MiraCosta College

CHEM 102 - INTRODUCTION TO ORGANIC AND BIOLOGICAL CHEMISTRY

Units Lecture	3.00	**Units Lab**	1.00	**Units Total**	4.00
Total Hrs Lecture	49.50	**Total Hrs Lab**	49.50	**Total Course Hrs**	99.00

COURSE DESCRIPTION

This course introduces organic chemistry and is designed for students pursuing health professions. Topics include nomenclature, bonding, isomerization, reaction mechanisms, and instrumental methods of interpreting aliphatic and aromatic compounds as well as the structure and reactions of carbohydrates, proteins, lipids, nucleic acids, enzymes, and metabolic functions. UC CREDIT LIMITATION: Credit for CHEM 102 or 104. No credit if taken after CHEM 210.

ENROLLMENT RESTRICTIONS

PREREQUISITES	***COREQUISITES***	***ADVISORIES***
CHEM 100 or CHEM 108		

OUTLINE OF COURSE CONTENT

The course will address the following topics:

Lecture:

I. Introduction to organic chemistry
A. Organic compounds
B. Alkanes
C. Alkanes with substituents
D. Properties of alkanes
E. Functional groups.

II. Alkenes, alkynes, and aromatic compounds
A. Alkenes and alkynes
B. Cis-trans isomers
C. Addition reactions
D. Polymers of alkenes
E. Aromatic compounds.

III. Alcohols, phenols, thiols, and ethers
A. Alcohols, phenols, and thiols
B. Ethers
C. Physical properties of alcohols, phenols, and ethers
D. Reactions of alcohols and thiols.

IV. Aldehydes, ketones, and chiral molecules
A. Aldehydes and ketones
B. Physical properties of aldehydes and ketones
C. Oxidation and reduction of aldehydes and ketones
D. Addition reactions of aldehydes and ketones
E. Chiral molecules.

V. Carbohydrates
A. Carbohydrates
B. Fischer projections of monosaccharides
C. Haworth structures of monosaccharides
D. Chemical properties of monosaccharides
E. Dissacharides
F. Polysaccharides.

VI. Carboxylic acids and esters
A. Carboxylic acids

B. Properties of carboxylic acids
C. Esters
D. Naming esters
E. Properties of esters.

VII. Lipids
A. Lipids
B. Fatty acids
C. Waxes, fats, and oils
D. Chemical properties of triacylglycerols
E. Glycerophospholipids
F. Sphingolipids
G. Steroids: cholesterol, bile salts, and steroid hormones
H. Cell membranes.

VIII. Amines and amides
A. Amines
B. Properties of amines
C. Heterocyclic amines and alkaloids
D. Amides
E. Hydrolysis of amides.

IX. Amino acids and proteins
A. Proteins and amino acids
B. Amino acids and zwitterions
C. Formation of peptides
D. Protein structure: primary and secondary levels
E. Protein structure: tertiary and quaternary levels
F. Protein hydrolysis and denaturation.

X. Enzymes and vitamins
A. Enzymes
B. Enzyme action
C. Factors affecting enzyme activity
D. Enzyme inhibition
E. Regulation of enzyme activity
F. Enzyme cofactors and vitamins.

XI. Nucleic acids and protein synthesis
A. Components of nucleic acids
B. Primary structure of nucleic acids
C. DNA double helix
D. DNA replication
E. RNA and transcription
F. Genetic code
G. Protein synthesis: translation
H. Genetic mutations
I. Recombinant DNA
J. Viruses.

XII. Metabolic pathways
A. Metabolism and cell structure
B. Adenosine triphosphate (ATP) and energy

C. Important coenzymes in metabolic pathways
D. Digestion of carbohydrates
E. Glycolysis: oxidation of glucose
F. Pathways for pyruvate
G. Glycogen metabolism
H. Gluconeogenesis: glucose synthesis.

XIII. Metabolism and energy production
A. Citric acid cycle
B. Electron carriers
C. Electron transport
D. Oxidative phosphorylation and ATP
E. ATP energy from glucose.

XIV. Metabolic pathways for lipids and amino acids
A. Digestion of triacylglycerols
B. Oxidation of fatty acids
C. ATP and fatty acid oxidation
D. Ketogenesis and ketone bodies
E. Fatty acid synthesis
F. Digestion of proteins
G. Degradation of amino acids
H. Urea cycle
I. Fates of the carbon atoms from amino acids
J. Synthesis of amino acids.

Laboratory:
Lab investigations are designed to be hands-on, collaborative activities that support and complement accompanying lecture theories. All topics addressed in lecture are applied and extended in the lab component. In addition the lab component addresses the following:

I. Introduction to the lab environment (lab safety, metric system, scientific inquiry)

II. Molecular models and structures

III. Properties of hydrocarbons, alcohols, aldehydes, and ketones

IV. Identification of properties, distillation, sublimation, extractions, preps, spectral ID, molecular models of organic and biological molecules

V. Syntheses of carboxylic acids and esters (aspirin)

VI. Synthesis of an amide polymer (nylon)

VII. Saponification and making soap

PERFORMANCE OBJECTIVES
Upon successful completion of this course, students will be able to do the following:
1). Identify the compounds of carbon and recognize the importance of organic chemistry to other science subjects
2). Identify organic formulas and relate organic nomenclature to different functional groups, with special application to biological molecules
3). Write the important reactions in the preparation of compounds and predict the outcomes of the reactions
4). Assemble molecular models; investigate stereochemistry, molecular shapes, configurations, and conformations of organic molecules
5). Prepare organic compounds; analyze the properties of representative compounds
6). Evaluate instrumental results of organic analysis

7). Describe and analyze the structures of organic molecules in biochemistry, especially carbohydrates, lipids, amino acids, proteins, nucleic acids, and viruses
8). Relate organic and biochemistry to our life processes, foods, medicines, energy, and so many other compounds we use every day
9). Analyze the many biochemical processes that are required for a living organism to survive.

READING ASSIGNMENTS

Reading assignments will be consistent with, but not limited by, the following types and examples:

1). For each chapter, read respective textbook, noting the introduction and use of relevant terminology and support
2). Read assigned section of the lab manual for detailed instructions on laboratory activities for successful lab completion
3). Read articles from scientific magazines, reliable Internet sites, or lay but serious magazines to correlate and extend the lecture content to modern advances in chemistry and to write a research paper on bioethics.

WRITING ASSIGNMENTS

Writing assignments will be consistent with, but not limited by, the following types and examples:

1). Prepare short written responses to homework assignments that require analysis and/or assimilation of facts based on textbook readings and /or lecture content
2). Document laboratory exercises as written notebook entries while performing each lab activity
3). Present simple mathematical computations and summative statements (written interpretations/conclusions) as lab activity reports.

OUTSIDE-OF-CLASS ASSIGNMENTS (READING/WRITING/OTHER)

Outside-of-class assignments will be consistent with, but not limited by, the following types and examples:

1). Complete extensive reading assignments, in particular with regard to the assigned textbook
2). Complete extensive writing assignments directly related to homework or research papers
3). Study specific course material (chemical reactions, spectral identification), including reviewing lecture notes and related textbook readings and accessing publisher-provided supporting materials (such as websites, study guides, and practice test questions) or other instructor-provided study materials
4). Write a research paper on bioethics or other relevant topics followed by an in-class presentation of the topic to the entire class.

STUDENT LEARNING OUTCOMES

	Learning Outcome	*Mode of Assessment*
1.	Students will use knowledge of chemical reactivity of organic functional groups and molecular structures to predict and explain structures of new compounds formed.	On a short answer question on exam, students will be given a series of simple organic chemistry reactions and instructed to fill out missing reactants and/products when given reaction conditions.
2.	Students will use knowledge of peptide bonding, intermolecular forces and protein structures to predict and explain the structure of a given protein.	Written essay question on exam, including cause and effect reasoning. Students will be given a protein structure and instructed to list and describe the chemical bonding primarily responsible for maintaining that protein structure.
3.	Students will use knowledge of intermolecular forces and molecular structures to predict and explain differences in the boiling points and the existence of a trend.	Written essay question on exam, including cause and effect reasoning. Students will be given a series of organic compounds with similar molar masses and instructed to rank them in order of increasing boiling points and explain the ranking trend.

METHODS OF INSTRUCTION

Instructional methodologies will be consistent with, but not limited by, the following types or examples:

1). Lecture presentation and classroom discussions using the language of chemistry
2). Individual presentations of out-of-class research followed by in-class discussions
3). Laboratory lecture presentations and discussions using the language of chemistry
4). Instructor-guided demonstrations of equipment, procedures, and techniques.

METHODS OF EVALUATION

Evaluation methodologies will be consistent with, but not limited by, the following types or examples:

1). Objective examinations designed to assess acquisition of facts, mastery of chemical vocabulary, computational abilities, acquisition of lab skills, interpretation of experimental findings as well as more in-depth knowledge of subject matter as demonstrated by successful critical thinking related to the discipline (quizzes, tests, class performance)
2). Evaluation of other assignments (assigned papers and oral presentations; a bioethics, or similar, report is required of all students)
3). Lab examinations that assess mastery of lab procedure and interpretation of physical and chemical properties of chemical compounds
4). Evaluation of laboratory performance based on observation and/or written documents (lab notebook).

REQUIRED TEXTBOOKS

Examples of typical textbooks for this course include the following:

1). Timberlake, Karen C. General, Organic and Biological Chemistry: Structures of Life. 3rd ed., Prentice Hall, 2010. ISBN: 978-0136054542
2). Seager, Spencer L., and Michael R. Slabaugh. Chemistry for Today: General, Organic, and Biochemistry. 6th ed., Brooks Cole, 2007. ISBN: 978-0495112822
3). Hein, Morris, Scott Pattison, Susan Arena, and Leo R. Best. Introduction to General, Organic, and Biochemistry. 10th ed., Wiley, 2010. ISBN: 978-0470598801.

OTHER REQUIRED INSTRUCTIONAL MATERIALS

1). The laboratory experiments are available to students online from instructor's webpage
2). Scientific calculator.

COURSE REPEATABILITY

Total Completions Allowed:
1

In Combination With: