

# Chemistry 326

## Organic Chemistry II

### Spring, 2009

**Instructor:** David Lewis

**Office:** Phillips Hall 458 e-mail: lewisd@uwec.edu; office phone 836-4744.

My weekly schedule for this semester:

|       | Monday        | Tuesday       | Wednesday    | Thursday | Friday        |
|-------|---------------|---------------|--------------|----------|---------------|
| 8-9   | Chem 326 A0A  | 326 lab A02   | Chem 326 A0A | Research | Chem 326 A0A  |
| 9-10  | Research      | 326 lab A02   | Research     | Research | Research      |
| 10-11 | Research      | 326 lab A02   | Research     | Research | Research      |
| 11-12 | Research      | Research      | Research     | Research | Research      |
| 12-1  | DPC Mtg       | Research      | Faculty Mtg  | Lunch    | Chem 274      |
| 1-2   | 326 lab A01   | 326 lab A03   | Research     | Research | Research      |
| 2-3   | 326 lab A01   | 326 lab A03   | Research     | Research | Research      |
| 3-4   | 326 lab A01   | 326 lab A03   | Research     | Research | Research      |
| 4-5   | Review (P119) | Review (P276) | Research     | Research | Out of Office |
| 5-6   | Review (P119) | Review (P276) |              |          |               |

**Course Schedule:** MWF 8:00-8:50 P 007

**Textbook:** "Organic Chemistry" 5th Edition, by Brown, Foote, Iverson & Anslyn (Brooks/Cole, 2009)

**Purpose:** This course is the second half of a two-semester course in organic chemistry including laboratory. In this course, we will finish the study of functional group chemistry begun in Chemistry 325. This course addresses the following academic goals of the baccalaureate:

- an appreciation of the university as a learning community
- enhancement of the ability to inquire, think and analyze
- enhancement of the ability to write, read and listen
- an understanding of numerical data
- an understanding of science and the scientific method

**Attendance Policy:** It is in your own best interests to attend and participate in class. From time to time, a question may be asked in class, and the student answering (correctly or not) will be awarded bonus points. Attendance will be recorded, since we are required to keep attendance records for students obtaining financial aid, but your attendance will not be used in assigning your grade (except bonus points). Persons not attending the first lecture of the year may be dropped from the rolls and their space assigned to another student. Excessive absences will be reported to the Dean of Students. In the event of an absence, you are responsible for all material discussed, and all announcements and assignments made.

**Homework:** At the end of each week, you should complete the reaction learning sheets for all reactions covered that week in class. I will note each new reaction as we cover it in class. The reaction learning sheet is appended to the end of this course outline. These will be checked the following Monday, and will be worth 50 points total towards your grade for the semester. There are 14 weeks in the semester, so you

can expect to show 14 sheets. If you attend the Monday or Tuesday evening help sessions, you may bring your completed sheets to those sessions for credit.

**Weekly Review Sessions:** Last semester, I held regular weekly review sessions for the class. These were well enough attended to encourage me to continue the practice this semester. I will hold review sessions on Mondays and Tuesdays after the end of the afternoon lab period (should be 4:00 p.m.) until 6:00 p.m. Once attendance drops off for these sessions, I will discontinue them, but most students appeared to find them helpful.

**Assessment:** Your grade in this class will be determined by your performance in examinations and quizzes as measured by the total points gained. *Individual examinations and quizzes will not be curved.* Three 50-

|                   |                              |
|-------------------|------------------------------|
| Examination 1     | Friday, February 20          |
| Examination 2     | Friday, March 27             |
| Examination 3     | Wednesday, April 22          |
| Final Examination | Wednesday, May 13, 8:00 a.m. |

minute examinations (and that means 50 minutes, not 51 minutes) will be held during class during this semester, and the final examination will be held on Thursday, December 18, 2008, at 10:00 a.m. All examinations will be in "free-form answer" format. The examination schedule is at right; arrangements to take exams at times other than those scheduled should be made prior to when the exam is scheduled. *You will be permitted to bring molecular models to examinations in a clear plastic baggie.*

If you must miss an examination for a University-excused reason, see me to arrange an alternative. Examinations missed for excused absences may be made up by taking a make-up exam (but try not to miss: my make-up exams are, by student report, usually more difficult than the original in spite of my efforts to keep them at the same level of difficulty). If you are in doubt as to whether your absence should be excused, see the Office of the Dean of Students.

The total number of points possible in this course is 700 points: The final examination is comprehensive. You may replace your lowest 50-minute examination score with your percentage on the final examination if that improves your score (I think that if you show improvement on a comprehensive examination, you should be able to replace the results of one bad day)

|                             |            |
|-----------------------------|------------|
| Reaction Learning Sheets    | 50         |
| Semester Examinations (3)   | 300        |
| Final Examination           | 200        |
| Lab contribution            | 150        |
| <b>TOTAL POSSIBLE SCORE</b> | <b>700</b> |

The point scores shown at right will be required to earn the letter grade indicated:

Plus and minus grades *may* be assigned, but not necessarily. For students enrolled on a S/U basis, letter grades of C or higher will be recorded as an S, grades of C- or lower will be recorded as a U.

| Grade | Point Score | Percent Score |
|-------|-------------|---------------|
| A     | 600-700     | 85.7-100      |
| B     | 490-599     | 70.0-85.6     |
| C     | 380-489     | 54.3-69.9     |
| D     | 265-374     | 37.9-54.2     |
| F     | 0-264       | 0-37.8        |

### Statement on Academic Integrity

I consider any academic misconduct in this course as a serious offense, and I will pursue the strongest possible academic penalties for such behavior. The disciplinary procedures and penalties for academic misconduct are described in the UW-Eau Claire *Student Services and Standards Handbook* in the section titled, "Chapter UWS 14—Student Academic Disciplinary Procedures."

**Special Requirements:** I am well acquainted with the reasonable accommodations that we can make for students, and am happy to make these accommodations. Students in need of particular accommodations should feel free to discuss them with me.

## Reading Assignments

You will be expected to have read the following assignments *before* coming to lecture (the reading assignments after Examination #3 are tentative, and may change, depending on our progress during the semester):

| Date        | Readings                   | Topic   |
|-------------|----------------------------|---|
| 1/26        | Ch 1-9                     | Course Introduction; review of important material from Chem 325: alkene reactions, alkyne reactions, conformation, stereochemistry, free radicals, carbocations, onium ions, resonance, acid/base reactions, S <sub>N</sub> 1, S <sub>N</sub> 2, E1, E2; <i>mechanisms of important reactions</i> |
| 1/28        | Ch 1-9                     | review of important material from Chem 325 (continued)  |
| 1/30        | § 10.1-10.4                | alcohols: structure, nomenclature, properties, acid-base  |
| 2/2         | § 10.5-10.7                | sulfonates, acid-catalyzed dehydration, pinacol rearrangement   |
| 2/4         | § 10.8                     | alcohol oxidation   |
| 2/6         | § 11.1-11.6                | ethers: structure, nomenclature, properties, preparation, reactions   |
| 2/9         | § 11.8-11.9                | epoxides: synthesis, reactions  |
| 2/11        | § 11.10-11.11              | epoxides in synthesis; crown ethers   |
| 2/13        | § 15.1-15.3                | carbanionic nucleophiles: organometallic reagents; carbenes ( $\alpha$ -haloalkyl anions)   |
| 2/16        | § 16.1-16.5                | aldehydes & ketones: structure, nomenclature, properties, reactions with carbon nucleophiles  |
| 2/18        | § 16.5-16.8                | addition of carbon, oxygen and nitrogen nucleophiles  |
| <b>2/20</b> | <b>Examination #1</b>      |   |
| 2/23        | § 16.10-16.11;             | redox chemistry of aldehydes and ketones;   |
| 2/25        | § 16.10, 16.12             | keto-enol tautomerism; reactions at the $\alpha$ carbon   |
| 2/27        | § 17.1-17.4                | carboxylic acids: structure, nomenclature, properties, acidity  |
| 3/2         | § 18.1-18.3                | derivatives of acids: structure, nomenclature, typical reactions  |
| 3/4         | § 17.5-17.7                | preparation of acids; reactions of acids: reduction, esterification   |
| 3/6         | § 17.8; 18.4-18.6;<br>18.8 | conversion to acid chlorides; nucleophilic acyl substitutions   |
| 3/9         | § 18.9-18.10               | reactions with carbon nucleophiles; reduction of acid derivatives   |
| 3/11        | § 19.1-19.3                | enolate anions: aldol, Claisen, Dieckmann reactions   |
| 3/13        | § 17.9; 19.6-19.7          | decarboxylation of $\beta$ -ketoacids; acetoacetic ester synthesis, malonic ester synthesis   |
| 3/23        | § 19.5; 19.8-19.9          | enamines; aldol reactions, synthesis using enolate anions   |
| 3/25        | § 20.1-20.2                | properties and reactions of conjugated systems  |
| <b>3/27</b> | <b>Examination #2</b>      |   |
| 3/30        | § 21.1-21.2                | benzene and aromaticity   |
| 4/1         | § 21.3-21.5                | nomenclature of benzene derivatives; phenols and their reactions; benzyl position reactions   |
| 4/3         | § 22.1                     | electrophilic aromatic substitution   |
| 4/6         | § 22.2                     | polysubstitution and directing effects  |
| 4/8         | § 22.3; 23.1-23.4          | nucleophilic aromatic substitution;<br>amines: structure, nomenclature, properties  |
| 4/13        | § 23.5-23.7                | basicity, reactions, preparation of amines  |
| 4/15        | § 23.8-23.10               | reactions with nitrous acid; elimination from amines  |
| 4/17        | § 24.1                     | review of carbon-carbon bond forming reactions  |
| 4/20        | § 24.1                     | review of carbon-carbon bond forming reactions (continued)  |
| <b>4/22</b> | <b>Examination #3</b>      |   |
| 4/24        | § 24.2-24.5                | transition metals in organic chemistry: Heck, Suzuki, metathesis reactions  |
| 4/27        | § 24.6-24.7                | Diels-Alder reaction and pericyclic reactions   |
| 4/29        | § 29.1-29.5                | polymers: introduction, classification, molecular weights, step-growth polymerization   |
| 5/1         | § 29.5-29.6                | step-growth and chain growth polymerization   |
| 5/4         | § 29.6                     | chain growth polymerization   |
| 5/6         | §                          | Review before final examination   |
| 5/8         | §                          | Review before final examination   |
| <b>5/13</b> |                            | <b>FINAL EXAMINATION 8:00-9:50 a.m.</b>   |

## REACTION LEARNING SHEET

NAME OF REACTION (if any): \_\_\_\_\_

**General form of the reaction:**

| Reactant | Reagent | Product(s) |
|----------|---------|------------|
|          | →       |            |

**A specific example (try to make it non-trivial)**

| Reactant | Reagent | Product(s) |
|----------|---------|------------|
|          | →       |            |

**What ways can this specific example be asked on an exam (i.e. what flash cards do I need?)**

|   |   |   |
|---|---|---|
|   | → | ? |
| ? | → |   |
|   | → |   |

**What does this reagent do?**

**What is the mechanism of this reaction?**

**What is the stereochemistry of this reaction?** (e.g. Is it stereospecific, stereoselective, or non-stereoselective? Is it suprafacial (*syn*), antarafacial (*anti*), or neither?)

**What is the regiochemistry of this reaction?** (e.g. does it occur according to Markovnikov's Rule, or Zaitsev's Rule, or Hofmann's Rule?)

**Is there an intermediate involved in this reaction?** (e.g. a carbocation, a carbanion, a free radical, a three-membered cyclic onium ion, or some other high-energy intermediate?)

**Does this intermediate lead to any special reactivity or observations?**

**What reagent or combinations of reagents can be used to make the active reagent in this reaction?**