SYLLABUS

**CHE K210: INTRODUCTION TO ORGANIC CHEMISTRY**

**THREE RIVERS COMMUNITY COLLEGE**

**NORWICH, CONNECTICUT 06360**

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Office Hours:

| Day | Time | Time |
|---|---|---|
| Monday | 11:00 am – 12:00 pm | 3:30 pm – 4:30 pm |
| Tuesday | 2:00 pm – 3:30 pm | |
| Wednesday | 11:00 am – 12:00 pm | |
| Thursday | | |
| Friday | | |

**********Special Notice**********

***If you have a visible or hidden disability, which may require classroom, lab and/or test-taking modifications, please see me as soon as possible. If you have not registered with Chris Scarborough, learning specialist or a counselor in the Student Services Development Center, you must do so early in the semester.***

Spring 2009

# I. COURSE INFORMATION

**Course Title/Number**: Introduction to Organic Chemistry/CHE K210

**Credits**: 4 (3 hrs. lecture/ 3 hrs. laboratory)

**Textbook**: Essential Organic Chemistry, Paula Y. Bruice

**Other required materials**: Laboratory goggles (chemical safe), a calculator, nitrile gloves (available in the bookstore) and a three-hold folder

## Description of the Course

### A. Catalogue Description

A one semester introductory organic chemistry designed for students that need a general knowledge of organic compounds in science and technology related fields. Both theoretical and practical applications of carbon compounds will be studied. Topics covered will include: nomenclature, reaction mechanisms, the major groups of hydrocarbons and their derivatives, functional groups, carbohydrates, lipids, proteins and nucleic acids. Modern laboratory techniques involving optical isomerization, infrared spectroscopy and nuclear magnetic resonance spectroscopy will be introduced. (This course is not recommended for Science and Technology Programs requiring two semesters of Organic Chemistry.)

**Prerequisites**: MAT K137 or higher and CHE K111 or CHE K121 and K122 (all courses passed with grades of C or better).

### B. General Course Objectives

To aid the student in developing:

1) critical thinking skills.
2) an understanding of basic principles of organic chemistry.
3) an understanding of the vast amount of research that is being done in the field and the vast amount of unanswered questions that exist.

To encourage students to become more knowledgeable about the interrelationship between organic chemistry and other areas of science and technology.

## II. POLICIES

### Class Attendance Policy

Attendance of all class activities in lecture and laboratory is required.

5% of the overall grade is also based on the attendance of lecture and laboratory periods. Two absences are permitted over the course of the semester and these two absences will not result in deduction of points from the attendance score. However, the third absence and beyond will directly impact the attendance score, unless there is a clear documentation that shows that the absence was caused because of some emergency.

### Academic and Classroom Misconduct

1. The instructor has primary responsibility for control over classroom and/or laboratory behavior and maintenance of academic integrity, and can request the temporary removal or exclusion from the classroom or laboratory of any student engaged in conduct that:

a) violates the general rules and regulations of the institution.

b) is deemed hazardous in the laboratory.

2. Extended or permanent exclusion from lecture or laboratory activities or further disciplinary action can only be effected through appropriate procedures of the institution.

3. Plagiarism, cheating on quizzes or tests, or any form of academic dishonesty is strictly prohibited. Students guilty of academic dishonesty directly or indirectly will receive a zero for the exercise, quiz or test and may receive an **F** grade for the course in addition to other possible disciplinary sanctions which may be imposed through the regular institutional procedures.

4. Any student that believes that he or she has been erroneously accused may appeal the case through the appropriate institutional procedures if their grade was affected.

### College's Withdrawal Policy

Any student who finds it necessary to discontinue this course **MUST** complete a withdrawal form in the Registrar's Office at the time of the withdrawal. If you can not withdraw in person you may call the Registrar's Office and provide them with the appropriate information.

Students may withdraw from the course anytime during the first 14 weeks of class, **without** written authorization from the instructor or their academic advisor.

Once you withdraw from class you are no longer eligible to continue attending class and/or take any remaining quizzes or test**.**

Students who do not withdraw, but stop attending will be assigned an **F** grade in this course. Verbal withdrawals **CANNOT** be accepted.

## III. EXAMS AND QUIZZES

There will be a total of **6 quizzes, 2 unit exams and a final exam** for this course.

The two lowest quiz scores will be dropped.

The dates for the quizzes (given in the first twenty minutes of the class), the unit tests, and the final exam are as follows:

Quiz 1: February 04

Quiz 2: February 18

**EXAM 1: February 25**

Quiz 3: March 11

Quiz 4: April 01

**EXAM 2: April 13**

Quiz 5: April 27

Quiz 6: May 06

**FINAL EXAM: May 20**

Additionally, there are two laboratory exams. The laboratory exams (practicals) will be given on the following dates:

Laboratory Exam 1: March 03

Laboratory Exam 2: May 05

## IV. GRADING

There are five components toward the final grade for this course. Their contributions are listed in the parentheses:

### 1. Semester Average (40%)

The semester average is the average score of the two exams (100 points each) and the adjusted quiz score. The adjusted quiz score is the sum of the best four quizzes, scaled to a maximum score of 100.

### 2. Laboratory Average (20%)

The laboratory average is the average score of all the laboratory reports and the two laboratory exams.

### 3. Homework (15%)

Homework will be assigned often during the semester and graded.

### 4. Attendance (5%)

Absence from a maximum two lecture periods is allowed. Any additional absences will lower your score.

### 5. Final Exam (20%)

The final exam may be cumulative (with an emphasis on the later chapters).

Select students may be exempt from taking the final exam. This provision is contingent upon the students meeting the following requirements:

- 100% attendance throughout the semester

- score of 90% or higher in each of the top seven quizzes

- score of 90% or higher in each of the exams and laboratory reports

- a cumulative average of 95% or higher

- discretion of the instructor

### Grading Scale (tentative)

| | | | |
|---|---|---|---|
| A: | 100-93.50 | C: | 77.49-73.50 |
| A-: | 93.49-90.00 | C-: | 73.49-70.00 |
| B+: | 89.99-87.50 | D+: | 69.99-67.50 |
| B: | 87.49-83.50 | D: | 67.49-63.50 |
| B-: | 83.49-80.00 | D-: | 63.49-60.00 |
| C+: | 79.99-77.50 | F: | 59.99 and below |

## V. MAKE-UP POLICY

1. There will be no make-ups for any of the quizzes, since there is a provision for the two lowest quizzes to be dropped from your final score.

2. There will also be no make-up exams (including the final exam) unless a documented emergency prohibits you from taking the exam. In such cases, the make-up exam will be scheduled after a consultation between the instructor and the student.

## VI. MISCELLANEOUS

### Revisions to the Syllabus

The instructor may make revisions to the syllabus at any time during the semester. If a revision has been made, the students will be notified of the change in exam dates, change of deadlines, and change in material to be covered.

### Class Etiquette

Cellular phones and beepers are only allowed in class or lab if they are turned off or in silent mode. Under no circumstances are phones to be answered in class. When there are extenuating circumstances that require that a student be available by phone or beeper, that student must speak to the instructor prior to class, so that together they can arrive at an agreement.

IV) **Course Outcomes: CHE K210 Introduction to Organic Chemistry**

Outcomes 1-8 learned from prerequisite courses

1. The student will be able to describe the scientific method through examples and distinguish among the terms hypothesis, theory and scientific law.

2. The student will learn both the differences and relationships between science and technology.

3. The student will be able to distinguish between data and results.

4. The student will be able to define chemistry, and know its major subfields.

5. The student will recognize the interrelationships of the structure of matter and its physical and chemical properties.

6. The student will be able to understand the current model of modern atomic structure including the major particles that comprise the atom: protons, neutrons and electrons.

7. The student will be able to distinguish between atoms, ions, and isotopes.

8. The student will be able to explain the differences between ionic and covalent bonding, as well as, the differences between polar and non-polar covalent bonding.

9. The student will be able to list the major classes of organic compounds.

10. The student will learn to write condensed and structural formulas for saturated and unsaturated hydrocarbons.

11. The student will learn the rules of the I. U. P. A. C. nomenclature system.

12. The student will be able to draw structural isomers of simple organic compounds.

13. The student will write equations for combustion and halogenation reactions of hydrocarbons.

14. The student will write equations for addition reactions of alkenes, and apply Markovnikov's rule.

15. The student will learn the more common functional groups.

16. The student will learn the name and structure of the various hydrocarbon derivatives.

17. The student will learn the basic structural differences between aliphatic and aromatic compounds.

18. The student will be able to write the general structures for alcohols, phenols, ethers, thiols, aldehydes, and ketones.

19. The student will learn to classify alcohols as primary, secondary, or tertiary.

20. The student will write equations for dehydration and oxidation of alcohols.

21. The student will write equations for the oxidation and reduction of carbonyl compounds.

22. The student will write equations for the preparation of hemiacetals, hemiketals, acetals, and ketals.

23. The student will learn about carboxylic acids and esters that are of biomedical or environmental importance.

24. The student will draw and name the more common carboxylic acids and esters.

25. The student will learn the biological significance of thioesters and phosphoesters.

26. The student will write equations for the hydrolysis of esters.

27. The student will write equations for the synthesis of a carboxylic acid by the oxidation of primary alcohols or aldehydes.

28. The student will write equations for the synthesis of esters from carboxylic acids and alcohols.

29. The student will be able to define the term saponification and know how a soap works in the emulsification of grease and oils.

30. The student will be able to draw and name simple amines and amides.

31. The student will be able to list amines and amides of biomedical and environmental importance.

32. The student will be able to classify amines as primary, secondary, or tertiary.

33. The student will be able to draw and discuss the structure of the amide bond.

34. The student will write equations showing the basicity and neutralization of amines.

35. The student will write equations for the preparation and hydrolysis of amides.

36. The student will learn the differences between simple and complex carbohydrates.

37. The student will draw and name the common, simple carbohydrates using structural formulas and Fischer projection formulas.

38. The student will be able to recognize whether a sugar is reducing or non-reducing.

39. The student will be able to discuss the structural, chemical, and biochemical properties of the monosaccharides, oligosaccharides, and polysaccharides.

40. The student will become familiar with the physical and chemical properties and the biochemical functions of each of the families of lipids.

41. The student will learn the name of the more common lipids.

42. The student will learn the method of synthesizing glycerides and the reaction of glycerides, esterification, hydrolysis, saponification, and dehydrogenation.

43. The student will be able to write the general structure of an amino acid.

44. The student will learn the classification of R groups of the amino acids.

45. The student will be able to describe the four levels of protein structure.

46. The student will learn the name and and functions of the more common proteins of biological importance.

47. The student will be able to give biochemical properties of enzymes and explain enzymatic activity, as well as, the role of coenzymes and cofactors.

48. The student will name the six classes of enzymes based on the reactions they catalyze and the four types of enzyme specificity.

49. The student will describe the biochemical composition of the nucleic acids.

50. The student will describe the structure of both DNA and RNA.

51. The student will be able to list the three classes of RNA.

52. The student will be able to describe the biochemical mechanism of DNA replication.

53. The student will be able to explain the role of DNA and RNA in protein synthesis. (Transcription and Translation).

54. The student will be able to explain the role of spectroscopy in organic chemistry.

## V) COURSE OUTLINE: INTRODUCTION TO ORGANIC CHEMISTRY

### PART I: REVIEW

I. Science
- A. What is Science?
  - 1) The Scientific Method
- B. Data, Results, and Units
- C. Science and Technology
- D. What is Chemistry?
  - 1) Inorganic chemistry
  - 2) Organic chemistry
  - 3) Analytical chemistry
  - 4) Physical chemistry
  - 5) Biochemistry

II. Matter and Properties
- A. Physical properties of matter
- B. Chemical properties of matter
- C. Development of the atomic theory
- D. Modern atomic theory
- E. Atomic structure
  - 1) Protons
  - 2) Neutrons
  - 3) Electrons
    - a) valence electrons
    - b) ion formation and the octet rule
  - 4) Isotopes
- F. Ions and ionic bonding
- G. Covalent bonding
  - 1) Non-polar
  - 2) Polar
- H. Acids and Bases

### PART II: ORGANIC CHEMISTRY

I. Introduction
- A. The carbon atom
- B. Covalent bonding in organic compounds

II. Organic Molecules
- A. Molecular formulas and types of structural formulas
- B. Resonance
- C. Structural isomers

III. The Hydrocarbons
- A. Alkanes and cycloalkanes
  - 1) Structure of alkanes

2) Isomerism in alkanes
3) The IUPAC system of nomenclature
4) Naming alkanes
5) Cycloalkanes
6) Cis/trans isomerism in cycloalkanes
7) Physical properties of alkanes and cycloalkanes
8) Reactions of alkanes

B. Alkenes and Alkynes
1) Structure of alkenes
2) Naming alkenes
3) Physical properties of alkenes
4) Naturally occurring alkenes
5) Structure of alkynes
6) Naming alkynes
7) Physical properties of alkynes

C. Reactions of Alkenes
1) Reaction mechanisms
2) Addition reactions
3) Electrophilic addition reactions
4) Oxidation reactions
5) Reduction reactions
6) Polymerization

D. Aromatic Compounds
1) Substituted benzene compounds/aromaticity
2) Polycyclic and heterocyclic aromatic compounds
3) Nomenclature of benzene compounds
4) Electrophilic aromatic substitution
    a) Structural effects
    b) Interpretation of rate effects
    c) Interpretation of directing effects
5) Reactions of side chains
6) Functional group modification
7) Synthesis of substituted aromatic compounds

E. Stereochemistry
1) Isomerism
2) Chirality
3) Naming enantiomers
4) Fischer projection formulas
5) Cyclic molecules with two or more stereocenters
6) Noncyclic molecules with two or more stereocenters
7) Properties of stereoisomers
8) Separation of enantiomers
9) How chirality is detected in the laboratory
10) Reactions that produce stereocentered molecules

F. Functional Groups
1) Names

2) Structural formulas

G. Alkyl Halides
1) Naming alkyl halides
2) Preparation of alkyl halides
- radical chlorination of alkanes
3) Alkyl halides from alcohols
4) Reactions of alkyl halides
- Grignard reagents

H. Nucleophilic Substitution and Elimination Reactions

IV. Hydrocarbon derivatives

A. Alcohols and Phenols
1) The hydroxyl group
2) Classification and nomenclature of alcohols
3) Physical properties of alcohols
4) Reactions of alcohols
a) Acid-Base
b) Substitution
c) Dehydration
d) Oxidation
e) Synthesis
5) Phenols
6) Synthesis and reactions of phenols
7) Thiols and sulfides

B. Ethers and Epoxides
1) Ethers
a) Nomenclature
b) Physical properties
c) The Grignard reagent and ethers
d) Synthesis of ethers
e) Reactions of ethers
2) Epoxides
a) Synthesis of epoxides
b) Reactions of epoxides

C. Aldehydes and Ketones
1) The carbonyl group
2) Nomenclature of aldehydes and ketones
3) Physical properties of aldehydes and ketones
4) Redox reactions of carbonyl compounds
5) Addition reactions of carbonyl compounds
6) Synthesis of alcohols from carbonyl compounds
7) Addition of oxygen compounds
8) Formation of acetals and ketals
9) Addition of nitrogen compounds
10) Reactivity of the alpha carbon atom
11) The aldol condensation

D. Carboxylic Acids and Esters
   1) The carboxyl and acyl groups
   2) Nomenclature of carboxylic acid derivatives
   3) Physical properties of carboxylic acids and esters
   4) Acidity of carboxylic acids
   5) Synthesis of carboxylic acids
   6) Nucleophilic acyl substitution
   7) Reduction of acyl derivatives
   8) Synthesis of esters
   9) Hydrolysis of esters
   10) The claisen condensation
   11) Thioesters

E. Amines and Amides
   1) Organic nitrogen compounds
   2) Structure and classification of amines and amides
   3) Nomenclature of amines and amides
   4) Physical properties of amines and amides
   5) Basicity of nitrogen compounds
   6) Solubility of ammonium salts
   7) Nucleophilic reactions of amines
   8) Synthesis of amines
   9) Hydrolysis of amides
   10) Synthesis of amides
   11) Amides molecular models
   12) Amphetamines and polyamides

F. Synthetic Polymers

V. The Organic Chemistry of Biomolecules

A. Carbohydrates
   1) Classification of carbohydrates
   2) Chirality of monosaccharides
   3) Hemiacetals and hemiketals
   4) Conformation of monosaccharides
   5) Reduction of monosaccharides
   6) Oxidation of carbohydrates
   7) Glycosides
   8) Disaccharides/Oligosaccharides/Trisaccharides
   9) Polysaccharides
   10) The biological function of carbohydrates

B. Lipids
   1) Classification of lipids
   2) Fatty acids
      a) Structure and properties
      b) Chemical reactions of fatty acids
      c) Prostaglandins

3) Glycerides
    a) Neutral glycerides
    b) Phosphoglycerides
4) Nonglyceride lipids
    a) Sphingolipids
    b) Steroids
5) Cholesterol
6) Waxes
7) Saponification of triacylglerides
8) The biological functions of lipids

C. Amino acids, Peptides, and Proteins
1) The basic structure and naming of amino acids
2) Acid-base properties of amino acids
3) Essential amino acids
4) Peptides
5) Synthesis of peptides
6) Polypeptides and protein
7) Structure determination of proteins
8) Structure of proteins
9) Enzymes
    a) structural composition (coenzymes and cofactors)
    b) classification and function
10) Lipoproteins
11) The biological functions of proteins

D. Nucleosides, Nucleotides, and Nucleic Acids
1) The composition of nucleosides
2) Naming nucleosides
3) Nucleotides
    a) Composition
    b) Classification
4) Nucleic acids and nucleotides
5) The structure of DNA: Watson and Crick Model
6) DNA replication
7) Structure and synthesis of RNA/classification of RNA
8) The genetic code
9) Protein synthesis: Transcription and Translation
10) DNA sequencing and polymerase chain reaction

VI. Spectroscopy and Organic Chemistry
A. Optical isomerization
B. Infrared (IR) spectroscopy
C. Nuclear magnetic resonance (NMR) spectroscopy