

COURSE OUTLINE

Chemistry 105 Organic Chemistry

I. Catalog Statement

Chemistry 105 is an introductory study of the compounds of carbon, including the preparation, properties, and reactions of both aliphatic and aromatic hydrocarbons, halogen derivatives, alcohols, and ethers. Methods of synthesis are stressed, and reaction mechanisms and modern structural principles are introduced. Note: Required of pre-medical and pre-dental students; recommended for majors in chemistry, petroleum engineering, sanitary and municipal engineering, and pharmacy; and for certain home economic, public health and agriculture majors.

Units - 5.0

Lecture Hours - 3

Laboratory Hours - 6

Prerequisite: Chemistry 102 with a grade of "C" or better.

II. Course Entry Expectations

Skills Expectations: Reading - 5; Writing - 5; Listening/Speaking - 5 Math - 5

Prior to enrolling in the course, the student should be able to:

1. describe fundamental properties of solutions and apply theories of colligative properties;
2. apply principals of electron transfer to understand oxidation and reduction processes;
3. distinguish between the rate of a reaction and the potential for a reaction to occur;
4. apply the fundamentals of Collision Theory to the rate at which a reaction proceeds;
5. analyze the effects of changes in system conditions on the amount of reactants and products present in the system;
6. identify acids and bases and evaluate the effects that they may have on the properties of a solution;

7. analyze the composition of solutions based on properties of the components, including but not limited to, solubility, complex ion formation and redox;
8. apply the laws of thermodynamics to the direction of the universe and the direction in which chemical reactions proceed;
9. apply the laws of thermodynamics to analyze the ability to obtain work from a chemical process;
10. describe the method by which electrical energy may be obtained from chemical systems;
11. apply redox properties of substances to the development and understanding of batteries, corrosion, and fuel cells;
12. evaluate the interactions by which coordination compounds are stabilized;
13. identify nuclear reactions and predict nuclear stability as well as recognize the dangers of radioactivity;
14. demonstrate the proper use of laboratory equipment and the ability to handle chemicals safely.

III. Course Exit Standards

Upon successful completion of the required course work, the student will be able to:

1. familiarize themselves with the system of classification of compounds by structure which is the framework of organic chemistry;
2. delineate the principles of organic chemical reactions through techniques of lecture, laboratory problem solving and computer-simulated experiments;
3. acquaint themselves with the laboratory methods and specialized instruments typically used in organic chemistry;
4. keep accurate laboratory records;
5. prepare themselves for pre-professional examinations that include organic chemistry, i.e. MCAT, DAT, pharmacy and dental hygiene aptitude examinations;
6. read and evaluate scientific material of significance to them as citizens.

IV. Course Content

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|----------------------------------------------|----------|
| A. Introduction | 16 hours |
| 1. Definition and scope of organic chemistry | |
| 2. Chemical Bonding | |
| 3. Physical properties | |
| a. Melting point | |
| b. Boiling point | |
| c. Solubility | |

- 4. Isomerism
 - 5. Elemental analysis
 - 6. Empirical formula
 - 7. Molecular weight determination
 - 8. Stereochemistry and Enantiomers
- B. Alkanes 16 hours
 - 1. Methane
 - a. Structure
 - b. Physical properties
 - c. Chemical properties
 - 2. Substitution reactions, mechanism
 - 3. Rate of reaction
 - 4. Higher alkanes; homologous series, isomers, nomenclature; preparation, reactions
 - 5. Analysis of alkanes
- C. Alkenes 16 hours
 - 1. Structure - geometrical isomerism
 - 2. Nomenclature
 - 3. Preparation
 - 4. Carbonium ion mechanism
 - 5. Addition reactions
 - 6. Dienes; 1,4-addition
 - 7. Analysis of alkenes; determination of structure by degradation
 - 8. Stereochemistry and diastereomers
- D. Alkynes 16 hours
 - 1. Structure - geometrical isomerism
 - 2. Nomenclature
 - 3. Importance of acetylene
 - 4. Reactions of alkynes
 - 5. Tautomerism
 - 6. analysis of alkynes
- E. Cyclic Aliphatic Hydrocarbons 16 hours
 - 1. Structure - geometrical isomerism
 - 2. Nomenclature
 - 3. Reactions
 - 4. Baeyer strain theory
 - 5. Conformations
 - 6. Stereoisomerism of cyclic compounds
 - 7. Analysis of cyclic aliphatic hydrocarbons
- F. Aromatic Hydrocarbons 16 hours

1. Structure of benzene; resonance
 2. Reactions of benzene; mechanism
 3. Ring isomerism
 4. Nomenclature of benzene derivatives
 5. Arenes
 - a. Nomenclature
 - b. Preparation
 - c. Reactions
 6. Reactivity and orientation in aromatic substitution
 7. Analysis of aromatic hydrocarbons
- G. Spectroscopy 16 hours
 1. Mass spectrum
 2. Infrared spectrum
 3. Ultraviolet spectrum
 4. Nuclear magnetic resonance spectrum
- H. Alkyl Halides 16 hours
 1. Structure
 2. Nomenclature
 3. Preparation
 4. Reactions
 - a. Kinetics
 - b. S_N1 vs. S_N2 mechanisms
 5. Analysis of alkyl halides
- I Alcohols 8 hours
 1. Structure, classification, nomenclature, physical properties
 2. Preparation
 3. Optical isomerism
 4. Reactions
 5. Analysis of alcohols
- J. Ethers 8 hours
 1. Structure
 2. Nomenclature
 3. Preparation
 4. Reactions
 5. Epoxides
 6. Analysis of ethers

V. **Methods of Presentation**

The following instructional methodologies may be used in the course:

1. Traditional white board and lecture format.

VI. Assignments and Methods of Evaluation

1. Five one-hour examinations
2. Data and observations are recorded in a laboratory notebook the majority of which should be written in essay format. These reports are turned in and graded during the semester.
3. Final Examination of 2.5 hours.

VII. Textbook

Pavia, Introduction to Organic Lab Techniques, 2nd edition
Thompson, Brooks/Cole, 2004
13th Grade Textbook Reading Level. ISBN 0-534-40833-8

Wade, L.G. Organic Chemistry, 7th edition.
Prentice Hall, 2009
13th Grade Textbook Reading Level. ISBN 0-321-59871-7

Wade, Solution manual, 7th Edition
Prentice Hall, 2010
ISBN: 0321-59871-7

Tomasi, Special Problems Set 1, 1997

VIII. Student Learning Outcomes

1. Predict and explain the expected chemical and physical behavior of an organic compound based on its functional group(s) and geometry.
2. Discern chirality in an organic compound, draw stereoisomers in the standard 3-dimensional conventions, and determine relationships between pairs of stereoisomers drawn in these conventions, including conformational stereoisomers.
3. Outline a rational synthesis of a small target organic compound using reactions, reaction conditions and mechanisms learned in the course.
4. Write a rational mechanism to explain a given transformation of an organic compound, including proper use of the directed-arrow convention.
5. Apply the theory and practice of laboratory techniques used in the preparation, purification, separation and identification of organic compounds including the proper use of specialized glassware and output from instruments such as ¹H-NMR, ¹³C-NMR, FT-IR, GC, refractometer, polarimeter, Mel-Temp, etc.

6. Practice safety in the organic chemistry laboratory including personal safety and deportment, safe deployment and use of glassware and apparatus, as well as the proper handling of hazardous chemicals and management of chemical waste.
7. Maintain a complete and organized record of laboratory experimental data and observations in accordance with the format of the scientific notebook.