El Camino College

COURSE OUTLINE OF RECORD - Official

I. GENERAL COURSE INFORMATION

Subject and Number: Chemistry 21B
Descriptive Title: Survey of Organic and Biochemistry

Course Disciplines: Chemistry

Division: Natural Sciences

Catalog Description: The study of organic chemistry continues with the nomenclature, properties, preparation, reactions and derivatives of carboxylic acids, amines, aldehydes and ketones. Principles of biochemistry are introduced. Descriptions of the structures and biochemical reactions of carbohydrates, lipids, proteins, enzymes and nucleic acids will be analyzed. Catabolic/anabolic pathways as well as the energy consumed or produced by the metabolism of carbohydrates, fats and proteins will be examined. The chemistry of photosynthesis will be studied.

*Note: Students will not receive UC credit for Chemistry 21B if taken after Chemistry 7B.

Conditions of Enrollment: **Prerequisite**

Chemistry 21A with a minimum grade of C

Course Length: [X] **Full Term** [ ] **Other (Specify number of weeks):**
Hours Lecture: **4.00 hours per week** [ ] **TBA**
Hours Laboratory: **2.00 hours per week** [ ] **TBA**
Course Units: **4.00**

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: 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. On a written exercise, given the structures of reactants for a reaction, students will be able to write the correct structures of products and identify the reaction type.
2. Students will be able to create (via molecular models or drawings) accurate representations of compounds. The representations will contain appropriate bonds, lone pairs, and geometry.
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. The student will be able to write a name given a structure and vice-versa for the following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones.

   Completion
2. The student will be able to state common sources for the following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones.

   Completion
3. The student will be able to write equations for common equations for common reactions and methods of preparations for following: amines, esters, hydrocarbons, carboxylic acids, carboxylic acid derivatives, aldehydes and ketones.

   Completion
4. Identify the type of mechanism used in common organic chemistry reactions as either concerted, carbocation or carbanion and illustrate the mechanism for representative reactions studied.

   Objective Exams
5. The student will be able to draw the chain structures for the following: carbohydrates, lipids, proteins and nucleic acids.

Objective Exams

6. The student will be able to write equations for common reactions involving carbohydrates, lipids, proteins and nucleic acids.

   Objective Exams

7. Explain the Krebs cycle in terms of the structural changes involved in each step of the cycle, the energy produced by the cycle, and the places in the Krebs cycle where other cycles enter or leave the Krebs cycle.

   Essay exams

8. Discuss the genetic processes of replication, transcription and translation in terms of the structural changes involved.

   Essay exams

9. Analyze the effect of pH, temperature, concentration of substrate and concentration of enzyme on the ability of any enzyme to function normally.

   Multiple Choice

10. Name an enzyme on the basis of its function.

    Completion

11. Discuss how adenosine triphosphate (ATP) is made in the mitochondrion, the function of reduced nicotinamide adenine dinucleotide (NADH) and reduced flavin adenine dinucleotide (FADH) in this process and where the energy is stored in ATP.

    Quizzes

12. Analyze carbohydrate, lipid and protein metabolism (catabolism and anabolism) in terms of the structural changes involved in each step of these processes, ATP input and production and function of each process.

    Objective Exams

13. Demonstrate proficiency in basic laboratory skills, taking and recording observations of chemical systems, recording and interpretation of quantitative experimental data.

    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	4.5	I	Review of organic chemistry A. Nomenclature of hydrocarbons B. Bonding C. Chemical reactions D. Functional groups E. Equilibria F. Acid theories
Lecture	6	II	Carboxylic Acids and Acid Derivatives, Esters A. Common and IUPAC nomenclature B. Preparations and reactions of acid deriatives C. Diacids - through glutaric acid
Lecture	6	III	Aldehydes and Ketones A. Important structural features B. Common and IUPAC nomenclature

			C. Preparation 1. Hydrolysis of alkenes 2. Oxidation of alcohols D. Reactions 1. Redox 2. Nucleophilic addition of ROH 3. Claisen condensation
Lecture	1.5	IV	Amines and Amides A. Common and IUPAC nomenclature B. Acid-base reactions of amines C. Preparation and reactions of amides
Lecture	3	V	Introduction to Biochemistry A. General characteristics of biomolecules B. Bioenergetics C. Electron transport chain - chemiosmotic theory
Lecture	7	VI	Carbohydrates A. Introduction B. Monosaccharides 1. Classification 2. Characteristics of each class 3. Ring structures 4. Reactions C. Disaccharides 1. Important examples - maltose, lactose, cellobiose, sucrose 2. Characteristics of each example D. Polysaccharides 1. Definition 2. Important examples - starch, glycogen, cellulose 3. Characteristics of each example E. Tests for Carbohydrate classes
Lecture	6	VII	Lipids A. Definition B. Classification and structure 1. Simple - waxes and triacylgycerols 2. Complex - phospholipids and gylcolipids 3. Others - steroids, prostaglandins, fat soluble vitamins C. Soaps and detergents
Lecture	7	VIII	Proteins A. Definition B. Amino Acids - structure, effect of pH, isoelectric point, classification by R groups, reactions C. Peptide bond D. Proteins - definition, methods of classification, structural levels, primary structure determination, denaturation

Lecture	4	IX	Nucleic Acids A. Definition B. Mononucleotide - structure, linkages C. Nucleic acids - definition, nomenclature, structural levels D. RNA - types and functions E. Genetic processes - replication, transcription, translation F. Genetic code and Mutations
Lecture	6	X	Enzymes A. Definition B. Classification - by hydrolysis, IUB, traditional grouping C. Special enzymes D. Factors affecting activity - temperature, pH, concentration of substrate and of enzyme E. Enzyme inhibition - competitive and non-competitive F. Theories of how enzymes work - lock and key, induced fit
Lecture	5	XI	Carbohydrate Metabolism:Catabolism A. Digestion - steps and enzymes involved B. Glycolysis - structures and enzymes, ATP bookkeeping C. Krebs cycle (Citric Acid Cycle)
Lecture	4	XII	Lipid Metabolism: Catabolism A. Digestion - steps and enzymes involved B. Beta-oxidation cycle - steps, enzymes, structures, ATP bookkeeping C. Ketosis - definition, dangers of, causes of, steps involved
Lecture	3	XIII	Protein Metabolism: Catabolism A. Digestion, catabolism of amino acids, urea cycle
Lecture	5	XIV	Carbohydrates Metabolism: Anabolism A. Pentose phosphate shunt B. Gluconeogenesis C. Glycogenesis D. Glycogenolysis
Lecture	4	XV	Lipids Metabolism: Anabolism A. Synthesis of fatty acids B. Synthesis of fat
Lab	36	XVI	Laboratory Experiments: (select 8-10 experiments) A. Laboratory safety in the organic lab B. Characteristics of organic compounds 1. Nomeclature 2. Structures 3. Drawings C. Reactions involving Alcohols and Phenols D. Reactions involving Preparation of Aspirin E. Reactions involving Aldehydes, Ketones, and Carboxylic acids F. Introduction to carbohydrates

			G. Reactions involving Saponification of Triglycerides H. Introduction to Proteins I. Separation of Amino acids J. Introduction to Enzymes
Total Lecture Hours	72		
Total Laboratory Hours	36		
Total Hours	108		

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:**

The following proteins have the same molecular weight and size. The pI of each is: carboxypeptidase(6.0), pepsin(1.0), growth hormone(6.9) and ovalbumin (4.6). a. State whether each is (+) charged, (-) charged or uncharged at pH = 6.0. b. Draw an electrophoresis diagram of the mixture of the four proteins at pH = 6.0.

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

1. In the space provided, describe how the amino acids proline and lysine are related to the disease condition called scurvy.
2. Write a mechanism for the reaction of butanal with n-propyl alcohol in the presence of hydrogen chloride.

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

Essay exams

Performance exams

Objective Exams

Other exams

Quizzes

Written homework

Laboratory reports

Homework Problems

Multiple Choice

Completion

Matching Items

True/False

V. INSTRUCTIONAL METHODS

Demonstration
Discussion
Laboratory
Lecture

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
Required reading
Problem solving activities
Written work
Other (specify)
Reduced the study hours from 8 to 7 with the understanding that the 2 hours of lab was instrumental in supporting the lecture material.

Estimated Independent Study Hours per Week: 7

VII. TEXTS AND MATERIALS

A. **UP-TO-DATE REPRESENTATIVE TEXTBOOKS**
Seager and Slabaugh. Chemistry for Today: General, Organic and Biochemistry. 8th ed. Thomson, 2014.
Campbell and Wolf. Chemistry 21B Supplement. STS Printing, 1996.
Peller. Exploring Chemistry: Laboratory Experiments in General, Organic, and Biological Chemistry. 3rd ed. Prentice Hall, 2011.

B. **ALTERNATIVE TEXTBOOKS**

C. **REQUIRED SUPPLEMENTARY READINGS**

D. **OTHER REQUIRED MATERIALS**
Scientific Calculator
Safety Goggles

VIII. CONDITIONS OF ENROLLMENT

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

Requisites	Category and Justification

Course Prerequisite Chemistry-21A	Sequential

B. Requisite Skills

Requisite Skills
Use the language of general chemistry (vocabulary, nomenclature, formulas and equations) to describe chemical systems and changes (physical and chemical) they undergo. CHEM 21A - Use the language of general chemistry (vocabulary, nomenclature, formulas and equations) to describe chemical systems and changes (physical and chemical) they undergo.
Describe the structure of the atom in terms of the arrangement of subatomic particles and electronic configuration. CHEM 21A - Describe the structure of the atom in terms of the arrangement of subatomic particles and electronic configuration.
Utilize the principles of bonding to identify types of bonding, write Lewis structures, predict molecular geometry, bond angles and polarity. CHEM 21A - Explain the difference between ionic and covalent bonding and write Lewis structures for molecules and polyatomic ions.
Describe the bonding and geometry of carbon compounds in terms of hybridization and type of bonding orbital overlap (pi or sigma). CHEM 21A - Explain the difference between ionic and covalent bonding and write Lewis structures for molecules and polyatomic ions.CHEM 21A - Predict molecular geometry, bond angles and polarity.CHEM 21A - Analyze the bonding and geometry of carbon compounds in terms of hybridization and type of bonding orbital overlap (pi or sigma).
Solve introductory level quantitative problems applied to chemical systems by using dimensional analysis and algebra. CHEM 21A - Solve introductory level quantitative problems applied to chemical systems by using dimensional analysis and algebra. These problems include unit conversions, stoichiometry, gas laws, solution concentrations, and pH.
Identify types of intermolecular forces and how they relate to properties. CHEM 21A - Describe the properties of solids, liquids, gases and solutions and relate them to bonding and intermolecular forces.
Discuss the factors which affect the rate of reactions and apply Le Chatelier's Principle to equilibria. CHEM 21A - Discuss the factors which affect the rate of reactions and apply Le Chatelier's Principle to equilibria.
Identify types of acids and bases and interpret elementary acid-base equilibria. CHEM 21A - State the properties and definitions of acids and bases and interpret elementary acid-base equilibria.
Name and write equations for the preparation and important reactions of alkanes, alkenes, alkynes, alcohols and ethers. CHEM 21A - Determine the nomenclature and write equations for the preparation and important reactions of alkanes, alkenes, alkynes, alcohols and ethers.
Name common aromatic compounds and describe the structure and resonance of these compounds. CHEM 21A - State the names of common aromatic compounds and describe the structure and resonance of these compounds.
Identify a chiral center in an organic compound. CHEM 21A - Identify a chiral center in an organic compound, identify the different enantiomers.
Show how selected organic reactions take place by using reaction mechanisms. CHEM 21A - Devise mechanisms to show how selected organic reactions take place.
For laboratory: Be able to use common laboratory equipment including pipets, burets, balances and burners. Take and record observations of chemical systems and interpret qualitative and quantitative experimental data. Understand the rules and procedures for laboratory safety. CHEM 21A - Use common laboratory glassware and equipment.CHEM 21A - State and apply the rules and procedures for laboratory safety.CHEM 21A - Demonstrate the ability to use basic laboratory skills such as taking and recording observations of chemical systems and interpreting qualitative and quantitative experimental data.

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 Jack L. Wolf on 11/08/1971.

BOARD APPROVAL DATE:

LAST BOARD APPROVAL DATE: 10/19/2015

Last Reviewed and/or Revised by Soshanna Potter on 01/15/2015

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