

# ILLINOIS VALLEY COMMUNITY COLLEGE



## COURSE OUTLINE

**DIVISION: Natural Sciences and Business**

**COURSE: CHM 1005: Survey of Organic and Biochemistry**

Date: 7/2/2019

Credit Hours: 4

Prerequisite(s): CHM 1004 (or its equivalent) with grade of C or better

Delivery Method:

<input checked="" type="checkbox"/> Lecture	3 Contact Hours (1 contact = 1 credit hour)
<input type="checkbox"/> Seminar	0 Contact Hours (1 contact = 1 credit hour)
<input checked="" type="checkbox"/> Lab	3 Contact Hours (2-3 contact = 1 credit hour)
<input type="checkbox"/> Clinical	0 Contact Hours (3 contact = 1 credit hour)
<input type="checkbox"/> Online	
<input type="checkbox"/> Blended	

Offered:  Fall  Spring  Summer

IAI Equivalent –**Only for Transfer Courses**–go to <http://www.itransfer.org>: P1 902L

### CATALOG DESCRIPTION:

This course is designed to provide students with the knowledge and skills needed for Allied Health, Agriculture, and other related majors. It covers the fundamentals of Organic Chemistry with emphasis on nomenclature, isomerism, properties and reactions of different classes of organic compounds such as alkanes, alkenes, alkynes, arenes, alkyl halides, alcohols/thiols, aldehydes & ketones, amines, carboxylic acids and derivatives. In addition, the course provides an overview of biochemical topics such as amino acids, proteins, carbohydrates, lipids, enzymes, vitamins, generation of biochemical energy, nucleic acids and proteins

## GENERAL EDUCATION GOALS ADDRESSED

*[See last page for Course Competency/Assessment Methods Matrix.]*

### Upon completion of the course, the student will be able:

*[Choose up to three goals that will be formally assessed in this course.]*

- To apply analytical and problem solving skills to personal, social and professional issues and situations.
- To communicate successfully, both orally and in writing, to a variety of audiences.
- To develop an awareness of the contributions made to civilization by the diverse cultures of the world.
- To understand and use contemporary technology effectively and to understand its impact on the individual and society.
- To work and study effectively both individually and in collaboration with others.
- To understand what it means to act ethically and responsibly as an individual in one's career and as a member of society.
- To develop and maintain a healthy lifestyle physically, mentally, and spiritually.
- To appreciate the ongoing values of learning, self-improvement, and career planning.

### EXPECTED LEARNING OUTCOMES AND RELATED COMPETENCIES:

*[Outcomes related to course specific goals. See last page for more information.]*

### Upon completion of the course, the student will be able to:

1. Appreciate the versatility of carbon atoms and the remarkable array of compounds they can form and to demonstrate an understanding of the International Union of Pure and Applied Chemistry (IUPAC) rules of nomenclature associated with the fields of organic and biochemistry
2. Demonstrate an ability to recognize and predict the chemical behavior of organic compounds with different functional groups: alkanes, alkenes, alkynes, arenes, aldehydes, alcohols, thiols, sulfides, ethers, phenols, alkylhalides, ketones, carboxylic/derivatives, and amines
3. Demonstrate an understanding of what Biochemistry is all about, and how the structure and functional groups present in amino acids/proteins, carbohydrates, lipids, enzymes, vitamins etc., contribute to their function
4. Demonstrate an understanding of how biochemical energy is generated in the body
5. Conduct basic laboratory techniques in organic and biochemistry, and to practice them safely

## COURSE TOPICS AND CONTENT REQUIREMENTS:

**Outcome 1.** *to appreciate the versatility of carbon atoms and the remarkable array of compounds they can form and to demonstrate an understanding of the IUPAC rules of nomenclature associated with the fields of organic and biochemistry*

- 1.1. Students will be able to draw structural formulas based on molecular and line structures
- 1.2. Students will be able to draw isomeric structures from molecular formulae
- 1.3. Students will be able to name alkanes and cycloalkanes, given the structure, and to draw structures, given the name
- 1.4. Students will understand that organic biochemical compounds may contain nitrogen, oxygen, and halogen atoms in addition to carbon and hydrogen

**Outcome 2:** To demonstrate an ability to recognize and predict the chemical behavior of organic compounds with different functional groups: alkanes, alkenes, alkynes, arenes, alcohols, ethers, phenols, sulfides, alkylhalides, aldehydes, ketones, carboxylic/derivatives, and amines

- 2.1. Students will be able to use functional groups to classify organic molecules into families
- 2.2. Students will be able to predict the physical properties of alkanes, alkenes, alkynes, arenes, aldehydes, ketones, carboxylic acids/derivatives and amines
- 2.3. Students will be able to write the combustion and free radical substitution reactions of alkanes
- 2.4. Students will understand and be able to write addition reactions of alkenes and alkynes with halogens, hydrogen halides, water; and the formation of halohydrins with alkenes
- 2.5. Students will understand the concept of aromaticity with benzene and conjugated compounds
- 2.6. Students will be able to write electrophilic aromatic substitution reactions such as halogenations, nitration, sulfonation, Friedel-Crafts alkylation and acylation
- 2.7. Students will be able to describe the structures and uses of alcohols, phenols, ethers, thiols, and alkyl halides
- 2.8. Students will be able to give appropriate names for alcohols, phenols, ethers, thiols, and alkyl halides
- 2.9. Students will be able to understand the properties (such as polarity, H-bonding, and solubility) of alcohols, phenols, ethers, thiols, and alkyl halides
- 2.10. Students will be able to understand why alcohols and phenols are weak acids
- 2.11. Students will be able to predict and describe the products of dehydration of alcohols and oxidation of alcohols and thiols
- 2.12. Students will be able to demonstrate understanding of the occurrence and use of aldehydes and ketones
- 2.13. Students will be able to describe and predict the products of redox reactions of aldehydes and ketones,
- 2.14. Students will be able to recognize acetals and hemiacetals and show the conditions under which they form, as well as the products
- 2.15. Students will be able to identify the general occurrences and important members of acids, esters, and amides

- 2.16. Students will be able to show how acid chlorides, acid anhydrides, esters and amides are synthesized and the reactions they undergo
- 2.17. Students will be able to recognize and draw structures of phosphate esters
- 2.18. Students will be able to recognize the several kinds of alkyl, aryl, and heterocyclic amines
- 2.19. Students will be able to name amines and draw their structures
- 2.20. Students will understand the general properties of amines, particularly the effects on solubility, boiling point, hydrogen bonding, and acid-base interactions
- 2.21. Students will be able to write equations showing acid-base interactions of amines
- 2.22. Students will understand the importance of some alkaloids and to identify properties typical of amines

**Outcome 3.** To demonstrate an understanding of what Biochemistry is all about, and how the structure and functional groups present in amino acids/proteins, carbohydrates, lipids, enzymes, and vitamins contribute to their function

- 3.1. Students will appreciate how biochemistry unites the studies of medicine, nutrition, pharmacy, and many areas of biology.
- 3.3. Students will appreciate how biomolecules vary greatly in size and function and are equipped to carry out specific actions, but each molecule is made up of a carbon skeleton having specific functional groups that exhibit predictable properties.
- 3.4. Students will be able to recognize and describe amino acid structures and their bonding in proteins
- 3.5. Students will be able to understand how amino acid identity and structure depend on side chains and pH
- 3.6. Students will be able to define primary structure and understand how linkage of amino acids forms the primary structure of proteins
- 3.7. Students will be able to describe the types of bonding that stabilize secondary structures of proteins, understand how tertiary and quaternary structures are formed and stabilized.
- 3.8. Students will be able to understand protein hydrolysis and denaturation and some agents that cause denaturation
- 3.9. Students will be able to understand how enzymes are similar to traditional catalysts and how they act in chemical reactions
- 3.10. Students will be able to describe substrate, product, and enzyme interaction
- 3.11. Students will be able to understand the effects of temperature, pH, and enzyme and substrate concentration on rates of reaction
- 3.12. Students will be able to discuss the two major classes of vitamins, dietary necessity, and deficiencies
- 3.13. Students will be able to define the major classes of carbohydrates and place examples in the correct category
- 3.14. Students will be able to understand how chirality influences the biological use of carbohydrates
- 3.15. Students will understand how to represent open-chain and cyclic monosaccharide structures and explain relationships between them
- 3.16. Students will be able to recognize monosaccharide acetals and glycosidic bonds and to be able to identify reducing sugars and predict the products of their oxidation

- 3.17. Students will be able to identify disaccharides, monosaccharide components, and the types of linkages
- 3.18. Students will be able to understand how some complex carbohydrates function in biochemical applications
- 3.19. Students will be able to describe structures of starch, cellulose, and glycogen, their monosaccharide components and metabolic fates
- 3.20. Students will be able to understand chemical structures and properties of fatty acids, waxes, and fatty acid esters
- 3.21. Students will be able to describe hydrogenation and hydrolysis of triacylglycerols
- 3.22. Students will be able to identify membrane lipids and describe their structures and functions

**Outcome 4.** To demonstrate an understanding of how Biochemical energy is generated in the body

- 4.1. Students will be able to list the stages of catabolism and describe the role of each stage
- 4.2. Students will be able to understand how the citric acid cycle functions in energy production
- 4.3. Students will be able to describe the electron transport chain and its coupling to oxidative phosphorylation
- 4.4. Students will be able to identify some harmful by-products produced from oxygen and what protects against them

**Outcome 5.** Be introduced to the laboratory techniques used in organic and biochemistry, and to practice them safely

- 5.1. Students will be able to use physical and chemical properties to identify an unknown hydrocarbon
- 5.2. Students will be able to use characteristic chemical reactions to distinguish between alcohols and phenols
- 5.3. Students will be able to distinguish between aldehydes and ketones using characteristic chemical tests and the formation of derivatives
- 5.4. Students will demonstrate the solubility and acidity of carboxylic acids, prepare a variety of esters and note their odors, and demonstrate saponification
- 5.5. Students will be able to synthesize aspirin in the laboratory
- 5.6. Students will be acquainted with the conceptual and physical distinction between monomers and polymers, and be able to perform the synthesis of nylon by condensation polymerization
- 5.7. Students will be able to learn extraction techniques by extracting caffeine from tea leaves
- 5.8. Students will become familiar with reducing or nonreducing nature of carbohydrates and will compare monosaccharides, disaccharides and polysaccharides
- 5.9. Students will learn how to prepare a simple soap and investigate its properties
- 5.10. Students will be able to isolate and identify casein
- 5.11. Students will be able to demonstrate the separation of DNA from other cell constituents in onion and to prove their identity

## **INSTRUCTIONAL METHODS:**

- Lecture
- Problem solving
- Discussions
- Reading assignments
- Written assignments
- Laboratory Experiments
- Peer tutoring
- Cooperative learning exercises

## **INSTRUCTIONAL MATERIALS:**

1. Texts
  - Fundamentals of General, Organic and Biochemistry, John McMurray, Mary E. Castellion, and D. S. Ballentine, Pearson Prentice Hall, 7<sup>th</sup> edition, January, 2012
  - Laboratory experiments for General, Organic and Biochemistry; F. A. Bettelheim, J. M. Landesberg, Cengage Learning, 2012
2. Computer animations
3. Online homework/quiz system
4. Laboratory kits
5. Reference/learning material developed by the instructor
6. Chemical Splash Goggles
7. Molecular Model kits
8. Blackboard on-line management system

## **STUDENT REQUIREMENTS AND METHODS OF EVALUATION:**

1. Textbook and supplies
  - a. Fundamentals of General, Organic and Biochemistry, John McMurray, Mary E. Castellion, and D. S. Ballentine, Pearson Prentice Hall, 7<sup>th</sup> edition, January, 2012
  - b. Laboratory experiments for General, Organic and Biochemistry; F. A. Bettelheim, J. M. Landesberg, Cengage Learning, 2012
  - c. Chemical Splash Goggles
2. Lecture and laboratory attendance
3. Reading assignments
4. Written assignments, turned in, graded and discussed
5. Written quizzes and examinations
6. Participation in class discussion and learning exercises
7. Performance of laboratory experiments
8. Student Evaluation.
  - a. Written examinations
  - b. Quizzes, homework
  - c. Written laboratory reports
  - d. Observation and evaluation of laboratory skills
  - e. Class presentations/exercises and group work

A= 90-100

B= 80-89

C= 70-79

D= 60-69

F= 0-59

## **OTHER REFERENCES**

Dictionary of Organic Chemistry (Available in the library)

Organic Chemistry for Dummies, Arthur Winter, John Wiley and Sons, 2<sup>nd</sup> edition, 2014

Biochemistry for Dummies, John F. Moore, Richard H. Langley, John Wiley and Sons, 2<sup>nd</sup> edition, 2011

## Course Competency/Assessment Methods Matrix

CHM 1005 Survey of Organism & Biochemistry		Assessment Options																																
For each competency/outcome place an "X" below the method of assessment to be used.	<b>Assessment of Student Learning</b>	Article Review	Case Studies	Group Projects	Lab Work	Oral Presentations	Pre-Post Tests	Quizzes	Written Exams	Artifact Self Reflection of Growth	Capstone Projects	Comprehensive Written Exit Exam	Course Embedded Questions	Multi-Media Projects	Observation	Writing Samples	Portfolio Evaluation	Real World Projects	Reflective Journals	Applied Application (skills) Test	Oral Exit Interviews	Accreditation Reviews/Reports	Advisory Council Feedback	Employer Surveys	Graduate Surveys	Internship/Practicum /Site Supervisor Evaluation	Licensing Exam	In Class Feedback	Simulation	Interview	Written Report	Assignment		
	Assessment Measures – Are direct or indirect as indicated. List competencies/outcomes below.	<b>Direct/ Indirect</b>	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	I	I	I	I	D	D								
	Appreciate the versatility of carbon atoms and the remarkable array of compounds they can form and to demonstrate an understanding of the IUPAC rules of nomenclature associated with the fields of organic and biochemistry						X		X	X						X																		X
	Demonstrate an ability to recognize and predict the chemical behavior of organic compounds with different functional groups: alkanes, alkenes, alkynes, arenes, aldehydes, alcohols, thiols, sulfides, ethers, phenols, alkylhalides, ketones, carboxylic/derivatives, and amines					X	X		X	X						X																		X



