Butler Community College
Behavioral Science, Math, Science, and
Physical Education Division

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Fall 2003
Textbook Update Fall 2011

COURSE OUTLINE
Organic Chemistry II

Course Description: CH245. Organic Chemistry II. 5 hours credit. Prerequisite: CH240. Three single lecture/discussion periods and four hours of laboratory periods per week. A continuation of CH240 with emphasis upon the structures, synthesis, and reactions of principle functional groups and compounds of biological interest, with some advanced topics such as dyes, polymers, and heterocyclic chemistry.

Course Relevance: The impact of chemistry in everyday life is phenomenal. The ability to see chemistry in action on the micro (molecular) and macro scale is necessary to develop a fuller knowledge and understanding of the world around us. Chemistry will enrich the student's appreciation of the world and help him/her better understand the studies of science and the scientific methods.

Required Materials:
Wade. *Organic chemistry(w/bind-in access code)*. Prentice Hall

Hayden. *Student lab notebook*.

* - For complete textbook information, refer to http://www.butlercc.bkstr.com

Learning Outcomes:
The intention is for the student to be able to analyze scientific materials in various forms demonstrating:

1. An understanding of the scientific method
2. An ability to read, communicate and understand scientific materials
3. Knowledge of basic math skills
4. An ability to apply scientific reasoning to real world problems

Primary Learning PACT Skill(s) that will be DEVELOPED and/or documented in this course:
Through the student involvement in this course, he/she will develop his/her ability in the following PACT skill areas:

1. Critical thinking
   - The student will demonstrate scientific reasoning through a variety of mathematical, graphical, experimental, and written assignments.
2. Writing
   - The student will write laboratory reports, which include observations, and analysis of the experiment.
   - The student will write a research paper on an approved topic in chemistry.

Secondary skills (developed but not documented)

Speaking
Computer literacy
Internet use
Teamwork
Ethical conduct

Major Summative Assessment Task(s):

These learning outcomes and the primary learning PACT skills will be demonstrated by:

1. Write laboratory reports, including purpose, procedural, observations, and analysis of the experiment using scientific reasoning
2. Writing a research paper upon a topic of the student's choice related to chemistry
3. Final assessment of the course using the ACS standardized exam

Course Content:

I. Themes - Key recurring concepts that run throughout the course:
   A. Scientific method
   B. Scientific reasoning
II. Issues - Key issues that will be addressed in this course: areas of conflict that must be understood in order to achieve the intended outcome:
   A. The balance between the conceptual and mathematical models
   B. The cumulative nature of science and the world
   C. The cumulative influence of scientific discoveries and the subsequent application of the discoveries
   D. The balance between "wet" lab chemistry and computer interfacing, collection and analysis of data
III. Concepts – Key concepts that must be understood to address the issues:
   A. Mathematics
   B. Visual/conceptual
   C. Scientific Methods
   D. Scientific Reasoning
   E. Modeling
   F. Scientific writing
   G. Scientific principles
   H. MLA writing format
   I. Word processing
   J. Excel spreadsheet
   K. Graphing
   L. Characteristics and impact of science in the world around them
IV. Skills/Competencies - Actions that are essential to achieve the course outcomes:
   A. Mathematics
   B. Writing
   C. Reading
   D. Speaking
   E. Computer Literacy
   F. Computer Spreadsheet/Graphing
   G. Internet Use
   H. Teamwork

Learning Units

I. Lecture
   A. Spectroscopy
      1. State the relationship between wavelength, frequency, wave number, and energy of light photons
      2. Identify the general regions of the total electromagnetic spectrum
      3. Describe the fundamentals of light emission and absorption
      4. Describe the basic concepts of infrared spectrometry and the general molecular motion on which it is based
      5. Interpret the results of an infrared spectrum and state how that may be utilized
      6. Describe the principle behind nuclear magnetic resonance (NMR) spectra
      7. Interpret simple NMR spectra and determine a simple molecular structure for them
      8. Describe the principles and application of mass spectroscopy
      9. Describe the principles and application of gas chromatography
      10. Describe the principles and application of ultraviolet spectrum
      11. Describe the principles and application of CMR spectroscopy
      12. Describe the principles and application of the HPLC
   B. Alcohols, Ethers, and Epoxides
      1. Describe the basic structural features of alcohols
      2. Name alcohols and draw structures using the IUPAC nomenclature system
      3. Explain the importance of hydrogen bonding in alcohols
      4. Predict what alcohol can be formed from various starting compounds and explain the mechanism
      5. Demonstrate how alcohols can react to form various compounds and the mechanism involved
      6. Describe the basic analysis for the identification for alcohols
      7. Describe the basic structural characteristics of steroids
      8. Identify important factors affecting cholesterol, its physiological action, and its relationship to other hormones
      9. Distinguish between androgens and estrogens by their physiological action
      10. Identify the general precursors of sex hormones in organisms
      11. Identify the uses of adrenal hormones
      12. Describe the physiological action of vitamin B3 in human beings
      13. Describe the basic structural features of ethers and epoxides
      14. Name ethers and epoxides and draw structures using the IUPAC method
      15. Predict what ethers and epoxides can be formed from various starting compounds and explain the mechanism
      16. Describe the test for peroxides in ethers
   C. Aldehydes and ketones
      1. Name and draw structures of aldehydes and ketones in the accepted manner
      2. Draw the tautomeric forms of various aldehydes and ketones
      3. Illustrate how aldehydes and ketones are synthesized from alcohols
      4. Describe the reaction mechanism leading to the reduction of aldehydes and ketones to form alcohols
      5. Describe the biologically induced oxidation of alcohol and reduction of

ketones or aldehydes in living systems
6. Predict the products of a Grignard reaction, aldol condensation, and cyanohydrin synthesis
7. Describe how formalin is formed
8. Identify hemiacetals or hemiketals and acetals or ketals
9. Distinguish aldehydes from ketones by specific chemical test reactions
10. Explain what information is actually obtained from a Benedict test
11. Identify some examples of aldehydes and ketones found in nature

D. Carboxylic acids and derivatives
1. Name and draw structures of organic acid and esters using the IUPAC method
2. Identify the primary methods of organic acid synthesis
3. Describe the general structure of fatty acids, and the number of carbons in the fatty acids
4. Explain why most fatty acids contain an even number of carbon atoms
5. Illustrate what is meant by the term “acid” derivative
6. Illustrate the synthesis of esters by esterification and by a method other than esterification
7. Show the accepted mechanism of esterification
8. Discuss the fundamental structure and use of glycerides
9. Identify factors that create rancidity in fat, and explain how rancidity can be prevented
10. Compare biological esterification with laboratory analogs
11. Show mechanisms of acid- and base- catalyzed ester hydrolysis
12. Predict the products of simple Claisen condensation hydrolysis
13. Identify the roles of pheromones in the insect world
14. Identify the physiological role of prostaglandins
15. Demonstrate how carboxylic acids and their derivatives react and are produced

E. Enolates and Carbanions
1. Write, predict and develop the mechanism of the Aldol Condensation reaction
2. Write, predict and develop the mechanism of the Claisen Condensation reaction
3. Write, predict and develop the mechanism of the Malonic Ester synthesis
4. Write, predict and develop the mechanism of the Acetoacetic Ester synthesis

F. Amines and derivatives
1. Name simple amines
2. Identify or classify amines as primary, secondary, or tertiary
3. Explain the importance of hydrogen bonding in amines with respect to the deoxyribonucleic acid (DNA)
4. Give products of neutralization reactions involving amines
5. Be examining the Kb values of various amines, state which is the most basic
6. List and explain the relative order of the basicity of amines
7. Draw the resonance forms or structures of aromatic amines
8. Identify alkaloids on the basis of certain characteristics inherent in all alkaloids
9. Describe the type of physiological activities that alkaloids can cause in an animal, especially a human

10. State the sequence of events in nerve impulse transmission and nerve paralysis
11. Describe the theory that shows why alkaloids act as poisons
12. Identify the general structural components in an alkaloid that cause it to act as structure similar to morphine
13. Name structural features of amines that can act as central nervous system stimulants

G. Phenols
1. Describe the basic structural features of phenols
2. Identify some natural occurring phenol based compounds found in nature
3. Demonstrate how phenols react and how that are synthesized and explain the mechanism

II. Laboratory

A. Working in the laboratory in accordance with good laboratory practices
1. Dress in an appropriate manner as to promote safety in the laboratory, wearing a lab coat and goggles when anyone is working with chemicals in the laboratory
2. Follow written directions accurately
3. Work safely and effectively, using equipment and chemicals carefully and correctly
4. Demonstrate use of required safety and common laboratory techniques
5. Dispose of waste products in a proper manner

B. Gather and record qualitative and quantitative data accurately
1. Acquire data using balances and volumetric glassware
2. Make and record visual observations
3. Use computers, when appropriate, as data acquisition tools
4. List or describe experimental assumptions made and any deviations from the written experimental procedures

C. Handle and evaluate data in logical, productive, and meaningful ways
1. Create notebooks and laboratory reports that are clear, understandable, and accurately represent the date collected
2. Display computer data in a spreadsheet or graphically, as appropriate
3. Correlate observations with chemical or physical processes
4. Carry out suitable calculations with quantitative data, recognizing when data and calculates are within a reasonable range
5. Use observations of experimental data to present relevant conclusions pertaining to the experimental procedure

D. Correlate laboratory work with principal topics in Organic II lecture

Learning Activities:

Independent and collaborative learning activities will be assigned within and outside the classroom and laboratory to achieve the intended course outcomes. Classroom discussion, lecture, and textbook reading assignments will also contribute to the learning process.

Grade Determination:
Grade determination may include tests, projects, quizzes, homework, written assignments and laboratory experiments. Other methods may be used at the discretion of the instructor. At the end of the semester, a comprehensive ACS final is administered covering topics in Organic I and Organic II.