PREREQUISITE

CHM 234 (Organic Chemistry I) or equivalent.

TEXT AND MOLECULAR MODELS


If you are the first person to point out an error in the text or solutions manual (5th edition only), you will get one extra credit point. Minor typos may not count.

OFFICE HOURS

My office is in room 349 Hannah Hall, with voice mail at 248-370-2091. You can also leave messages with the Chemistry Department secretary at 248-370-2320. I have e-mail at ott@oakland.edu. I will have office hours on Mondays and Wednesdays from 9:00 AM to 9:30 AM and Thursdays from 11:45 AM to 12:45 PM. You can also try to find me in my office before lecture on other days, or arrange to meet me before or after class.

LECTURES

We will start with chapter 13 and go as far as chapter 22 of the text, thus each chapter will need to be covered in about two or three lectures. The material will be rather rapidly paced. You are encouraged to read the chapters in advance of the lecture. If you miss a lecture you need to find out on your own, outside of class, what was missed.

It is expected that you have signed up for this course intending to come to class and do the work. While occasional absences due to work or illness are inevitable, and the grading scheme is designed to accommodate that by allowing you to drop one test and providing more than the minimum number of assignments to be done in class, if you plan to miss large amounts of class you may want to reconsider if this is a suitable semester to be taking this course. Tests and group assignments (except the final exam) will not be given outside of the class times of 9:45 to 11:20 AM, Monday through Thursday.

This course is the continuation of Organic Chemistry I. Topics include nuclear magnetic resonance spectroscopy, reactions of carbonyl compounds, oxidation reactions, reactions of amines, and possibly carbohydrates and proteins.
The grade will be determined by scores on tests, homework assignments, group assignments done during class, and a final exam. Five tests worth 50 points each will be given each Wednesday starting on July 14. The last test will be on Tuesday, August 10, as there are restrictions on tests given too close to the end of the semester. The tests will only take a portion of the class time on the particular day. Material for the test will be announced the preceding Thursday. Although each test will focus on material covered since the previous test, organic chemistry is cumulative in nature so you may still need to know prior material. Four of the tests will count towards your grade. If you miss a test for any reason that test will be dropped. (This includes illness, funerals, and work.) If and only if you take all five tests, your lowest score will be dropped. Tests may not be retaken.

Six homework assignments worth 20 points each will be given out on Wednesdays to be turned in the following Mondays. The first one will be due on the Tuesday because of a holiday. The first assignment will be handed out on June 30th and the last on August 5th. Five of the six homework assignments will count towards the grade. If you turn in all the assignments then the lowest score will not count. If you do not turn in an assignment it will count as your drop. Because I usually go over assignments in class on the day they are due, I do not want to accept late assignments.

At various times during the course you will divide into groups and do group exercises in class. These will be worth 10 points each. The group assignments are not pre-scheduled, and will be given as we finish various topics. A minimum of five such exercises will be given; if there are more you will get extra credit or they can make up for exercises that you may have missed. You will not be allowed to make up any such assignments that you miss.

The final exam will be given on Monday, August 16 from 8 AM to 11 AM as scheduled in the course schedule. The exam will be a comprehensive exam worth 150 points. If you miss the final exam, you need to contact me by 5 PM, August 19 to be allowed to take a make-up final exam. If you do not take the make-up exam before I assign grades, you will get a temporary grade based upon your point total as of August 17.

The overall grading scheme is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 of 5 tests @ 50 points</td>
<td>200</td>
</tr>
<tr>
<td>5 of 6 homework assignments @ 20 points</td>
<td>100</td>
</tr>
<tr>
<td>5 group assignments (minimum) @ 10 points</td>
<td>50</td>
</tr>
<tr>
<td>Final exam</td>
<td>150</td>
</tr>
<tr>
<td>Total points possible</td>
<td>500</td>
</tr>
</tbody>
</table>

4.0 = 455+ points (91+%)  
3.7 = 430-439 points (86-87%)  
3.9 = 440-454 points (88-90%)  
3.5 = 425-429 (85%)  

Below 425 points, every 5 points means a grade of 0.1 less, i.e., 84% = 3.4, 80% = 3.0, 28% = 2.8, etc.

If you come to class and do not officially withdraw you can expect to get a grade of 0.0. The deadline for dropping the course is August 2nd. According to the official University policy an incomplete (I) can only be given in extreme circumstances.

Midterm grades may be given out only to students who are making unsatisfactory progress (below 70%).
ACADEMIC INTEGRITY
Students are expected to follow the Academic Conduct Regulations in the student handbook, available online at www2.oakland.edu/deanofstudents/handbook/acr.efm.

EXTRA CREDIT
You can get extra credit for group assignments beyond the first five and for finding mistakes in the text or study guide. Occasionally I have given other extra credit assignments, but not always, and you should not depend on it. Such extra credit cannot be used to replace missing tests or homework assignments or to compensate for not doing five group assignments. No extra credit will be given out to be due after the final exam, nor will individual extra credit assignments be given out.

WEB SITE
The course site on Moodle will have course documents and some study questions for each chapter. This is accessible through Moodle at https://moodle.oakland.edu. (The preferred browser for Moodle is Firefox, available for free at http://www.mozilla.com/firefox/.) The questions do not necessarily cover all the information you need in each chapter.

TENTATIVE LECTURE SCHEDULE
Lecture topics are tentative. Exams are fixed and will only be changed in the unlikely event that class does not meet on an exam day.

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 28 Mon</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>June 29 Tue</td>
<td>Chapter 13</td>
</tr>
<tr>
<td>June 30 Wed</td>
<td>Chapter 13, 14. Homework #1 handed out</td>
</tr>
<tr>
<td>July 1 Thu</td>
<td>Chapter 14</td>
</tr>
<tr>
<td>July 5 Mon</td>
<td>Independence Day holiday. No class.</td>
</tr>
<tr>
<td>July 6 Tue</td>
<td>Chapter 14 Homework #1 due</td>
</tr>
<tr>
<td>July 7 Wed</td>
<td>Chapter 14 and 15. Homework #2 handed out</td>
</tr>
<tr>
<td>July 8 Thu</td>
<td>Chapter 15</td>
</tr>
<tr>
<td>July 12 Mon</td>
<td>Chapter 15and 16. Homework #2 due</td>
</tr>
<tr>
<td>July 13 Tue</td>
<td>Chapter 16</td>
</tr>
<tr>
<td>July 14 Wed</td>
<td>TEST 1. Lecture on Chapter 16. Homework #3 handed out</td>
</tr>
<tr>
<td>July 15 Thu</td>
<td>Chapter 16</td>
</tr>
<tr>
<td>July 19 Mon</td>
<td>Chapter 16 Homework #3 due</td>
</tr>
<tr>
<td>July 20 Tue</td>
<td>Chapter 17</td>
</tr>
<tr>
<td>July 21 Wed</td>
<td>TEST 2. Lecture on Chapter 17, Homework #4 handed out</td>
</tr>
<tr>
<td>July 22 Thu</td>
<td>Chapter 17</td>
</tr>
<tr>
<td>July 26 Mon</td>
<td>Chapter 17. Homework #4 due</td>
</tr>
<tr>
<td>July 27 Tue</td>
<td>Chapter 18</td>
</tr>
<tr>
<td>July 28 Wed</td>
<td>TEST 3. Lecture on Chapter 18. Homework #5 handed out</td>
</tr>
<tr>
<td>July 29 Thu</td>
<td>Chapter 18</td>
</tr>
<tr>
<td>August 2 Mon</td>
<td>Chapter 19. Homework #5 due</td>
</tr>
<tr>
<td>August 3 Tue</td>
<td>Chapter 19</td>
</tr>
<tr>
<td>August 4 Wed</td>
<td>TEST 4. Lecture on Chapter 19. Homework #6 handed out</td>
</tr>
<tr>
<td>August 5 Thu</td>
<td>Chapter 20</td>
</tr>
<tr>
<td>August 9 Mon</td>
<td>Chapter 20. Homework #6 due</td>
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<tr>
<td>August 10 Tue</td>
<td>TEST 5. Lecture on Chapter 20</td>
</tr>
<tr>
<td>August 11 Wed</td>
<td>Chapter 21</td>
</tr>
<tr>
<td>August 12 Thu</td>
<td>Chapter 22 and review</td>
</tr>
<tr>
<td>August 16 Mon</td>
<td>FINAL EXAM 8:00 to 11 AM</td>
</tr>
</tbody>
</table>
GOALS FOR THE COURSE

Chapter 13:
- Be able to determine the structure of a compound based upon its $^1$H-NMR spectrum (13.3, 13.4, 13.5, 13.6, 13.7, 13.9, 13.10, 13.13, 13.14, 13.16)
- Understand how $^{13}$C-NMR works (13.19)
  
  *Suggested problems, pp. 621 ff: 43, 45, 46, 50, 51, 52, 54, 56, 58, 62, 66, 69, 71, 72*

Chapter 14:
- Be able to recognize structures as being aromatic (14.3) or antiaromatic (14.6)
- Be able to name monosubstituted benzenes (14.8)
- Understand how benzene reacts (14.9, 14.10)
- Know how benzene can be halogenated (14.11), nitrated (14.12), sulfonated (14.13), acylated (14.14), or alkylated (14.15)
- Know the Clemmensen and Wolff-Kischner reactions (14.16)
- Know how to alkylate benzene by coupling reactions (14.17)
- Learn how some substituents on benzene can be converted into other substituents, particularly to make benzoic acid or aniline (14.19)
  
  *Suggested problems, pp. 673 ff: 31, 32, 35, 37, 43, 45, 47*

Chapter 15:
- Be able to name disubstituted and polysubstituted benzenes (15.1)
- Understand how substituents can be activating, deactivating, ortho-para directors, and meta directors (15.2), and be able to used these rules in syntheses (15.3, 15.6, 15.7)
- Be able to use arenediazonium salts to synthesize substituted benzenes (15.9)
- Be able to use arenediazonium salts to synthesize azo compounds (15.10)
- Understand the S$_N$ Ar reaction (15.12)
- Understand how benzyne intermediates are used in synthesis (15.13)
  
  *Suggested problems, pp. 714 ff: 34, 35, 35, 38, 42, 43, 45, 47, 48, 49, 52, 54, 62*

Chapter 16:
- Be able to name carboxylic acids using IUPAC nomenclature, and using common names for smaller compounds (4 carbons or less) (16.1)
- Be able to name acyl halides, acid anhydrides, esters, amides, and nitriles (16.1)
- Understand the relative reactivities of carboxylic acids and their derivatives (16.6)
- Know the reactions of anhydrides (16.9), esters (16.10, 16.11, 16.12), carboxylic acids (16.15), amides (16.16, 16.17), and nitriles (16.19)
- Be able to show how to synthesize a primary amine by the Gabriel synthesis (16.18)
- Know how to activate carboxylic acids (16.21)
- Know how to name dicarboxylic acids by IUPAC nomenclature, and using common names for dicarboxylic acids of six or fewer carbons (16.23)
  
  *Suggested problems, pp. 779 ff: 45, 46, 47, 54, 55, 56, 57, 58, 62, 64, 75, 77, 81*

Chapter 17:
- Know how to name aldehydes and ketones using IUPAC nomenclature, and using common names for ketones and for aldehydes of four or fewer carbons (17.1)
- Understand how aldehydes and ketones react (17.3)
- Be able to show how carbonyl compounds react with Grignard reagents (17.4) and acetylide ions (17.5)
- Know how aldehydes and ketones are reduced (17.6)
- Learn the reactions of aldehydes and ketones with hydrogen cyanides (17.7) and amines and their derivatives (17.8)
- Know the reactions of aldehydes and ketones with alcohols (17.10)
- Understand how to use protecting groups in synthesis (17.11)
- Learn how to reduce aldehydes and ketones using thiols and Raney nickel (17.12)
- Know how to synthesize compounds with the Wittig reaction (17.13)
Chapter 17, continued
- Know how nucleophiles add to $\alpha,\beta$-unsaturated aldehydes and ketones (17.16) and carboxylic acid derivatives (17.17)
  
  Suggested problems, pp. 841 ff: 45, 46, 48, 49, 52, 53, 58, 59, 60, 61, 62, 64, 66, 69, 75, 76, 79

Chapter 18:
- Understand how the acidity of an $\alpha$-hydrogen can be used in syntheses (18.1)
- Know the importance of keto-enol tautomers (18.2)
- Understand how enolate ions can form and react (18.3, 18.4)
- Know the haloform reaction (18.5) and Hell-Volhard-Zelinski reaction (18.6)
- Know how LDA can be used in synthesis (18.8, 18.9)
- Be able to do syntheses using enamine intermediates (18.10)
- Be able to do syntheses using the Michael reaction and Stork enamine reaction (18.11)
- Know the aldol reaction (18.12, 18.13, 18.14, 18.17)
- Know the Claisen condensation (18.15, 18.16, 18.17)
- Learn how 3-oxocarboxylic acids can be decarboxylated, and how this reaction is synthetically useful (18.18)
- Know the malonic ester synthesis of carboxylic acids (18.19) and the acetoacetic acid synthesis of ketones (18.20)
  
  Suggested problems, pp. 899 ff: 48, 49, 50, 53, 54, 55, 58, 59, 60, 62, 64, 65, 67, 68

Chapter 19:
- Know the various ways to reduce alkenes, alkynes, aldehydes, ketones, carboxylic acids, esters, acyl chlorides (19.1)
- Know the ways that alcohols can be oxidized (19.2)
- Know the ways that aldehydes and ketones can be oxidized (19.3)
- Know the reactions of potassium permanganate with alkenes to form diols (19.5) and carboxylic acids (19.7)
- Learn the other reactions for oxidation of alkenes (19.5) and ozonolysis (19.7)
- Know how the oxidative reactions affect alkynes (19.8)
  
  Suggested problems, pp. 936 ff: 31, 32, 33, 34, 35, 36, 37, 38, 39, 41, 42, 45, 46, 47, 49, 50, 52, 53, 56, 57, 59, 61

Chapter 20:
- Know how to name amines, including some of the heterocyclic amines (20.1)
- Understand how amines act as bases and as nucleophiles (20.1)
- Know the Hofmann elimination reaction (20.4)
- Know how amines can be synthesized (20.7)
- Know the structures of pyrrole, pyridine, and furan (20.8, 20.9) and how they can react in substitution reactions (20.8)
  
  Suggested problems, pp. 973 ff: 26, 27, 35, 42, 43, 49

Chapter 21:
- Be able to identify ketoses, aldoses, and understand other basics of carbohydrate nomenclature (21.1, 21.2), and glucose and fructose (21.1)
- Be able to draw Haworth structures, and know how rings are formed (21.11)
- Know how glycosides form (21.13)
- Understand anomers (21.14)
- Know the simple disaccharides maltose, lactose, sucrose, and cellobiose (21.16)
- Know the polymers amylose, amylpectin, and cellulose (21.17)
- Learn some of the biological roles of carbohydrates (21 introduction, 21.17, 21.18, 21.19)
  
  Suggestions of problems may be made later

Goals for Chapter 22 may be made later, as it is uncertain if we will get that far in the course.
Chapter 22:

- Be able to identify an amino acid, and know what “essential amino acid” means (22.1)
- Identify amino acids as being acidic, basic, hydrophilic, and hydrophobic (22.1)
- Understand the acid-base properties of amino acids (22.3)
- Know how peptide bonds form (22.8)
- Understand how proteins may be held together by disulfide bonds (22.8)
- Know what primary, secondary, tertiary, and quaternary structure of proteins means (22.12, 22.14, 22.15, 22.16) and how the structures are formed (22.16)

*Suggestions of problems may be made later*