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SAN DIEGO COMMUNITY COLLEGE DISTRICT
CITY, MESA, AND MIRAMAR COLLEGES
ASSOCIATE DEGREE COURSE OUTLINE

SECTION I

SUBJECT AREA AND COURSE NUMBER: Chemistry 231

COURSE TITLE: Organic Chemistry I - Lecture

Units: 3

Letter Grade or Pass/No Pass Option

CATALOG COURSE DESCRIPTION:

This course is the first semester of a one-year course in organic chemistry. Major themes include, but are not limited to, bonding, molecular structure, isomerism, conformational analysis, nomenclature, reaction mechanisms, and synthesis. Emphasis is placed on the reactions of aliphatic compounds, such as alkanes, cycloalkanes, alkenes, alkynes, alkyl halides, and alcohols. Organic chemistry literature and spectral interpretation using techniques, such as infrared and nuclear magnetic spectroscopies, are introduced to support the above topics. This course is designed for students pursuing a degree in the chemical sciences or training in chemical technology, as well as other transfer students who need organic chemistry as part of preparation for majors, such as molecular biology, premedical, predental, and pharmacy.

REQUISITES:

Prerequisite:
CHEM 201 with a grade of "C" or better, or equivalent
&
CHEM 201L with a grade of "C" or better, or equivalent

Corequisite: Completion of or concurrent enrollment in:

CHEM 231L with a grade of "C" or better, or equivalent

Advisory:

ENGL 101 with a grade of "C" or better, or equivalent or Assessment Skill Level R6/W6
or
ENGL 105 with a grade of "C" or better, or equivalent or Assessment Skill Level W6/R6

FIELD TRIP REQUIREMENTS:
May be required

TRANSFER APPLICABILITY:
Associate Degree Credit & transfer to CSU IGETC UC Transfer Course List Limitation: CHEM 130, 130L and 231, 231L combined: maximum credit, one course (with lab). CSU General Education

CID:
CHEM 160S (CHEM 231, 231L, 233, 233L)

TOTAL LECTURE HOURS:
48 - 54

TOTAL LAB HOURS:

STUDENT LEARNING OBJECTIVES:
Upon successful completion of the course the student will be able to:

1. Formulate molecular structures from analytical data on compound composition and explain the importance of isotopic labeling
2. Draw Lewis and skeletal (line-angle) structures including resonance forms, recognize constitutional isomers and tautomers, and calculate formal charges on atoms for given molecular structures
3. Correlate molecular structure with physical properties of organic compounds and analyze polarity and intermolecular forces for given molecular structures
4. Analyze orally or in writing current theories of bonding in organic compounds
5. Differentiate between functional groups, identify functional groups present in molecules, and assign these to the corresponding classes of organic compounds
6. Apply International Union of Pure and Applied Chemistry (IUPAC) conventions to name simple organic compounds
7. Compare and contrast current theories of acids and bases, relate molecular structure to acidity and basicity, and illustrate acid-base reactions of organic compounds
8. Distinguish between the various conformers for alkanes and cycloalkanes and assign relative energies to each
9. Explain isomerism and recognize, draw and differentiate between molecular structures that exhibit stereoisomerism
10. Illustrate and analyze mechanisms of organic reactions (including selected heterolytic and homolytic substitutions, additions and eliminations, and oxidations and reductions) using thermodynamic, kinetic and stereochemical principles
11. Propose and evaluate strategies for the synthesis of selected classes of organic compounds, including, but not limited to, alkanes, alkenes, alkynes, alkyl halides and alcohols
12. Differentiate molecular structures of organic compounds using physical and chemical evidence as well as basic spectroscopic information, especially from infrared and nuclear magnetic resonance spectroscopy
13. Analyze and differentiate between molecular structures using print and electronic media (such as selected handbooks, reference volumes, computer software, library and/or on-line sources) within the organic chemistry literature.

SECTION II

1. COURSE OUTLINE AND SCOPE:

A. **Outline Of Topics:**
The following topics are included in the framework of the course but are not intended as limits on content. The order of presentation and relative emphasis will vary with each instructor.

I. Molecular formula of organic compounds
  A. Isotopes of carbon and hydrogen
  B. Empirical formula from analytical data
  C. Molecular formula from empirical formula
II. Molecular structure of organic compounds
  A. Lewis structures from molecular formulas
  B. Skeletal (line-angle) structures
  C. Formal charges
  D. Resonance
  E. Conjugation (electron delocalization)
  F. Constitutional isomers
  G. Tautomers
  H. Valence shell electron pair repulsion (VSPER) theory
  I. Two- and three-dimensional representations of molecular structures
III. Relationship of molecular structure to physical properties of organic compounds
  A. Polarity analysis

B. Intermolecular forces
C. Physical properties

IV. Bonding theories
A. Lewis electron dot theory for bonding in organic compounds.
B. Linear combination of atomic orbital (LCAO)
C. Valence bond theory (VBT)
D. Molecular orbital theory (MO)
E. Recent advances in bonding theories.

V. Functional groups and the corresponding classes of organic compounds
A. Identification
B. Structure
C. Two- and three dimensional representations

VI. Nomenclature of organic compounds
A. Common conventions
B. International Union of Pure and Applied Chemistry (IUPAC) system

VII. Acid-base theories
A. Brönsted-Lowry theory
B. Lewis theory
C. Correlation of molecular structure to acid and base strength
D. Acid-base reactions, equilibrium, and pKa of organic compounds

VIII. Conformational analysis of organic compounds
A. Aliphatics
B. Cyclics
C. Bicyclics
D. Two- and three-dimensional representations

IX. Isomerism
A. Constitutional
B. Stereoisomerism

X. Organic reactions
A. Classes of reactions
B. Chemical reactivity
C. Reaction outcomes
D. Reactive intermediates
E. Energy diagrams, intermediates, and transition states
F. Mechanisms

XI. Synthetic methods
A. Retrosynthesis
B. Organic Compounds
C. Organometallic Compounds

XII. Spectral analysis of organic compounds
A. Infrared spectroscopy (IR)
B. Nuclear Magnetic Resonance spectroscopy (NMR)

XIII. Chemical literature
A. Print media
B. Electronic media.

B. **Reading Assignments:**
Reading assignments are required and may include but, are not limited to, the following:

I. Course textbook(s).
II. Instructional packets containing handouts or articles clarifying or amplifying course content; for example, a handout highlighting key concepts which relate molecular structure to acidity and basicity, and illustrate acid-base reactions of organic molecules.
III. Newspaper articles and articles from such periodicals as Chemical and Engineering News or articles in journals such as the Journal of Organic Chemistry which contain information relevant to the course objectives.
IV. Electronic media such as instructor created materials, or online sources such as the web sites containing reference materials and sites maintained by textbook publishers or the American Chemical Society.

C. **Writing Assignments:**
Writing assignments are required and may include, but are not limited to, the following:

I. An assignment in which students explain the relationship between physical properties of a compound and its three dimensional molecular structure.
II. An assignment in which students correlate graphically, in writing, and/or on a computer physical and chemical properties to chemical structure and nomenclature.
III. An assignment in which students work out in writing, and/or on a computer a synthetic pathway linking a reactant molecule to a final target molecule.
IV. A single sentence response that explains why one specific molecule is chiral and why another is not.
V. A short paragraph response that discusses the dependencies of acidity and basicity as a function of molecular structure.
VI. A multi-paragraphed essay comparing and contrasting the different types of mechanisms for elimination and substitution under varying reaction conditions.
VII. An assignment in which students analyze in writing the relevance of organic chemistry to the issues and problems faced by the broader society, as these problems are defined by community members and not by academics acting independently of the views of others.

D. **Appropriate Outside Assignments:**
Outside assignments may include, but are not limited to, the following:

I. Problem solving exercises assigned from the textbook, study guide, instructor packets and/or electronic media. For example, exercises, such as molecular structure formulation from analytical data on compound composition; drawing organic reaction mechanisms using the electron pushing convention; application of International Union of Pure and Applied Chemistry (IUPAC) nomenclature rules; and, completion of reaction equations by filling in the missing information
II. Assignments from electronic media which involve solving interactive tutorial problems on the subjects discussed in class.
III. Topic search assignments, which may involve use of the library or the Internet.
IV. Visits to local research, analytical, or production chemical laboratories.
V. Attendance at local seminars or conferences pertinent to topics covered in the course.
VI. Reading and writing assignments.

E. **Appropriate Assignments that Demonstrate Critical Thinking:**
Critical thinking assignments are required and may include, but are not limited to, the following:

I. Distinguish and differentiate among reaction mechanisms for addition, elimination, substitution, oxidation, reduction, rearrangement, and acid-base reactivity under varying reaction conditions.
II. Design appropriate synthetic pathways for selected organic molecules based upon known structures and properties of simpler molecules.
III. Predict the equilibrium ratio of conformers based upon estimates of the interactions between substituents in the molecule.
IV. Evaluate and analyze current topics related to course objectives with in-class discussion and/or oral presentation. For example, a presentation on a practical application of the use of substitution reactivity as it relates to the synthesis of a designated molecule.
V. Analyze through peer review a student's in-class discussion of data. For example, a written critique of a student's presentation of the practical application of the use of substitution reactivity as it relates to the synthesis of a designated molecule (see 4 above).

2. METHODS OF EVALUATION:

A student's grade will be based on multiple measures of performance unless the course requires no grade. Multiple measures may include, but are not limited to, the following:

I. Unit exams, final exams, and/or American Chemical Society approved standardized exams which evaluate the student's ability to solve problems involving the above topics plus topics covered previously in the one-year sequence of general chemistry.
II. Written exercises on a variety of topics covered in the classroom, textbook, or outside reading

material.
III. Oral, written, and/or multimedia presentations on assigned topics related to course objectives.
IV. Effective participation in class activities.

3. METHODS OF INSTRUCTION:

Methods of instruction may include, but are not limited to, the following:

* Lecture
* Lecture Discussion
* Audio-Visual
* Collaborative Learning
* Other (Specify)
* Field trips
* Multi-media presentations
* Chemical demonstrations.

4. REQUIRED TEXTS AND SUPPLIES:
Textbooks may include, but are not limited to:

TEXTBOOKS:
1. Carey, Francis A. and Robert Giuliano. Organic Chemistry, 9th ed. McGraw-Hill, 2013, ISBN: 9780073402741
2. McMurry, John E. Organic Chemistry, 8th ed. Cengage Learning, 2011, ISBN: 9780840054449
3. Solomons, T. W. Graham and Craig B. Fryhle. Organic Chemistry, 11th ed. Wiley, 2013, ISBN: 9781118133576
4. Vollhardt, K. Peter C. and Neil E. Schore. Organic Chemistry: Structure and Function, 7th ed. W.H. Freeman, 2014, ISBN: 9781464120275
5. Wade Jr., L.G. Organic Chemistry, 8th ed. Pearson, 2012, ISBN: 9780321768414

MANUALS:

PERIODICALS:

SOFTWARE:

SUPPLIES:
1. Scientific calculator
2. Molecular model kit
3. Flash drive

ORIGINATOR: Duane Short
ORIGINATION DATE: 11/16/2010
PROPOSAL ORIGINATOR: Nancy Crispen
CO-CONTRIBUTOR(S)
PROPOSAL DATE: 03/10/2015