have also completed a course in analytical chemistry (CHE 211/221). This course will begin with a review of the development of the theory of atomic structure from the Thomson model of the atom to the currently accepted quantum mechanical atomic paradigm. The student's understanding of acid-base chemistry will be extended and the principles of bonding from a molecular orbital approach will be discussed. The chemistry of organic compounds will be studied by considering systematically the classes of organic compounds created when various functional groups occur in organic molecules. Methods of introducing each functional group into an organic molecule will be thoroughly discussed. The reactions characteristic of each functional group will also be examined in detail. Other important aspects of the course include symmetry properties of organic molecules, organic reaction mechanisms, and spectroscopic methods of organic analysis. Finally, the role of organic molecules in biological and environmental processes will be explored.

III. COURSE OBJECTIVES

The general objectives of the course are:

1. To acquire a sound foundation of basic organic chemical knowledge,
2. To learn the language, logic and methods of organic chemistry,
3. To master the mental skills required to acquire new information through experimentation in organic chemistry,
4. To utilize the theories of organic chemistry to understand a few simple biochemical systems and life processes, and
5. To gain insight into the relevance of organic chemistry to societal problems.

IV. TEXTBOOKS AND MATERIALS

The required textbook for the course is ***Organic Chemistry*** (7th edition) by Francis A Carey. Students will find the ***Study Guide and Solutions Manual*** by Francis A. Carey and Robert C. Atkins a useful supplement to the textbook. However, purchase of the ***Study Guide*** is optional as is the purchase of the Framework Molecular Model Kit (Prentice-Hall). The Online Learning Center and Learning with Modeling CD-ROM bundled with the textbook will also permit the three-dimensional visualization of organic molecules and exercises in molecular modeling. ChemDraw Pro v.11 may be used to publish organic structures in reports and papers and is available to all students with an email address @uu.edu. The installation disk for Windows or Mac OSX can be checked out in Dr. Randy Johnston's office. Exercises in molecular-modeling may also be performed using the Chem3D software. Students have found the latter study aids particularly useful while learning to visualize the structures of organic molecules. Use of the model kit is permitted on all tests and quizzes (Exceptions: ACS Standardized Examinations).

V. ASSIGNED READING AND RESEARCH

The required reading for this course includes chapters 1-12 of the textbook. Additional reading may be necessary in order to achieve full comprehension of the topics covered in the course. Helpful sources may be found in the bibliography attached to this syllabus. There is also a helpful reading list for each chapter in the textbook.

VI. SPECIAL PROJECTS/ACTIVITIES

There are no special projects or activities required for the successful completion of the objectives of this course. However, from time to time, regular library and homework assignments will be made.

VII. METHOD OF INSTRUCTION

The course is taught by the lecture/demonstration/discussion/dialogue methods. The instructor relies heavily on student participation during the course of each lecture. This requires that students thoroughly review class notes between each class meeting and read the portions of the textbook pertinent to the topics scheduled for each session of the class**. Students are encouraged to form study groups/teams that will promote interactive learning.** To reinforce several concepts, computer-assisted instructional programs/materials will be available for use in the computer laboratories and via the Internet on an individual basis. All students are encouraged to develop word processing and computational skills with the computer.

VIII. METHOD OF EVALUATION

Each student's grade in the course shall be determined by his/her performance on major quizzes, short quizzes (usually each Friday), library/homework assignments, and a comprehensive final examination. Each student may accumulate a total of 1000 points. The short quizzes taken together carry the same weight as one major quiz. The major quiz or short quiz total that makes

VIII. METHOD OF EVALUATION (continued):

the least contribution to the final point total will be excluded in the final computation. **No make-up quizzes shall be given unless arrangements are made in advance of foreseen absences or immediately following unforeseen absences due to sickness or family trauma.**

Each activity shall be weighted as follows:

Activity	Points
Major Quizzes (3)	600
Short Quizzes (~8)	
Library/Homework Assignments	150
Final Examination	250
TOTAL	**1000**

The final course grade will be assigned utilizing the following scale.

Total Points	Course Grade
1000-900	A
800-899	B
700-799	C
600-699	D
Below 600	F

The major quiz schedule is as follows:

Major Quiz	Date
Major Quiz #1	Friday, September 25, 2009
Major Quiz #2	Monday, October 26, 2009
Major Quiz #3	Monday, November 23, 2009

These evaluation procedures are subject to ratification by the class at its first meeting.

IX. ATTENDANCE POLICY

It should be recognized that courses of study that are most worthwhile are those that necessitate much study and preparation by the student and the instructor. It is the instructor's opinion (and personal goal) that each class meeting will be worthy of the student's attendance and participation. Although no point deduction will occur for unexcused absences, excessive absences will render impossible the achievement of the course objectives. Students are responsible for all material covered in class and should obtain class notes from fellow class members when absences do occur.

X. OUTLINE OF COURSE

I. Atomic Structure
   A. Electronic configuration
      1. Bohr's *aufbau* principle
      2. Pauli exclusion principle
      3. Hund's rule
   B. Classical atomic models
      1. J. J. Thomson
      2. E. Rutherford
      3. N. Bohr
   C. Quantum mechanical model

II. Molecular Structure
   A. Chemical bonds
      1. ionic bonding
      2. covalent bonding
      3. coordinate covalent bonding
   B. Molecular orbital theory
      1. hybridization
   C. Bond properties
   D. Molecular geometry
   E. Intermolecular forces
   F. Isomerism

III. Alkanes
   A. Classification of hydrocarbons
   B. Functional groups and organic compound classification
   C. Stuctural characteristics and descriptive chemistry
   D. Nomenclature
      1. common
      2. IUPAC
      3. alkyl groups
      4. cycloalkanes
   E. Sources and physical properties
   F. Chemical properties (reactions)
      1. oxidation
      2. halogenation
   G. Thermochemistry and its applications
      1. enthalpy
      2. potential energy
   H. Principles of oxidation/reduction
      1. oxidation number

IV. Conformations of Alkanes and Cycloalkanes
- A. Conformational analysis of ethane
- B. Conformational analysis of butane
- C. Conformations of higher alkanes
- D. Shapes of cycloalkanes
- E. Conformational analysis of cycloalkanes
  1. Baeyer strain theory
- F. Conformational analysis of substituted cycloalkanes
  1. relative stabilities
- G. Polycyclic ring systems
- H. Heterocyclic compounds

V. Alcohols and Alkyl Halides
- A. Classification and nomenclature
- B. Physical properties
- C. Acids and bases revisited
  1. mechanism of proton transfer
  2. aciditiy of alcohols
- D. Preparation of alkyl halides from alcohols
- E. Carbocations
  1. structure
  2. relative stabilities
  3. rearrangement
- F. Mechanism(s) of Sn1 and Sn2 reactions
  1. unimolecular nucleophilic substitution Sn1
  2. bimolecular nucleophilic substitution Sn2
- G. Halogenation of alkanes
- H. Free radicals
  1. structure, and relative stabilities
  2. rearrangement ? (Brown-Russell experiment)
- I. Mechanism of chlorination
- J. Halogenation of higher alkanes
  1. estimation of product distribution

VI. Alkenes
- A. Structure and nomenclature
  1. geometric isomerism
     a. *cis/trans* notation
     b. *E-Z* notation
  2. physical properties
  3. relative stabilities
- B. Preparation
  1. Elimination reactions
     a. dehydrohalogenation of alkyl halides
     b. dehydration of alcohols
     c. Zaitsev Rule and stereoselectivity
- C. Elimination reactions
  1. evidence for E1 and E2 mechanisms
  2. orientation, reactivity, and stereochemistry

VI. Alkenes (continued)
- D. Reactions of alkenes
  1. addition of hydrogen
     a. heats of hydrogenation
     b. stereochemistry of hydrogenation
  2. addition of hydrogen halides
     a. Markovnikov's Rule
     b. mechanism(s) of hydrohalogenation reactions
  3. addition of sulfuric acid
  4. hydration
- F. Other reactions
  1. hydroboration-oxidation
  2. halogenation
  3. epoxidation (CH_2Cl_2, $CHCl_3$, and acetic acid) and hydroxylation (water)
  4. ozonolysis
     a. structure analysis
  5. dimerization
  6. polymerization
     a. stereochemistry of polymerization
- G. Organic chemical synthesis

VII. Stereochemistry
- A. Optical activity (±)
- B. Enantiomerism and chirality
- C. Absolute (C-I-P *R/S*) and relative configuration (prior to 1951)
  1. Fischer projection formulas
  2. Reaction creating stereogenic centers
  3. diasteromers and meso compounds
- D. Resolution of enantiomers
  1. optical purity
- E. Configurational isomers

VIII. Nucleophilic Substitution
- A. Reaction rates and kinetics
  1. unimolecular nucleophilic substitution Sn1
  2. bimolecular nucleophilic substitution Sn2
  3. strength of leaving groups
  4. strength of nucleophiles
- B. Stereochemistry of Sn1 and Sn2 reaction
- C. Carbocations revisited
  1. structure
  2. relative stabilities
  3. rearrangement
- D. Solvent effects
  1. solvent bonding and solubility
  2. protic and aprotic solvents
  3. solvolysis reactions

IX. Alkynes
- A. Sources, structure and nomenclature
- B. Physical and chemical properties
  1. acidity
- C. Preparation
  1. alkylation
  2. elimination
- D. Reactions
  1. hydrogenation
  2. metal-ammonia reduction
  3. hydrohalogenation
  4. hydration
  5. halogenation
  6. ozonolysis

X. Conjugation and Resonance
- A. Allyl group chemistry
  1. allyl carbocations
  2. allyl free radicals
- B. Dienes
  1. classification
  2. relative stabilities
  3. electron delocalization in conjugated dienes
  4. allenes
- C. Stabilization of carbocations
- D. Dienes
  1. preparation
  2. addition reactions in conjugated systems
     a. 1,2 and 1,4 addition
     b. kinetic versus thermodynamic control of reaction rates
- E. Diels-Alder reactions
  1. stereoselectivity
- F. Electrocyclic reactions of polyenes
- G. Molecular orbital analysis of mechanisms
  1. Conservation of MO symmetry
  2. Woodward-Hoffmann Rules

XI. Arenes and Aromaticity
- A. Structure
  1. resonance theory
  2. molecular orbital theory
- B. Nomenclature
- C. Reactions
  1. electrophilic addition
  2. orientation of substitution
  3. mechanism of electrophilic addition
- D. Arenes
  1. physical properties
  2. preparation, and reactions
  3. oxidation, halogenation, alkenylbenzenes

XI. BIBLIOGRAPHY

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