Chem 332 Elements of Organic Chemistry II

Summer Session 2007

Term #2 7/23 to 8/23 MTWTh 9:15-11:00 UTS 505

INSTRUCTOR Dr. Nicolas N. Hamel—mail box in Chemistry office; leave important phone messages 725-3811; office in room UTS 505; ½ hour before ½ hour after class.

REQUIRED *Introduction to Organic Chemistry*, 3rd ed., by Brown and Poon.

OPTIONAL Study guide to accompany text and molecular model kits in PSU bookstore are recommended.

ATTENDANCE Regular attendance is expected and strongly encouraged. You are responsible for all material presented in lecture including topics and reactions not in the book, announcements, and/or changes to the outline or schedule. No make-up exams will be given without prior agreement (**well in advance**) or in case of a documented medical reason.

UNIT EXAMS and FINAL The unit exams will be given on or near the times listed in the course calendar. You are responsible for knowing about any changes made to the calendar. Some unit exam questions will be similar to those listed as *Primary Questions* for each chapter. Other will be different in style or more involved and in depth. These will come from examples and/or special subjects presented in lecture. A nationally standardized final examination will be given on the time listed in the Summer Session schedule.

GRADING The two lowest scores, including the final exam, will count as 20% each toward your class points. The two highest will count as 30% each. If the number of exams changes, these percents will be adjusted.

CLASS POINTS AND GRADE EARNED

below 50 F	58 – 62 D+	70 – 74 C+	82 – 86 B+
50 – 54 D-	62 – 66 C-	74 – 78 B-	86 – 90 A-
54 – 58 D	66 – 70 C	78 – 82 B	above 90 A

I reserve the right to lower any or all cut-offs for grades but cut-offs will not be raised.

IMPORTANT Portland State University policy will be strictly followed concerning course deadline dates (withdrawal, *etc*) and academic honesty.

HELPFUL HINTS

Organic Chemistry is a wonderful science that enables you to apply a small handful of interrelated topics (normally covered in a general chemistry course) to understand the commonality of what appears to be a staggering amount of information. Having completed a sequence of organic chemistry you will have the tools necessary to appreciate the underlying chemical compounds, properties, and reactions of such diverse substances as the components making up proteins in your body, sugars in your foods, rubber on your shoe soles and acrylic adhesives used in dentistry.

Success in an organic chemistry course depends mainly on two things:

- recognizing that the topics are indeed interrelated
- staying on top of the material

How can you get the most out of this course? See the two statements above! Organic chemistry is often described as being a bunch of memorization. Some of this is true, but only a small portion. Understanding how a few key tools, readily at your fingertips, can be applied over and over again is the most useful way for you to master the course material. Falling behind in the course work is probably the worse thing you can do. New concepts build on material previously applied. By falling behind, many students attempt to memorize their way through the chapters. Can this be done? Certainly, but only by very few people.

How will the instructor help you get the most out of this course? See the two statements above! I will act as a guide to steer you through the concepts needed in order for you to master the topics. I will organize lecture materials, clarify concepts in the textbook, reinforce topics you encounter in "real life", suggest alternative methods and models for mastering the material, and will steer you toward practice exercise on which you can build and test your own knowledge. But I am only your guide—you, yourself, must get to your goal!

Keys to success are included on the next page. You may already use some or all of these on your own, or you may have other means of studying. Even so, keep these with you throughout the course and please, get your questions cleared up at once and don't get behind. Summer session goes at a very quick pace!

STUDY HINTS

- It is very hard to study without a pencil in your hand!

- Do suggested exercises until you **understand** the topics and logic involved.

    1. You will understand how to solve a problem better if you solve it yourself.

    2. Looking at the answers is ok, provided that afterward you can close the book and solve the problem on your own.

    3. Understanding a problem does not occur just by watching another person solve the same or similar problem.

- Stuck on a problem? Try the following:

    1. Think about what was discussed in class, re-read the sections in your book, look at similar topics and practice problems.

    2. Identify what you do understand and write it down.

    3. Identify what you don't understand and write it down. This is crucial, it tells you what you need to go back and work on.

    4. Go back and work on what you need to. Don't assume that only the current problem is important, you have just identified a tool that you cannot use!

- Stay current so you will know when you need help.

    1. **Cramming does not work!**

    2. Do not put off getting help then expect to learn an entire chapter in one session.

Finally--- **PLEASE,** come to me for help as often as you like. Bring your notes, book, and specific questions. Be sure to come before it is too late.

TENTATIVE SCHEDULE

(see attached chapter outlines)

Monday	**Tuesday**	**Wednesday**	**Thursday**
23 July Chapter 10. Amines	**24 July** Chapter 11. Infrared Spectroscopy	**25 July** Chapter 11.	**26 July** Chapter 12. NMR Spectroscopy
30 July Chapter 12. NMR Spectroscopy	**31 July** Chapter 13. Aldehydes and Ketones	**1 Aug** **unit exam I** **Chapters 10,11,12.**	**2 Aug** Chapter 13.
6 Aug Chapter 14. Carboxylic Acids	**7 Aug** Chapter 14.	**8 Aug** Chapter 15. Derivatives of Carboxylic Acids	**9 Aug** Chapter 15.
13 Aug Chapter 16. Enolate Anions	**14 Aug** **unit exam II** **Chapters 13,14,15.**	**15 Aug** Chapter 18. Carbohydrates	**16 Aug** Chapter 18.
20 Aug Chapter 19. Amino Acids and Proteins	**21 Aug** Chapter 19.	**22 Aug** **unit exam III** Chapters 16,18,19	**23 Aug** **Final Exam** ACS Final Exam.

CHAPTER OUTLINES

(see tentative schedule for dates)

Questions? Write your questions or homework problems here. **Be sure to ask !**	**Chapter(s), hints & homework.** Problems in the body of the chapter should be worked as the sections are read (unless listed below as "omit". Also suggested end-of-chapter problems are listed below as primary (you must be able to solve them) or secondary (use these for extra practice if needed). Do not spend time on problems not listed.
	Chapter 10. Amines. Page 280 don't memorize the names for the structures on the top of the page but, do know meaning of heterocyclic aliphatic and heterocyclic aromatic. Understand the cause of the physical and chemical properties of amines. Review chapter 2 as needed to be comfortable with pKb, pKa, and equilibria. **Body-of-chapter problems:** all. **End-of-chapter problems:** primary 9, 10, 13, 14, 16 (excellent), 17 (excellent), 18, 19, 20, 21 (excellent), 23, 27, 28, 29 (excellent), 34, 42, 43, 44, 45; secondary 11, 12, 13, 15, 22, 31, 32, 35.
	Chapter 11. Infrared Spectroscopy. Page 306 don't memorize quantitative conversions of *wave number* and λ but do understand the qualitative relationships. Understand the cause of infrared-activity, intensity, and location in spectra and be able to relate this to dipole and bond strength. (For example… why is the C—O relatively intense and why is it at a lower wavenumber than C=O?). Be able to calculate the "index of hydrogen deficiency" or "degrees of unsaturation" using the alternative $(2C + N + 2 - H - X)/2$. Note: Some of the above is not addressed in your textbook. **Body-of-chapter problems:** all. **End-of-chapter problems:** primary all.

	<u>Chapter 12. Nuclear Magnetic Resonance.</u> Pages 330 don't memorize field strengths or joules, etc. Understand the cause of resonance, shielding, and general use of NMR instruments. Be able to relate shielding of local electrons to chemical shifts to resonance ppm. In turn you should be able to relate local electron density to neighboring atoms and functional groups (*e.g.* What <u>causes</u> the trend in the alkyl iodide to alkyl fluoride chemical shift seen in table 12.1? <u>Why</u> is the RCOOH shift so far downfield?) Note: The above is not addressed in your textbook. Be able to calculate the "index of hydrogen deficiency" or "degrees of unsaturation" using the alternative $(2C + N + 2 – H – X)/2$. **Body-of-chapter problems:** all. **End-of-chapter problems:** <u>primary</u> 8, 9, 11, 12, 13, 14, 17, 18, 20, 21, 24, 25, 27, 30, 35, 36, 37, 38; <u>secondary</u> 10, 15, 16, 22, 23, 26, 28, 29, 31, 32, 34.
	<u>Chapter 13. Aldehydes and Ketones.</u> Page 367 don't memorize acetophenone or benzophenone. Review appropriate sections from 8.3 and 9.7. This chapter uses some very detailed reaction mechanisms. Learn how to correctly and use and show "electron moving" using the curved arrow technique. Don't just memorize a specific mechanism. Instead, understand what it represents and how the steps logically progress. This takes practice, lots of failed attempts, and finally, asking for needed help! Be able to calculate specific oxidation *states using the **assumption** that all bonds are ionic.* **Body-of-chapter problems:** all. **End-of-chapter problems:** primary 12-18, 20, 23, 24, 26-29, 31, 33, 34, 35, 36, 39(excellent), 41(excellent); secondary 21, 22, 25, 30, 36.

	<u>Chapter 14. Carboxylic Acids.</u> Don't memorize all the common names, just the C_1-C_5 mono and dioic acids, also the α, β, γ, and δ prefixes. Understand the <u>cause</u> of the physical and chemical properties. Fischer esterification represents perhaps one of the most studied reaction mechanisms in organic chemistry. We will see variations of this mechanism and compare other mechanisms to it in later chapters. <u>Understand</u> the logic of the sequence of steps. Pay attention also to the decarboxylation of malonic acid, we will see it later as well. **Body-of-chapter problems**: all. **End-of-chapter problems:** <u>primary</u> 7, 8, 9, 11(excellent), 12, 13, 16, 17, 19, 20, 21(excellent, explain the cause of the differences), 22, 23, 25, 27, 28, 29, 30, 31, 32, 33, 34, 35, 38, 39, 40, 43, 46, 48; <u>secondary</u> 10, 14, 15, 18, 24(note: there is an error about what section to look at, use the index of your book), 26, 41.
	<u>Chapter 15. Carboxylic Acid Derivatives.</u> Recognize that each of these derivatives can also be formed from inorganic acids such as phosphoric acid. We will see examples of these in later chapters. Recognize lactones, lactams, and imides but don't worry about nomenclature. Recognize the similarities and differences between these substitution reactions and the nucleophilic addition reaction seen in chapter 17. Understand how the presence or lack of a good leaving group determines the fate of these reactions. Understand what makes a good leaving group. **Body-of-chapter problems:** all. **End-of-chapter problems:** <u>primary</u> all, but omit 44, 46, and 47.

	<u>Chapter 16. Enolate Anions.</u> Understand the factors contributing to the acidity of α hydrogens and how the pKa can vary. Look at the examples on page 469, why must the base used be ethoxide? You should recognize that most of these mechanisms start out like the addition and substitution reactions studied in chapters 13 and 15, now **you** need to look for the presence or absence of leaving groups. **Body-of-chapter problems:** all. **End-of-chapter problems:** <u>primary</u> 11 & 12 (excellent; explain your answers), 13, 14, 15, 16, 17, 18, 20 (excellent), 21, 23 (excellent), 25, 27, 28, 30, 3, 36; <u>secondary</u> 19, 22, 29, 32, 33.
	<u>Chapter 18. Carbohydrates.</u> Important—review chair conformations of cyclohexane and how to draw it, the (R) and (S) designations, Fischer projections, and acetals. This chapter is heavy in three-dimensional shapes. You need a model kit to really understand this stuff! In a nutshell—sugars are just alcohols and aldehydes (or ketones). A few other functional groups may be present, but it's the –OH and C=O that are of major concern. The reactions in this chapter are just applications of ones you have seen! Do not memorize all the structures. Do memorize glucose. Know **D** and **L**. Understand how to turn Fischer projections into Haworth projections. Understand how furan and pyran are involved. Understand the nomenclature (1,6 glycoside, etc). Understand the relation ships of glucose/starch/glycogen. **Body-of-chapter problems:** all. **End-of-chapter problems:** <u>primary</u> 8, 9, 10, 11, 12, 13, 14, 15(excellent), 17, 19, 24(excellent), 25(excellent), 26, 30, 34(use this as a structural problem, don't memorize), 37(excellent); <u>secondary</u> 16, 21, 23, 31, 33, 36.

	<u>Chapter 19. Amino acids & proteins.</u> Don't memorize specific amino acid structures or properties. Instead understand the general structure and how other groups influence properties. Note: the structural formulas shown in Table 19.1 are neither Fischer projections nor the standard "N-group on left and acid-group on right". They are drawn just to conveniently fit the page. Understand the acid/base properties, zwitterions, and the forms present at various pH's but please don't memorize pK_a's! Understand the basis of electrophoresis (but don't memorize ninhydrin). Understand the convention of writing poly-peptides. Understand the goal of each amino acid analysis and sequence analysis (1° structure), but don't memorize specific reactions. Understand the cause and consequences of the geometry of peptide bonds. Understand 2°, 3°, and 4° structures. **Body-of-chapter problems:** all. **End-of-chapter problems**: omit these: (8, 17, 19, 27, 30, 35, 36, 37, 39, 42, 43); <u>primary</u> 11, 12, 13(excellent), 14, 16, 20, (22 through 26 excellent), (28, 29 excellent), 31, 32, 33(excellent), 38(excellent), (40, 41 excellent), 44(excellent), 45, 46, 47(excellent); <u>secondary</u> 9, 10, 15, 18, 21, 34.