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**BOROUGH OF MANHATTAN COMMUNITY COLLEGE**
City University of New York

**Department of Science**

**Title of Course:** Organic Chemistry I
**CHE 230**
**Semester:**
**Credits:** 5

**Class hours:** 3
**Lab hours:** 4
**Instructor:**
**Phone:**
**Email:**

**Course Description**
This two-semester course sequence is the study of the structure and properties of the fundamental classes of organic compounds with emphasis on reactivity, reaction mechanism, stereochemistry, electronic theory and applications to allied fields.

**Basic Skills:** ACR 94, ENG 088 or ESL 54, and MAT 051

**Prerequisites/Co-requisites:** MAT 056 CHE 201 and CHE 202.

**Student Learning Outcomes**
Students will be able to understand, discuss and show proficiency in concepts shown below by applying being able to apply them to solve new problems.

1. Structure and bonding. Hybridization and the structure of saturated and unsaturated hydrocarbons.
2. Polar Covalent Bonds and their relationship to Brønsted-Lowry and Lewis Acids and Bases.
3. Resonance.
4. Conformational analysis of alkanes and cycloalkanes.
5. Addition, elimination, substitution, and rearrangement reactions.
6. Structure, reactivity, reactions and synthesis of alkanes, alkenes, and alkynes.
7. Stereochemistry of enantiomers, diastereomers, and meso compounds.
8. Structure, reactivity, and synthesis of alkyl halides.
9. Nucleophilic substitution and elimination reactions of alkyl halides.
10. Synthetic organic techniques for the building of small and large molecules and to show their relationship with biological structures.
11. Organic laboratory techniques and skills to synthesize, separate, purify and characterize organic compounds.

**Assessment: Exam questions, homework and laboratory assignments**

**Evaluation & Requirements of Students**
Each semester there will be a minimum of three examinations, a comprehensive final examination, and fulfillment of laboratory requirement. The average of your lecture exams and final exam grades must be greater than 60% to permit a passing grade, regardless of your laboratory grade.

**Below are the college's general education learning outcomes, the outcomes that are checked in the left-hand column indicate goals that will be covered and assessed in this course. (Check at least one.)**

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| | **General Education Learning Outcomes** | **Measurements (means of assessment for general education goals listed in first column)** |
|---|---|---|
| ☐ | **Communication Skills-** Students will be able to write, read, listen and speak critically and effectively. | |
| ☒ | **Quantitative Reasoning-** Students will be able to use quantitative skills and the concepts and methods of mathematics to solve problems. | To record experimental data and to use to plot graphs and calculate reactant concentrations, limiting reagents, theoretical yield and percentage yields% |
| ☒ | **Scientific Reasoning-** Students will be able to apply the concepts and methods of the natural sciences. | Exam questions, homework assignment, laboratory assignments and case study |
| ☐ | **Social and Behavioral Sciences-** Students will be able to apply the concepts and methods of the social sciences. | |
| ☐ | **Arts & Humanities-** Students will be able to develop knowledge and understanding of the arts and literature through critiques of works of art, music, theatre or literature. | |
| ☐ | **Information & Technology Literacy-** Students will be able to collect, evaluate and interpret information and effectively use information technologies. | |
| ☐ | **Values-** Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility. | |

**Required Text & Readings**

*1.Organic Chemistry, 3rd Ed* by David Klein, John Wiley & Sons, Inc., 2017
ISBN 978-1-119-31615-2

**ISBN: 978-1-119-31615-2**

**Other Resources (Highly recommended)**

1.*Student Study Guide and Solutions Manual* by David Klein, Edition binder ready version, ISBN: 978-1-119-42253-2 John Wiley & Sons, Inc., 2017.

2. A small Scale Approach to Organic laboratory Techniques , 3rd Ed. by Donald Pavia, Gary Lampman, George Kriz and Randall Engel, Brooks/Cole Cengate Learning, 2011 ISBN-13: 978-1-4390-4932-7 and ISBN-10: 1-4390-4932-

3. Lab coats or aprons

4. Molecular modeling kit

The laboratory will be evaluated in preparation, work, and report. A student who is absent from more than one laboratory session seriously jeopardizes his/her grade for the course.

The students are encouraged to work as many problems found at the end of the chapter until the main content of the chapter is mastered. The use of the molecular models is recommended to visualize the stereochemistry and the three-dimensional aspect of the organic compounds. The *Student Study Guide and Solutions Manual* is useful for checking your answers.

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**Outline of Topics**

| Chapter | Lecture Topics |
|---|---|
| **1** | **A Review of General Chemistry: Electrons, Bonds, and Molecular Properties** |
| 1.1 to 1.13 | The Structural Theory of Matter. Electrons, Bonds, and Lewis Structures. Formal Charges. Induction and Polar Covalent Bonds. Atomic Orbitals. Valence Bond and Molecular Orbital Theory. Hybridized Atomic Orbitals. VSEPR. Dipole Moments and Polarity. Intermolecular Forces and Physical Properties. Solubility. |
| **2** | **Molecular Representations** |
| 2.1 to 2.13 | Molecular Representations. Bond-Line Structures. Functional Groups. Formal Charges. Lone Pairs. Three-Dimensional Structures. Resonance. Curved Arrows. Formal Charges in Resonance Structures. Drawing Resonance Structures via Pattern Recognition. Assessing Relative Importance of Resonance Structures. Resonance Hybrid. Delocalized and Localized Lone Pairs. |
| **3** | **Acids and Bases** |
| 3.1 to 3.9 | Bronsted-Lowry Acids and Bases, Acidity. Flow of Electron Density: Curved Arrow Notation. Position of Eqilibrium. Choice of reagents. Levelling Effects. Solvating Effects. Counterions. Lewis Acids and Bases. |
| **4** | **Alkanes and Cycloalkanes** |
| 4.1 to 4.15 | Alkanes: Introduction, Nomenclature, Constitutional Isomers, Relative Stability of Isomers, Sources and Uses. Newman Projections. Conformational Analysis of Ethane, Propane, and Butane. Cycloalkanes: Conformations, Monosubstituted and Disubstituted. Cyclohexane: Conformations, cis-trans Stereoisomerism. Polycyclic Systems. |
| **5** | **Stereoisomerism** |
| 5.1 to 5.11 | Isomerism. Stereoisomerism. Configuration Using the Cahn-Ingold-Prelog System. Optical Activity. Enantiomers and Diastereomers. Symmetry and Chirality. Fischer Projections. Conformationally Mobile Systems. Resolution of Enantiomers. *E* and *Z* Designations. |
| **6** | **Chemical Reactivity and Mechanism** |
| 6.1 to 6.12 | Enthalpy. Entropy. Gibbs Free Energy. Equilibria. Kinetics. Energy Diagrams. Nucleophiles and Electrophiles. Arrow Pushing. Drawing Curved Arrows. Carbocation Rearrangements. Reversible and Irreversible reaction arrows. |
| **7** | **Alkyl Halides: Nucleophilic Substitution and Elimination Reactions** |
| 7.1 to 7.13 | Introduction to Substitution and Elimination Reactions. Nomenclature and uses of Alkyl Halides. SN2 Reactions. E2 Reactions. Nomenclature and stability of alkenes. Regiochemical and Stereochemical Outcomes for E2 Reactions. Unimolecular reactions. Kinetic Isotope Effects in Elimination reactions. Predicting Products: Substitution vs. Elimination. Substitution and Elimination Reactions with Other Substrates. Synthetic Strategies. |
| **8** | **Addition Reactions of Alkenes** |
| 8.1 to 8.14 | Introduction to Addition Reactions. Addition vs. Elimination. Hydrohalogenation. Acid-Catalyzed Hydration. Oxymercuration-Demercuration. Hydroboration-Oxidation. Catalytic Hydrogenation. Halogenation and Halohydrin Formation. *Anti* and *Syn* Dihydroxylation. Oxidative Cleavage. Predicting Products of an Addition Reaction. Synthesis Strategies. |
| **9** | **Alkynes** |
| 9.1 to 9.11 | Introduction, Nomenclature, Preparing, Reduction, Hydrohalogenation, Hydration, Halogenation, Ozonolysis. Acidity of Acetylene and Terminal Alkynes. Alkylation of Terminal Alkynes. Synthesis Strategies. |
| **10** | **Radical Reactions** |
| 10.1 to 10.10 and 10.13 | Radicals. Radical Mechanisms. Chlorination of Methane. Halogenation: Thermodynamic Considerations , Regioselectivity, and Stereochemistry. Allylic Bromination. Autooxidation and Antioxidants. Halogenation as a Synthetic Technique. |

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**Experiments:**

| Experiment Title | Week |
|---|---|
| Laboratory Safety and Laboratory Rules, Check-in | 1 |
| Melting Point Determination | 2 |
| Purification of Acetanilide | 3 |
| Simple and Fractional Distillation | 4 |
| Conformers of Alkanes and Cycloalkanes | 5 |
| Isolation and Purification of Caffeine | 6<br>7 |
| Synthesis and Purification of Acetaminophen | 8 |
| Oil of Cinnamon | 9<br>10 |
| Synthesis of cyclohexene | 10<br>11 |
| SN1/SN2 reactions | 12 |
| Nanotechnology/Case Study | 13<br>14 |
| Review for Final Examination | 15 |



**College Attendance Policy**
At BMCC, the maximum number of absences is limited to one more hour than the number of hours a class meets in one week. For example, you may be enrolled in a three-hour class. In that class, you would be allowed 4 hours of absence (not 4 days). In the case of excessive absences, the instructor has the option to lower the grade or assign an F or WU grade.

**Academic Adjustments for Students with Disabilities**
Students with disabilities who require reasonable accommodations or academic adjustments for this course must contact the Office of Services for Students with Disabilities. BMCC is committed to providing equal access to all programs and curricula to all students.

**BMCC Policy on Plagiarism and Academic Integrity Statement**
Plagiarism is the presentation of someone else's ideas, words or artistic, scientific, or technical work as one's own creation. Using the idea or work of another is permissible only when the original author is identified. Paraphrasing and summarizing, as well as direct quotations require citations to the original source. Plagiarism may be intentional or unintentional. Lack of dishonest intent does not necessarily absolve a student of responsibility for plagiarism.

Students who are unsure how and when to provide documentation are advised to consult with their instructors. The library has guides designed to help students to appropriately identify a cited work. The full policy can be found on BMCC's web side, www.bmcc.cuny.edu. For further information on integrity and behavior, please consult the college bulletin (also available online).