Chemistry 030-206-21 Syllabus
Organic Chemistry

Summer II 2017

Lectures: **Monday, Tuesday, Wednesday, Thursday, and Friday 9:00-11:30 am: Mudd 26**

Lecturer: **Dr. Eric Hill**

Office Hours **Wednesday: 1:00-3:00 pm (Remsen 335)**

Text and Molecular Model

- P. Bruice, *Organic Chemistry*, 7th ed. with solutions manual; a molecular model kit is **strongly recommended**
- Though not required, I strongly encourage you to purchase: Electron Flow in Organic Chemistry: A Decision-Based Guide to Organic Mechanisms by Paul H. Scudder.

Problems

You will work problems during your recitation session but mostly, you will work them on your own. Specific homework assignments for grade will not be made. Working the problems within the chapter and at the end of the chapter is one of the best methods to learn the material and prepare for the exams. It is anticipated that you will be able to solve all the problems. The problems that develop the necessary basic skills and those that are particularly indicative of what to expect on the exams are listed at the end of the syllabus as "Suggested Problems." You are expected to do **all** of the problems within the chapter.

Course Content

For the purpose of exams, the course content is defined by (a) the lectures, (b) the relevant chapters in the text, and (c) any other specific assignments that are made. The outline and order of the topics covered is presented at the end of this handout. Please note that not all chapters will be covered in the order they are in the book. Some sections have been omitted and some will be covered at a later time. The sections that have been excluded will not be covered in the lectures, and the material will not be a part of the exams.

Grades

Your course grade is based on the following criteria:

- Three comprehensive exams, 100, 100, 100 points
- Comprehensive final exam, 150 points*

Final grades are based on performance on exams. There are no set grade lines and it is important to note that there is no set percentage of a certain grade. In fact, the entire class *can* get an "A". After each exam, you will receive some feedback as to how your numerical scores **might** translate into class grades. It is provided only to help you evaluate your own efforts and scores in the course. These indications should be treated as **rough** estimates of your final grade. Grade-lines have to be drawn somewhere, and the unavoidable consequence is that some students are just "a point" away from a higher grade. For the reason of fairness, the policy in this course is to NOT adjust students' grades in such circumstances.

*The final exam is based on 150 points. The first 100 points of the exam may be used to replace **ONE** of your midterm scores if it is higher.

Exams

- 1st exam Friday, July 14th, 2017 (9:00-10:20 AM)
- 2nd exam Friday, July 21st, 2017 (9:00-10:20 AM)
- 3rd exam Friday, July 28th, 2017 (9:00-10:20 AM)
- Final exam Friday, August 4th, 2017 (9:00 AM-12:00 PM)

The exam locations will be announced in class.

All exams will be cumulative (but they will emphasize the material covered since the previous test). They will be constructed in such a way as to emphasize active understanding of the material. To take the exam, you will need a pen or a pencil. You cannot use books, scratch paper (other than furnished), calculators, cell phones, or electronic devices of any kind including those not yet invented. You may, however, use a molecular model kit (it may not contain any written materials). If an exam is missed, it will be replaced with a comprehensive exam that will be administered during reading period. A valid excuse which requires written justification from an appropriate official such as a non-parent physician or the Dean of Student Life is required. You should never take an exam if you are sick or otherwise compromised. However, the grade for an unexcused exam will be a zero.

Regrades

Your examinations are marked according to an explicit key and set of guidelines provided by the Professor to the TAs. If you think that a question has been graded incorrectly, submit the exam to your TA.

In rare instances, an addition error of points may be made; please check for these at once and report any such to the TA *immediately* and turn in the exam.

The assignment of points and partial credit is to be considered accurate; the score you receive is not an "opening bid" in some putative haggling process. NEVER bring such issues to the Professor. In extraordinary circumstances only, a "regrade" may be entertained, subject to the following regulations:

1. The request for regrade must be submitted to your TA by the end of conference when the exam is returned, and must be accompanied with a written explanation of the problem. ("I think I deserved more points" is a non-starter.)
2. The **entire** exam will be regraded--this may result in no change, or a lower or a higher score**. NOTE: All exams are scanned.**

Advice: The neater and more orderly your exam, the more likely you are to receive full marks. When TAs have to hunt about for your answer, or decipher squiggles and jots, or cast about to guess at your manner of proceeding, it is more likely that the credit you receive will be lower than you might like. Therefore, fill out exam papers in an orderly and straightforward way with clear, to-the-point explanations. Practice this method of answering when writing out your homework exercises. You are encouraged to discuss chemistry and/or the course with your teaching assistant and your instructor Simple questions or comments can also be sent via e-mail. For administrative questions, see your teaching assistant.

Rules for Class Periods, Exams, and General Considerations

Organic Chemistry is a difficult course. It covers a lot of demanding material. As such, you should pay attention during lecture. Therefore, **no electronic devices are to be used in the class or during exams.** Observations made over the past few years suggest some generally useful strategies that help to improve student performance. These are summarized below, and a more extensive discussion is provided on the web.

- read the chapter material *before* the lecture
- study *everyday*; do reviews weekly
- solve as many end-of-chapter problems as possible (resort to answer book only after you have attempted the problem)
- study with a friend; if you can explain a concept to your study-mate, you understand it
- just reading and understanding the material (passive understanding) is insufficient; you should be able to use the just learned concepts in situations not previously encountered, and make logical connections with concepts learned previously (active understanding)
- constantly probe your understanding by asking (and answering) the question "why?" in relation to all statements and logical constructions
- do not fall behind in your study; it is virtually impossible to prepare well for the exam in just a few days

Academic Ethics

Cheating is wrong. Cheating hurts our community by undermining academic integrity, creating mistrust, and fostering unfair competition. The university will punish cheaters with failure on an assignment, failure in a course, permanent transcript notation, suspension, or expulsion. Offenses may be reported to medical, law, or other professional or graduate schools when a cheater applies.

Violations can include cheating on exams, plagiarism, reuse of assignments without permission, improper use of the

internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Ignorance of these rules is not an excuse. Such infractions are considered cause, at the least, for awarding a "0" on the exam in question with additional sanctions that are listed above.

Working together before the exam is desired but you must complete all exams on your own. You may not have someone else take the exams for you. You may not obtain information from another student or provide information to a student about the exam either by communicating with them or looking at anything that another student has written. You may not allow another student to see anything that you have written.

On every exam, you will sign the following pledge: "I agree to complete this exam without unauthorized assistance from any person, materials, or device. [Signed and dated]" For more information, see the guide on "Academic Ethics for Undergraduates": http://e-catalog.jhu.edu/undergrad-students/student-life-policies/#Violations_of_acad

Getting Help

There are a number of mechanisms for you to get help. One of the teaching assistants will be available at 5 PM during the week. Office hours will be announced. Also, consider the problems solving course and forming your own study group.

Chemistry 030.206.21: Outlines of Lectures

1. Structure Determination (5 lectures*)

- Nuclear Magnetic Resonance (^{1}H, ^{13}C)
- Infrared Spectroscopy
- Mass Spectrometry (important fragments only)
- UV spectroscopy (review)

Sections covered: 14.1-14.22; 15.1-15.24
Suggested problems: 14.44-14.73, 15.46-15.78

3. Aldehydes and Ketones: Nucleophilic Addition Reactions and Organometallic Reagents (6 lectures*)

- Overview of chemistry of carbonyl compounds (molecular orbital description of the carbonyl group, nucleophilic addition/substitution reactions, α-substitution, enolates, condensations)
- Preparation (oxidation of alcohols, ozonolysis, functional-group interconversions)
- Nucleophilic addition (irreversible: hydride, organometallic reagents, Wittig; reversible: HCN, alcohols, amines)
- Imine and enamine formation; reductive amination
- Protecting groups
- Baeyer-Villiger Oxidation
- Organometallic reagents (Grignard, organolithium, Gilman, Suzuki, and Heck)
- Reactions and the formation of new carbon-carbon bonds

Sections covered: 17.1-17.19; 11.5, 11.7; 12.1-12.4
Suggested problems: 17.53-17.93 (a only); 11.59, 11.67, 11.75; 12.23-12.26, 12.28 (except c)-12.31, 12.35

4. Carboxylic Acids and Derivatives: Nucleophilic Acyl Substitution Reactions (5 lectures*)

- Structure and acidity (pK_a) of carboxylic acids
- Preparation of carboxylic acids (oxidation, haloform reaction, Grignard carboxylation, nitrile hydrolysis)
- Preparation of carboxylic acid derivatives (acyl chlorides, anhydrides, esters, amides, nitriles)
- Mechanism and relative reactivity of carboxylic acid derivatives in nucleophilic acyl substitution reactions
- Hofmann and Curtius Rearrangements

Sections covered: 16.1-16.12, 16.14-16.17, 16.19-16.22
Suggested problems: 16.57-16.77, 16.84, 16.87-16.90, 16.93

5. Carbonyl α-Substitution Reactions and Carbonyl Condensation Reactions (4 lectures*)

- Enols/enolates, (pK_a of carbonyl compounds)
- Reactions with electrophiles (halogens, alkylations)
- Aldol and Claisen condensations
- Michael reaction
- Conjugate addition (HCN, cuprates)

Sections covered: 18.1-18.22
Suggested problems: 18.48-18.62, 18.64-18.83, 18.85-18.87

6. Amines and Aryl Amines (1 lecture*)

- Properties and Reactions

Sections covered: 20.1-21.8 (not nucleophilic aromatic substitution, pp. 1002-3)
Suggested problems: 20.22 (all but b), 20.22-28, 20.33, 20.38

7. Pericyclic Reactions (2 Lectures*)

- Electrocyclic reactions
- Cycloadditions (Diels-Alder (review) and [2+2])
- Sigmatropic rearrangements (Cope and Claisen rearrangements)

Sections covered: 28.1-28.7
Suggested problems: 28.23-28.38, 28.44

8. Carbohydrates (3 lectures*)

- Structure of carbohydrates
- Reactions of monosaccharides
- Di and polysaccharides
- Fischer determination of the structure of D-glucose

Sections covered: 21.1-21.17, 21.19
Suggested problems: 21.31-21.36, 21.40-21.46, 21.55, 21.57, 21.62, 21.63, 21.66

9. Amino Acids, Peptides and Proteins; Heterocycles and Nucleic Acids (4 lectures)

- Structures, properties, and synthesis of amino acids
- Peptide synthesis and sequencing
- Protein structure
- DNA and RNA bases
- DNA structure (nucleotide, double helix forms)
- Replication, Transcription, Translation overview

Sections covered: 22.1-23.6, 22.8-22.12, 22.14-22.17; 26.1-26.14
Suggested problems: 22.47, 22.48, 22.50-22.54, 22.56, 22.58, 22.70, 22.71; 26.25, 26.26, 26.30-26.32, 26.34-26.40

10. Catalysis (2 lectures*)

- Acid-base catalysis (specific and general)
- Nucleophilic catalysis
- Intramolecular catalysis
- Metal ion catalysis
- Enzyme catalyzed reactions: proteases

Sections covered: 23.1-23.9, (23.11 and 23.12 covered under section 12)
Suggested problems: 23.30, 23.31-23.42

11. The Organic Chemistry of Coenzymes (2 lectures*)

- NADH and NADPH
- FAD and FMN
- TPP, Biotin, SAM , THF,
- B_{12} and PLP if time allows

Sections covered: 24.1-24.7
Suggested problems: 24.25-24.30, 24.37, 24.38

12. The Organic Chemistry of Metabolic Pathways (4 lectures*)

- ATP and phosphoryl transfer reactions
- Catabolism and Anabolism
- Catabolism of fats and carbohydrates
- Glycolysis and the TCA cycle

Sections covered: 25.1-25.8, 25.9-25.14
Suggested problems: 25.38-25.49, 25.56-25.63

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* The number of lectures is only approximate; adjustments may be made as necessary. You should solve all in-chapter problems.