

KINGSBOROUGH COMMUNITY COLLEGE  
The City University of New York

Organic Chemistry 2 (CHM 32)

Credits: 5

**Instructor:** Prof. Varattur D. Reddy

**Lab:** S335

**Office:** S-345; Phone: (718) 368-5760

[vreddy@kbcc.cuny.edu](mailto:vreddy@kbcc.cuny.edu)

**TEXT:** "Organic Chemistry" by *L.G. Wade Jr.*, Eighth Edition, Pearson Education Inc., 2013. Essential problem-solving skills, and each skill is followed by problem numbers exemplifying that particular skill are included at the end of each chapter.

**Solutions Manual:** To the above text.

**Molecular Models:** Model set or the models available in the campus bookstore or on the Internet (<http://www.darlingmodels.com>, KIT #1). Other brands of molecular models are also acceptable.

**Lab Manual:** "Greener Organic Chemistry Experiments 2: A Miniscale and Microscale Approach" by *Varattur D. Reddy*, Third Edition, John Wiley & Sons, NJ, 2015.

Utmost importance is given to impart high quality education and delivery of the subject matter effectively to students. The following lecture schedule and homework problems are intended to prepare students for exams. Students are encouraged to try any additional problems in the chapters covered. Students should work on the homework problems as soon as possible the corresponding chapter is covered in the lecture.

### Lecture Schedule

<p><b>Week 1:</b> Chapter 12. <b>Infrared spectroscopy and mass spectrometry</b> Introduction. The electromagnetic spectrum, the infrared region, molecular vibrations, IR active and IR inactive vibrations, measurement of the IR spectrum. Infrared spectroscopy of hydrocarbons and different organic functional groups. Simplified summary of IR stretching frequencies. Reading and interpreting IR spectra. Using infrared spectroscopy to distinguish between two compounds. All the sections 12-1 to 12-15 are covered and homework problems assigned.</p>
<p><b>Part of Week 1 and Week 2:</b> Chapter 13. <b>Nuclear Magnetic Resonance Spectroscopy (NMR)</b> Introduction. Theory of nuclear magnetic resonance. The NMR spectrometer, the chemical shift, number of signals, integration, spin-spin splitting, complex splitting and coupling constants. Interpret <math>^1\text{H}</math> NMR and carbon-13 NMR. All the sections 13-1 to 13-14 are covered (except some subsections of 13-13 in section 13) and homework problems assigned.</p>
<p><b>Part of Week 2 and Week 3:</b> Chapter 15. <b>Conjugate systems, orbital symmetry, and UV spectroscopy</b> Introduction and stability of dienes. Molecular orbital theory of conjugated systems. Allylic cations, allylic radicals, molecular orbitals of the allylic system. 1,2 and 1,4 addition reactions. Kinetic versus thermodynamic control, Introduction to pericyclic reaction. Diels-Alder reactions, MO description of cycloaddition reactions. UV-VIS spectroscopy. All the sections 13-1 to 13-14 are covered and homework problems assigned.</p>
<p><b>Part of Week 3:</b> Chapter 16. <b>Aromatic compounds</b> Introduction. Structure, Stability, and molecular orbitals of Benzene. Aromatic Compounds other than Benzene. Aromatic, antiaromatic, and nonaromatic compounds. Heterocyclic compounds.</p>

Nomenclature of benzene derivatives. Spectroscopy of aromatic compounds. All the sections 16-1 to 16-15 are covered and homework problems assigned.
<b>Week 4: EXAMINATION 1</b> <b>Part of Week 4 and Week 5: Chapter 17. Reactions of aromatic compounds</b> Electrophilic aromatic substitution reactions. Mechanism of an Aromatic Substitution Reaction. Halogenation, nitration, and sulfonation. Fried el-Crafts Alkylation and Acylation. Activating and Deactivating Groups. Directing Effects of a Substituent. Multiple Substituents. Synthesis Strategies. Nucleophilic Aromatic Substitution. Elimination-Addition. Aromatic substitution using organometallic reagents. Side-chain reactions of benzene derivatives: oxidation and halogenation at benzylic position. All the sections 17-1 to 17-16 are covered and homework problems assigned.
<b>Week 6 and part of Week 7: Chapter 18. Ketones and Aldehydes</b> Introduction, nomenclature, physical properties. Synthesis. Addition Reactions with oxygen, nitrogen, hydrogen, and carbon nucleophiles. Mechanisms. Synthesis Strategies. Spectroscopic Analysis. All the sections 18-1 to 18-20 are covered and homework problems assigned.
<b>Part Week 7 and Week 8: Chapter 19. Amines</b> Introduction, classification of amines, nomenclature, physical properties, basicity. Reactions of amines: acylation, alkylation, elimination, oxidation, cope elimination, arenediazonium salt formation. Reactions of arenediazonium salts. Mechanisms. Synthesis of amines: reductive amination, acylation-reduction. Synthesis limited to primary amines. Synthesis Strategies. Spectroscopic Analysis. All the sections 19-1 to 19-19 are covered and homework problems assigned.
<b>Week 9: EXAMINATION 2</b> <b>Part of Week 9: Chapter 20. Carboxylic acids:</b> Introduction, nomenclature, structure and physical properties, acidity. Synthesis. Reactions of carboxylic acids to give carboxylic acid derivatives. Mechanisms. Spectroscopy. All the sections 20-1 to 20-15 are covered and homework problems assigned.
<b>Week 10: Chapter 21. Carboxylic acid derivatives:</b> Introduction, structure, nomenclature, physical properties. Reactions of Acid Chlorides, Acid Anhydrides, Esters, Amides, and Nitriles. Introversion of acid derivatives. Mechanisms. Synthesis Strategies. Spectroscopy. All the sections 21-1 to 21-16 are covered and homework problems assigned and homework problems assigned.
<b>Week 11: Chapter 22. Condensations and alpha substitutions of carbonyl compounds</b> Introduction. Enols and enolates. Keto-enol tautomerism, Alpha Halogenation. Aldol and crossed aldol condensations, aldol cyclizations, Claisen and crossed Claisen condensations, Claisen cyclization or Dieckmann condensation. Alkylation of the Alpha Position leading to substituted acetic acid and substituted acetone. Conjugate Addition Reactions (Michael addition) and Robinson annulations. Synthesis Strategies. All the sections 22-1 to 22-19 are covered and homework problems assigned.
<b>Week 12: EXAMINATION 3</b> <b>Part of Week 12: Very briefly some sections of Chapter 23. Carbohydrates and Nucleic Acids and Chapter 24. Amino acids, Peptides, and Proteins</b> are covered so that the students appreciate the materials that they learned in organic chemistry are used to understand biomolecules (biochemistry) in Chapter 23 and 24 and thus derives satisfaction for their hard work in this hard course.
<b>FINAL EXAMINATION</b>

## Examinations

There will be three in-class examinations (100 points each) for 50%, final exam (125 points) for 25%, and a Lab grade 25%. Make-up exams are NOT offered. The final exam is mandatory and comprehensive. The average of your lecture exams and final exam grades must be greater than 60% to permit a passing grade and 70% to pass the lab component. Tutorial services are offered in L605 and phone: 718-368-5118.

These major examinations include lecture material, modeled after the problems assigned from the text, and may include questions on laboratory work as well. Though the assigned problems are not graded they are strongly recommended as the best means of preparing for the examinations. The examinations will generally consist of about 10 questions, some of which will have multiple parts. Like the homework problems, the exam questions will be short answers, often requiring the drawing of a chemical structure, predicting the outcome of a chemical reaction or designing the synthesis of an organic compound. There will be a strong emphasis on the reaction mechanism involved.

The laboratory work (250 points) consists of exercises dealing with laboratory techniques, synthesis, spectroscopy, and qualitative organic analysis. This grade is determined by the student's performance in the laboratory, laboratory reports, and the student's notebook.

## Study Hints for Organic Chemistry 2 (CHM 32)

All students can learn and excel in Organic Chemistry. It is a **hard course** and requires lot of work, and it is very difficult to keep up. Students required to putting in lot of work by going through the notes, textbook, and working through homework problems **many times** to do very well. A good 8-9 hours per week is required. Learning organic chemistry requires lot of practice like learning any new language. You must begin working hard right from the first week. **You cannot wait until the first exam to begin studying.** There is simply too much material for anyone to absorb at the last minute. **Don't get behind! The course moves too fast and it is hard to catch up.**

Lot of material to learn in organic chemistry and thus do not try and simply memorize it. **Organic chemistry concepts are fairly simple but they lot of require practice. Learning individual examples will be easier by applying basic concepts, rationale or reasoning, and the underlying reaction mechanisms.** *Organic chemistry is really fun if students master these principles.* The best way to prepare yourself is through working the homework problems few times keeping in mind basic concepts like **electrophiles (acids) and nucleophiles (bases)**. Study with paper and pencil. **Practice drawing the chemical structures and writing the basic mechanisms.** Organize a study group of 3-4 students and work through the problems assigned and similar problems from the book. Study group forces students to keep up with the homework problems and explaining something to someone else often helps them to clarify in their own mind. Students have to be well-organized, self-motivated, and willing to work very hard. The exams are modeled based on homework problems emphasizing the major concepts and reaction mechanisms. Practice reaction mechanisms and the rationale for the observed reactivity. Organic Chemistry has enormous application in day-to-day life and it is vital to understand the life processes at the cellular and molecular level.

## Laboratory Notebook and Grading – Organic Chemistry 2 (CHM 32)

25% assigned for the laboratory part of the course. Lab grade is determined on the following: lab write-up, doing the experiment and recording the data, accuracy of the experimental data, and post-laboratory questions. You are required to submit a lab report for each experiment. There will be a comprehensive lab final examination.

The laboratory notebook-hard bound, composition-type book of at least 150 pages must be used. This is the working record of what you are going to do in the lab and what you have actually done and observed. The notebook **must be prepared in advance** for each experiment. The instructor will grade your notebook for each lab period.

Students are expected to arrive in the lab prepared for the experiment that they are going to perform. And students are required to come on time for pre lab lecture so that they are fully aware of safety precautions and understanding of the experiment.

### A good notebook should consist of the following:

I Table of contents-First three pages

II Numbered pages

III Experimental Write-up

- a. Heading: Experiment title and date
- b. Reference: This is where you found the experiment; that is, lab manual or hand sheets, page number
- c. Purpose of experiment: This is simply a brief, one sentence description of the experiment
- d. Preparation experiments. (We don't always prepare a compound, so the exact format may not apply. Use your judgment.)
  1. Table of physical constants for the materials used and the products. You should record: grams used, molecular weight, number of moles, melting point, boiling point, density.
  2. Note any unusual warnings or cautions.
  3. Diagram of the experimental set-up. This is not always appropriate, depending on the experiment. Usually, the exact nature of the experiment will be discussed immediately prior to the lab in the recitation hour and this section will be completed at that time.
  4. Concise, step-by step procedure
  5. Experimental observations. These should be added as the experiment is being performed. These observations often deal with color changes, temperature at which your compound boiled or distilled, etc. Record any changes you made to the procedure for whatever reason. Be honest. Record exactly what happened. You are still learning in the laboratory and many things go wrong, even for the experienced chemist. You are not being judged solely on the result but on your sincere efforts and the accuracy of your observations.

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**Organic Chemistry II (CHM 32)**

Lab Manual: "Greener Organic Chemistry Experiments 2: A Miniscale and Microscale Approach"  
by *Varattur D. Reddy*, Third Edition, John Wiley & Sons, NJ, 2015.

**Mandatory:** Safety glasses and lab coat.

Utmost importance is given to impart high quality education and delivery of the subject matter effectively to students. The emphasis is placed on coordinating the concepts presented mechanistically in lecture material with the laboratory experiments utilizing microscale and miniscale green approach. For example, the product synthesized in one experiment is utilized in other experiments, multistep-synthesis, atom economy, use of nature solvents and amount of solvents, and recovery of solvents. Strong emphasis placed on safety and waste disposable rules.

**Laboratory Schedule**

<b>Week</b>	<b>Experiment</b>
1	Check in, Safety Determining the structure of organic compounds by use of spectroscopy
2	Conversion of Acetaminophen to phenacetin by Williamsons Ether Synthesis
3	Friedel-Crafts Reaction
4	Synthesis of p-nitroaniline from aniline (three step synthesis, two-lab period (i)Acetylation of Aniline
5	(ii) p-Nitroacetanilide (iii) p-Nitroaniline
6	Qualitative tests for carbonyls: Unknowns
7	Qualitative tests for Amines: Unknowns
8	Preparation of p- Iodonitrobenzene
9	Synthesis of Dibenzalacetone Cannizzaro's Reaction Part-I
10	Cannizzaro's Reaction Part-II
11	Preparation of Methylbenzoate (Fischer Esterification)
12	Lab Final Exam Checkout.

### **College Attendance Policy**

A student in any course who has been absent 15% of the total number of instructional hours that a class meets during a semester or session is deemed excessively absent. Where the course includes classroom lectures plus another component such as a lab/field placement, etc., the 15% excessive absence policy applies to either component. Excessive absences may result in the instructor assigning either a lower grade or a "WU" for that course.

### **Students with Disabilities**

College can be stressful for most individuals. For individuals with disabilities, it can be a daunting task. Access Ability Services (AAS) helps students with disabilities to recognize their potential by removing potential barriers to their education. KBCC is committed to providing equal access to all programs and curricula to all students (Disability related services D205) and [www.kbcc.cuny.edu](http://www.kbcc.cuny.edu).

### **Plagiarism and Academic Integrity**

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. The full academic integrity policy can be found on KBCC's web site, [www.kbcc.cuny.edu](http://www.kbcc.cuny.edu)

### **Academic freedom-Henderson rules**

The tradition of the university as a sanctuary of academic freedom and center of informed discussion is an honored one, to be guarded vigilantly. The basic significance of that sanctuary lies in the protection of intellectual freedoms; the rights of professors to teach, of scholars to engage in the advancement of knowledge, of students to learn and to express their views, free from external pressures or interference. These freedoms can flourish only in an atmosphere of mutual respect, civility and trust among teachers and students, only when members of the College community are willing to accept self-restraint and reciprocity as the condition upon which they share in its intellectual autonomy. The full academic freedom can be found on KBCC website, [www.kbcc.cuny.edu](http://www.kbcc.cuny.edu)