

This syllabus is provided as a general informational guide. Some of the information may vary depending on the specific course section and instructor. Different sections of the same course may require different textbooks. Verify the section specific textbook information in the CUNY's Academic Course Schedule Web Page. Modifications of the grading system presented here will be communicated by the instructors of the sections when they meet the class.

BOROUGH OF MANHATTAN COMMUNITY COLLEGE

The City University of New York

Department of Science

Title of Course ORGANIC CHEMISTRY II **Class Hours** 3

Course Code CHE240 - **Laboratory Hours per Week** 4

Semester _____

Instructor Information:

Credits 5

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 094; ENG 088 OR ESL 054; and MAT 051

Prerequisites MAT 056, CHE201, CHE 202 and CH 230

Corequisites NONE

Course Student Learning Outcomes (Students will be able to...)	Measurements (means of assessment for student learning outcomes listed in first column)
1. Structure determination using Infrared and Proton Nuclear Magnetic Resonance Spectroscopy.	1. In-class participation and/or worksheets Exam and Laboratory experiments/reports.
2. Conjugated dienes and their reactivity, the Diels-Alder reaction. Benzene, Aromaticity, and Hückel's $4n + 2$ and $4n$ rules.	2. In-class participation and/or worksheets, Exam and Laboratory experiments/reports.
3. Chemistry of Benzene: electrophilic and nucleophilic aromatic substitution reactions such as Friedel-Crafts alkylation/acylation, aromatic halogenation, nitration, sulfonation, etc.	3. In-class participation and/or worksheets Exam and Laboratory experiments/reports.
4. Structure, reactivity, reactions and synthesis of alcohols, phenols, ethers, and epoxides.	4. In-class participation and/or worksheets Laboratory Experiments/reports, and Exam.
5. Structure, reactivity, reactions and synthesis of carbonyl containing compounds such as aldehydes, ketones, carboxylic acids, esters, anhydrides, and amides.	5. In-class participation and/or worksheets, Exam and Laboratory experiments/reports.

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6. Nucleophilic addition reactions of aldehydes and ketones.	6. In-class participation and/or worksheets, Exam and Laboratory experiments/reports.
7. Carbonyl alpha-substitution reactions.	7. In-class participation and/or worksheets and Exam.
8. Organic transformations of carboxylic acids and nitriles.	8. In-class participation and/or worksheets, Exam and Laboratory experiments/reports.
9. Synthetic organic techniques for the building of small and large molecules and to show their relationship with biological structures.	9. Exam, and Laboratory experiments/reports.
10. Organic laboratory techniques and skills to synthesize, separate, purify and characterize (by chemical and spectroscopic techniques) organic compounds.	10. In-class participation and/or worksheets, Laboratory experiments/reports.

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.)

	General Education Learning Outcomes	Measurements (means of assessment for general education goals listed in first column)
<input type="checkbox"/>	Communication Skills- Students will be able to write, read, listen and speak critically and effectively.	
<input checked="" type="checkbox"/>	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%
<input checked="" type="checkbox"/>	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
<input type="checkbox"/>	Social and Behavioral Sciences- Students will be able to apply the concepts and methods of the social sciences.	
<input type="checkbox"/>	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.	
<input type="checkbox"/>	Information & Technology Literacy- Students will be able to collect, evaluate and interpret information and effectively use information technologies.	

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<input type="checkbox"/>	Values- Students will be able to make informed choices based on an understanding of personal values, human diversity, multicultural awareness and social responsibility.	
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Required Text: *Organic Chemistry* by David Klein, John Wiley & Sons, Inc., 2017 THIRD EDITION. ISBN

978-1-119-31615-2

Other Resources: *A small Scale Approach to Organic laboratory Techniques*, 3rd Ed. by Donald Pavia, Gary

Lampman, George Kriz and Randall Engel, Brooks/Cole Cengage Learning, 2011 ISBN-13: 978-1-4390-4932-7 and ISBN-10: 1-4390-4932-7.

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

Lab coats or apron and Molecular modeling kit.

Evaluation and Requirements of Students

The laboratory will be evaluated in preparation, laboratory technique and lab reports (laboratory notebook/journal). A student who is absent from more than two laboratory sessions, 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.

OUTLINE OF CONTENTS

Outline of Topics

Week	Chapter	Lecture Topics
1	14	Infrared Spectroscopy Introduction to Spectroscopy. Infrared Spectroscopy. Signal Characteristics: Wavenumber, Intensity, Shape. Analyzing an Infrared Spectrum. Using Infrared Spectroscopy to Distinguish between Two Compounds. Hydrogen Deficiency Index: Degrees of Unsaturation.

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2	Nuclear Magnetic Resonance Spectroscopy
15	Introduction to NMR Spectroscopy. Acquiring a ^1H NMR Spectrum. Characteristics of a ^1H NMR Spectrum. Number of Signals. Chemical Shift. Integration. Multiplicity. Drawing the Expected ^1H NMR Spectrum of a Compound. Using ^1H NMR Spectroscopy to Distinguish between Compounds. Analyzing a ^1H NMR Spectrum.
3	11 Synthesis
	One-Step and Multi-Step Syntheses. Functional Group Transformations. Reactions that Change the Carbon Skeleton. How to Approach a Synthesis Problem. Retrosynthetic Analysis. Practical Tips for Increasing Proficiency.
4,5	12 Alcohols and Phenols
	Structure and Properties of Alcohols. Acidity of Alcohols and Phenols. Preparation of Alcohols via Substitution or Addition. Preparation of Alcohols via Reduction. Preparation of Diols. Preparation of Alcohols via Grignard Reagents. Protection of Alcohols. Preparation of Phenols. Reactions of Alcohols: Substitution and Elimination. Reactions of Alcohols: Oxidation. Biological Redox Reactions. Oxidation of Phenol. Synthesis Strategies.
6	13 Ethers and Epoxides; Thiols and Sulfides
	Introduction, Nomenclature, Structure, Properties Preparation and Reactions of Ethers. Nomenclature and Preparation of Epoxides. Enantioselective Epoxidation. Ring-Opening Reactions of Epoxides. Thiols and Sulfides. Synthesis Strategies Involving Epoxides.
7,8	16 Conjugated Pi Systems and Pericyclic Reactions
	Classes of Dienes. Conjugated Dienes. Molecular Orbital Theory. Electrophilic Addition. Thermodynamic Control vs. Kinetic Control. An Introduction to Pericyclic Reactions. Diels-Alder Reactions. MO Description of Cycloadditions. Electrocyclic Reactions. Sigmatropic Rearrangement. UV-VIS Spectroscopy.
9	17 Aromatic Compounds
	Introduction. Nomenclature of Benzene Derivatives. Structure and Stability of Benzene. Aromatic Compounds Other than Benzene. Reactions at the Benzylic Position. Reduction of the Aromatic Moiety. Spectroscopy of Aromatic Compounds.
10,11	18 Aromatic Substitution Reactions
	Introduction. Halogenation. Sulfonation. Nitration. Friedel-Crafts Alkylation and Acylation. Activating and Deactivating Groups. Directing Effects of a Substituent. Multiple Substituents Synthesis Strategies. Nucleophilic Aromatic Substitution. Elimination-Addition. Mechanism of an Aromatic Substitution Reaction.

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12	19	Aldehydes and Ketones Introduction, Nomenclature, and Preparation. Nucleophilic Addition Reactions. Mechanism. Oxygen, Nitrogen, Sulfur, Hydrogen, and Carbon Nucleophiles. Baeyer-Villiger Oxidation of Aldehydes and Ketones. Synthesis Strategies. Spectroscopic Analysis.
13	20	Carboxylic Acids and Their Derivatives Introduction, Structure, Properties, Reactions, and Derivatives. Preparation and Reactions of Acid Chlorides, Acid Anhydrides, Esters, Amides, and Nitriles. Synthesis Strategies. Spectroscopy of Carboxylic Acids and Their Derivatives.
14,15	21	Alpha Carbon Chemistry, Enols and Enolates Introduction. Alpha Halogenation. Aldol Reactions. Claisen Condensations. Alkylation of the Alpha Position. Conjugate Addition Reactions. Synthesis Strategies.

Lab Schedule – CHE240

WEEK	EXPERIMENTS FOR ORGANIC CHEMISTRY I
1	Laboratory Safety and Laboratory Rules and Check-in
2	Infrared Spectroscopy analysis of selected compounds
3	NMR Spectroscopy analysis of selected compounds
4	Case Study on Retrosynthetic Analysis
5	Qualitative analysis of Alcohols (Handout)
6	Extraction of Thymol (Handout)
7	Hydrocarbon Classification tests (Handout)
8	Diels - Alder reaction
9	Nitration of Methylbenzoate
10	The Cannizzaro Reaction
11	Qualitative analysis of Aldehydes and Ketones (Handout)
12	Acetylsalicylic acid – Ester formation
13	Aldol reaction (Handout)
14	Case Study on Alpha Carbon Chemistry

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Class Participation

Participation in the academic activity of each course is a significant component of the learning process and plays a major role in determining overall student academic achievement. Academic activities may include, but are not limited to, attending class, submitting assignments, engaging in in-class or online activities, taking exams, and/or participating in group work. Each instructor has the right to establish their own class participation policy, and it is each student's responsibility to be familiar with and follow the participation policies for each course.

BMCC is committed to the health and well-being of all students. It is common for everyone to seek assistance at some point in their life, and there are free and confidential services on campus that can help.

Single Stop www.bmcc.cuny.edu/singlestop, room S230, 212-220-8195. If you are having problems with food or housing insecurity, finances, health insurance or anything else that might get in the way of your studies at BMCC, come by the Single Stop Office for advice and assistance. Assistance is also available through the Office of Student Affairs, S350, 212-220- 8130.

Counseling Center www.bmcc.cuny.edu/counseling, room S343, 212-220-8140. Counselors assist students in addressing psychological and adjustment issues (i.e., depression, anxiety, and relationships) and can help with stress, time management and more. Counselors are available for walk-in visits.

Office of Compliance and Diversity www.bmcc.cuny.edu/aac, room S701, 212-220-1236. BMCC is committed to promoting a diverse and inclusive learning environment free of unlawful discrimination/harassment, including sexual harassment, where all students are treated fairly. For information about BMCC's policies and resources, or to request additional assistance in this area, please visit or call the office, or email olevy@bmcc.cuny.edu, or twade@bmcc.cuny.edu. If you need immediate assistance, please contact BMCC Public safety at 212-220-8080.

Office of Accessibility www.bmcc.cuny.edu/accessibility, room N360 (accessible entrance: 77 Harrison Street), 212-220-8180. This office collaborates with students who have documented disabilities, to coordinate support services, reasonable accommodations, and programs that enable equal access to education and college life. To request an accommodation due to a documented disability, please visit or call the office.

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 site, www.bmcc.cuny.edu. For further information on integrity and behavior, please consult the college bulletin (also available online).