El Camino College

COURSE OUTLINE OF RECORD - Official

I. GENERAL COURSE INFORMATION

Subject and Number: Chemistry 7B
Descriptive Title: Organic Chemistry II

Course Disciplines: Chemistry

Division: Natural Sciences

Catalog Description: This course involves a comprehensive study of aromatic compounds and the major classes of oxygen-containing and nitrogen-containing organic compounds. This includes nomenclature, structure, properties, stereochemistry, reactions, synthetic methods and spectroscopy. Emphasis is placed on a systematic approach to understanding the material through the use of bonding theories, energy concepts, kinetics, and reaction mechanisms. A study of biochemistry focuses primarily on lipids, carbohydrates, amino acids and proteins. In the laboratory, emphasis is on qualitative organic analysis, common organic reactions and multistep synthesis.

Conditions of Enrollment: **Prerequisite**
Chemistry 7A with a minimum grade of C

Course Length: [X] Full Term [ ] Other (Specify number of weeks):
Hours Lecture: 3.00 hours per week [ ] TBA
Hours Laboratory: 6.00 hours per week [ ] TBA
Course Units: 5.00

Grading Method: Letter
Credit Status Associate Degree Credit

Transfer CSU: [X] Effective Date: Prior to July 1992
Transfer UC: [X] Effective Date: Prior to July 1992

General Education:

El Camino College: 1 – Natural Sciences
Term: 1991 Other: Approved

CSU GE:

B1 - Physical Science
Term: Fall 1991 Other:

B3 - Laboratory Sciences
Term: Fall 1991 Other:

IGETC:

5A - Physical Science with Lab

Term: Fall 1991 Other:

5C - Science Laboratory

Term: Fall 1991 Other:

II. OUTCOMES AND OBJECTIVES

A. COURSE STUDENT LEARNING OUTCOMES (The course student learning outcomes are listed below, along with a representative assessment method for each. Student learning outcomes are not subject to review, revision or approval by the College Curriculum Committee)

1. Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will dipict appropriate bonds, lone pairs and geometry.
2. Given a compound name or formula, the student will create a correct representation of the compound.
3. Students will adhere to safety protocol in the laboratory regarding eye protection. Students will follow the proper procedure regarding wearing goggles in the laboratory, and keeping them on to protect their eyes.

The above SLOs were the most recent available SLOs at the time of course review. For the most current SLO statements, visit the El Camino College SLO webpage at http://www.elcamino.edu/academics/slo/.

B. Course Student Learning Objectives (The major learning objective for students enrolled in this course are listed below, along with a representative assessment method for each)

1. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will draw a structure given a specific name and vice-versa.

   Objective Exams
2. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will list the most common and important compounds.

   Essay exams
3. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will predict and explain properties in terms of structure and bonding.

   Multiple Choice
4. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will evaluate a molecule for the existence of structural and stereoisomers and draw formulas for all structural isomers and stereoisomers.

   Objective Exams
5. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will determine products given reactants and vice-versa for common reactions.

   Multiple Choice
6. Demonstrate an extensive knowledge for many of the reactions studied by writing mechanisms, particularly those involving carbanion, carbocation, or radical

intermediates.

Other (specify)

short answers

7. Demonstrate an extensive knowledge for many of the reactions studied by explaining how kinetic studies and energy measurements are used to support or disprove a proposed mechanism.

   Essay exams

8. Compare and contrast competing reactions using factors such as mechanistic differences, structural effects, steric effects, solvent effects, temperature, electronic effects, and conjugation and resonance.

   Essay exams

9. Predict the structural and stereochemical outcome of reactions where isomeric products are possible.

   Multiple Choice

10. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will arrange a series of related compounds in order of a given physical or chemical property.

    Multiple Choice

11. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will plan and then outline a synthesis of a given organic compound choosing from a limited variety of starting materials and utilizing the reactions studied.

    Other (specify)

    short answers

12. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will describe how to distinguish between different compounds using simple tests.

    Other (specify)

    short answers

13. For aromatic compounds, oxygen-containing and nitrogen-containing organic compounds, carbohydrates and amino acids the student will analyze infrared spectroscopy (IR) and nuclear magnetic resonance (NMR) spectra of a compound to its structural features and then predict its structure.

    Objective Exams

14. In the laboratory the student will set up and carry out several common reactions which illustrate single-step and multi-step syntheses and a variety of methods for running organic reactions.

    Other (specify)

    short answers

15. In the laboratory the student will collect data on unknown compounds by carrying out preliminary examinations, solubility tests, elemental analyses and chemical classification tests.

    Laboratory reports

16. In the laboratory the student will collect data on unknown compounds by measuring physical constants and recording IR spectra.

    Laboratory reports

17. In the laboratory the student will analyze data collected on unknown compounds to classify them by functional group and then to determine their structure.

Laboratory reports

III. OUTLINE OF SUBJECT MATTER (Topics are detailed enough to enable a qualified instructor to determine the major areas that should be covered as well as ensure consistency from instructor to instructor and semester to semester.)

Lecture or Lab	Approximate Hours	Topic Number	Major Topic
Lecture	6	I	Benzene and the concept of aromaticity A. Structure, nomenclature, and spectroscopy B. Huckel's rule and antiaromaticity C. Electrophilic aromatic substitution reactions of benzene and derivatives
Lecture	5	II	Aldehydes and Ketones A. Structure, nomenclature, and spectroscopy B. Physical properties C. Reactions
Lecture	5	III	Enols and Enolates A. Alpha-carbon acidity and enolate ion formation in carbonyl compounds B. Keto-enol tautomerism C. Reactions
Lecture	5	IV	Carboxylic Acids A. Structure, nomenclature, and spectroscopy B. Physical properties C. Reactions
Lecture	6	V	Carboxylic Acids Derivatives A. Structure, nomenclature, and spectroscopy B. Physical properties C. Reactions D. Fats and Oils
Lecture	5	VI	Amines and Their Derivatives A. Structure, nomenclature, and spectroscopy B. Physical properties C. Acid base properties D. Reactions
Lecture	5	VII	Phenols and Benzene Substituents A. Reactions
Lecture	3	VIII	Beta-dicarbonyl compounds A. Nomenclature B. Reactions
Lecture	6	IX	Carbohydrates A. Structure and nomenclature B. Structural representations of monosaccharides C. Optical activity D. Disaccharides and polysaccharides
Lecture	3	X	Heterocycles A. Nomenclature B. Aromaticity C. Reactions
Lecture	5	XI	Amino Acids, Peptides and Proteins A. Structure of biologically important amino acids B. Peptide bonds and polypeptides

			C. Introduction to protein structure and function
Lab	108	XII	Laboratory Experiments and Exercises such as: A. Qualitative Organic Analysis including: 1. Solubility and Element Unknowns 2. Chemical Classification Knowns 3. Computer Simulation 4. General Unknowns B. Several synthesis experiments utilizing common reactions such as electrophilic aromatic substitution, enamine, aldol condensation,carboxylic acid derivative hydrolysis and/or synthesis, etc. C. One or more Multi-step Synthesis D. Polarimetry: Measurement of Optical Rotation E. Chemical Properties of Carbohydrates F. Paper Chromatography of Amino Acids
Total Lecture Hours	54		
Total Laboratory Hours	108		
Total Hours	162		

IV. PRIMARY METHOD OF EVALUATION AND SAMPLE ASSIGNMENTS

A. **PRIMARY METHOD OF EVALUATION:**

Problem solving demonstrations (computational or non-computational)

B. **TYPICAL ASSIGNMENT USING PRIMARY METHOD OF EVALUATION:**

Cyclic anhydrides can be formed from only the cis-1,2-cyclopentane dicarboxylic acid, but from both the cis and trans-1,2-cyclohexandicarboxylic acids. In a short written answer and using complete sentences, explain how to account for this observation?

C. **COLLEGE-LEVEL CRITICAL THINKING ASSIGNMENTS:**

1. In complete sentences, explain how you would separate by chemical means a mixture of di-n-butyl ether and butanoic acid, recovering each component in reasonably pure form.
2. Provide the structures for compounds A through D in the following reactions:

   A. acetylene + CH_3MgBr --> A + CH_4

   B. A + CO_2 --> B + H^+ --> C

   C. C + H_20 + H_2SO_4 + $HgSO_4$ --> D

   D. D + $KMnO_4$ --> $CH_2(COOH)_2$

D. **OTHER TYPICAL ASSESSMENT AND EVALUATION METHODS:**

Objective Exams

Other exams

Quizzes

Written homework

Laboratory reports

Homework Problems

Multiple Choice

Completion

Matching Items

True/False

V. INSTRUCTIONAL METHODS

Discussion
Laboratory
Lecture
Multimedia presentations

Note: In compliance with Board Policies 1600 and 3410, Title 5 California Code of Regulations, the Rehabilitation Act of 1973, and Sections 504 and 508 of the Americans with Disabilities Act, instruction delivery shall provide access, full inclusion, and effective communication for students with disabilities.

VI. WORK OUTSIDE OF CLASS

Study
Answer questions
Skill practice
Required reading
Problem solving activities
Written work

Estimated Independent Study Hours per Week: 6

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Vollhardt and Shore. Organic Chemistry: Structure and Function. 7th ed. W. H. Freeman and Company, 2014.
Neil Shore. Study Guide and Solutions Manual for Organic Chemistry: Structure and Function. 7th ed. W. H. Freeman and Company, 2014.
Pavia, Lampman, Kriz and Engel. Introduction to Organic Laboratory Techniques: A Small Scale Approach. 2nd ed. Thompson/Brooks Cole, 2005.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**
Molecular Model Set for Organic Chemistry
Student Laboratory Notebook, Hayden-McNeil, spiral bound 100 carbonless duplicate sets
Department-Approved Goggles
Scientific Calculator

VIII. CONDITIONS OF ENROLLMENT

A. Requisites (Course and Non-Course Prerequisites and Corequisites)

Requisites	Category and Justification
Course Prerequisite Chemistry-7A	Sequential

B. Requisite Skills

Requisite Skills
For all major classes of organic compounds, the student should be able to: 1. Recognize the general formula and state the class name and vice-versa. 2. Identify the class to which a specific compound belongs and formulate specific examples for a given class. CHEM 7A - For all major classes of organic compounds, the student will: A. Recognize the general formula and state the class name and vice-versa. B. Identify the class to which a specific compound belongs and formulate specific examples for a given class.
For any given organic compound, the student should be able to: 1. Describe and illustrate the structure and bonding by: a. Constructing the Lewis structure. b. Sketching and labeling the molecular geometries within the molecule. c. Sketching and labeling the types of bonds and the overlap of hybrid orbitals. d. Comparing and contrasting bond polarities. e. Comparing and contrasting the conformations associated with the molecule. 2. Predict and explain properties in terms of structure and bonding. 3. Evaluate the molecule for the existence of structural and stereoisomers and draw formulas for all structural and stereoisomers. 4. Demonstrate knowledge of stereochemical concepts by: a. Locating all stereocenters in a stereoisomer. b. Deciding if a stereoisomer is chiral and if it is optically active. c. Classifying stereoisomers as enantiomers or disatereomers. 5. Analyze IR and proton NMR spectra of the compound to determine its structural features and then predict its structure. MS, UV and carbon-13 NMR spectra are also used. CHEM 7A - For any given organic compound, the student will: A. Describe and illustrate the structure and bonding by: 1. Constructing the Lewis structure. 2. Sketching and labeling the molecular geometries within the molecule. 3. Sketching and labeling the types of bonds and the overlap of hybrid orbitals. 4. Comparing and contrasting bond polarities. 5. Comparing and contrasting the conformations associated with the molecule. B. Predict and explain properties in terms of structure and bonding. C. Evaluate the molecule for the existence of structural and stereoisomers and draw formulas for all structural and stereoisomers. D. Demonstrate knowledge of stereochemical concepts by: 1. Locating all stereocenters in a stereoisomer. 2. Deciding if a stereoisomer is chiral and if it is optically active. 3. Classifying stereoisomers as enantiomers or disatereomers. E. Analyze IR and proton NMR spectra of the compound to determine its structural features and then predict its structure. MS, UV and carbon-13 NMR spectra are used to a lesser extent.
For the major classes of aliphatic hydrocarbons and of organic halides, alcohols and ethers, the student should be able to: 1. Draw a structure given a specific name and vice-versa. 2. List the most common and important compounds. 3. Determine products given reactants and vice-versa for common and/or important reactions. 4. Demonstrate an extensive knowledge for many of the reactions studied by: a. Writing mechanisms, particularly those involving radical or carbocation intermediates. b. Explaining how kinetic studies and energy measurements are used to support or disprove a proposed mechanism. c. Comparing and contrasting competing reactions using factors such as mechanistic differences, structural effects, steric effects, solvent effects, temperature, electronic effects, and conjugation and resonance. d. Predicting the structural and stereochemical outcome of reactions where isomeric products are possible. 5. Arrange a series of related compounds in order of a given physical or chemical property. 6. Plan and then outline a synthesis of a given organic compound choosing from a limited variety of starting materials and utilizing the reactions studied. 7. Describe how to distinguish between different compounds using simple tests. CHEM 7A - For the major classes of aliphatic hydrocarbons and of organic halides, alcohols and ethers, the student will: A. Draw a structure given a specific name and vice-versa. B. List the most common and/or important compounds. C. Determine products given reactants and vice-versa for common and/or important reactions. D. Demonstrate an extensive knowledge for many of the reactions studied

by: 1. Writing mechanisms, particularly those involving radical or carbocation intermediates. 2. Explaining how kinetic studies and energy measurements are used to support or disprove a proposed mechanism. 3. Comparing and contrasting competing reactions using factors such as mechanistic differences, structural effects, steric effects, solvent effects, temperature, electronic effects, and conjugation and resonance. 4. Predicting the structural and stereochemical outcome of reactions where isomeric products are possible. E. Arrange a series of related compounds in order of a given physical or chemical property. F. Plan and outline a synthesis of a given organic compound choosing from a limited variety of starting materials and utilizing the reactions studied. G. Describe how to distinguish between different compounds using simple tests.
In the laboratory the student should be able to: 1. Carry out fundamental organic laboratory techniques by separating mixtures and/or purifying compounds using recrystallization, extraction, chromatography (including column, gas, paper, and thin layer chromatography), and distillation (including simple, fractional, and steam distillation). 2. Set up and carry out several common reactions which illustrate a variety of methods for running organic reactions. 3. Record IR spectra using an infrared spectrometer. CHEM 7A - In the laboratory the student will: A. Learn and practice fundamental organic laboratory techniques by separating mixtures and/or purifying compounds using recrystallization, extraction, chromatography (including column, gas, paper, and thin layer chromatography), and distillation (including simple, fractional, and steam distillation). B. Set up and carry out several common reactions which illustrate a variety of laboratory techniques. C. Record IR spectra using an infrared spectrometer.

C. Recommended Preparations (Course and Non-Course)

Recommended Preparation	Category and Justification

D. Recommended Skills

Recommended Skills

E. Enrollment Limitations

Enrollment Limitations and Category	Enrollment Limitations Impact

Course created by Robert W. Long on 02/01/1965.

BOARD APPROVAL DATE:

LAST BOARD APPROVAL DATE: 08/17/2015

Last Reviewed and/or Revised by Soshanna Potter on 03/07/2015

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