

## CHEM 226 Spring 2012

## Organic Chemistry II

Spring 2012

Lecture MWF 9-9:50 AM, Rm. 205 Crawford Hall

Lab Mon. (sect. A) 2-5 PM, Lab Wed. (sect. B) 2-5PM, Lab Wed.

Dr. M. Werner office: CRW 327, phone: 635-2281 email: [mwerner@lssu.edu](mailto:mwerner@lssu.edu)  
Office hours: MWF 10-12AM, or by appointment. (If I'm not in my office, check the lab)

Required Text: *Organic Chemistry*, J.G. Smith, 3<sup>rd</sup> ed (or 1<sup>st</sup> or 2<sup>nd</sup> ed. if only one available).

**Course Description:** (From the catalog) A continuation of CHEM225 covering the structures, properties, and reactions of aromatic compounds, carbonyl compounds, carboxylic acids and their functional derivatives, phenols, amines, organometallics, carbohydrates, amino acids, and proteins. The course will introduce the study of spectral methods of structure determination and expand the study of organic synthesis and mechanisms. The laboratory will include experiments in spectroscopy, organic synthesis and mechanisms, qualitative organic analysis, and instrumental analysis. Prerequisite: CHEM 225 with a grade of C (2.0) or better.

**Course Objectives:** At the conclusion of CHEM 226, the student will be able to:

1. Identify organic functional groups and provide IUPAC names for organic molecules.
2. Recognize and identify products of the major types of organic reactions.
3. Recognize and describe organic oxidation and reduction reactions.
4. Draw appropriate chemical structures and reactions using a mechanistic approach.
5. Describe organic acid and base reactions and compounds with an emphasis on  $pK_a$ .
6. Recognize and interpret stereochemistry and its role in organic and biologically active compounds.
7. Conduct laboratory experiments that involve organic synthesis, product purification, and product characterization using both physical property measurements and spectroscopy.

These objectives summarize the "major topics" that I expect you to understand after taking the course. Exam questions will obviously be more detailed.

## Syllabus (Subject to change slightly)

<b>*Week of:</b>	<b>Topics</b>	<b>Smith Chapter</b>
Jan. 9	Welcome Back: Review Arrow Pushing	CH 1-11, handouts
11	Review of Semester One Organic	CH 1-11, handouts
13	Organic Nomenclature – All you need to know	Lecture, Appendix B
Jan. 16	Review of Spectroscopy	CH 13-14, <b>Spectroscopy Problems</b>
18	Retrosynthetic Analysis in Organic Synthesis	CH 11 (sect. 12)
20	Oxidation and Reduction	CH 12
Jan. 23	Oxidation and Reduction	CH 12
25	Oxidation and Reduction	CH 12
27	<b>EXAM 1</b>	<b>EXAM 1 (Inclusive CH. 1-14)</b>
Jan. 30	Radical Reactions	CH 15
Feb. 1	Radical Reactions	CH 15
3	Conjugation, Resonance, Dienes	CH 16
Feb. 6	Dienes, Kinetic vs. Thermodynamic Control	CH 16
8	Diels Alder Reaction	CH 16
10	Benzene and Aromatic Compounds	CH 17
Feb. 13	Aromatic Compounds, Huckel's Rule	CH 17
15	Electrophilic Aromatic Substitution	CH 18
17	Electrophilic Aromatic Substitution	CH 18
Feb. 20	Carboxylic Acids	CH 19
22	Carboxylic Acids	CH 19
24	Carboxylic Acids	CH 19
<b>Feb. 25- Mar. 4</b>	<b>Take Home Exam SPRING BREAK</b>	<b>Take Home Exam (Inclusive CH. 1-19)</b>
Mar. 5	Carbonyl Chemistry	CH 20
7	Organometallic Reagents, Ox. / Red.	CH 20
9	$\alpha,\beta$ - unsaturated Carbonyls, Protecting Grps.	CH 20
Mar. 12	Aldehydes and Ketones	CH21
14	Reactions of Aldehydes and Ketones	CH21
16	Reactions of Aldehydes and Ketones	CH21
Mar. 19	Reactions of Aldehydes and Ketones	CH21
21	Carboxylic Acid Derivatives	CH22
23	Nucleophilic Acyl Substitution	CH22
Mar. 26	Nucleophilic Acyl Substitution	CH22
28	<b>EXAM 3</b>	<b>EXAM 3 (Inclusive CH. 1-22)</b>
30	$\alpha$ -Substitution Reactions	CH23
Apr. 2	Enolates, Racemization	CH23
4	Carbonyl Condensation Reactions, Aldol	CH24
6	Claisen Condensation	CH24
Apr. 9	Michael Reaction, Synthesis	CH24
11	Amines, Bases	CH25
13	Amines as Nucleophiles	CH25
Apr. 16	Reactions of Amines	CH25
18	<b>EXAM 4</b>	<b>EXAM 4 (Inclusive CH. 1-25)</b>
20	<b>Final Exam Review Session</b>	
<b>Apr. 25</b>	<b>Comprehensive ACS Final Exam</b>	<b>Wednesday April 25<sup>th</sup>, 7:30 AM</b>

\*This is a tentative schedule and may be modified as I deem necessary.

**Objective:** My aim is to introduce you to the concepts necessary for understanding organic chemistry. I realize that most of you have varied career plans, but if I can excite just one of you enough to want to take another chemistry course or become involved in chemical research or applications, I have succeeded in my objective.

**Format:** This course will follow the text, however the order of chapters has been rearranged. I realize this may be an inconvenience, but my lecture notes will present the material in a more cohesive and logical fashion than the book. Lectures will be 50 min containing copious problem solving examples. Your active participation in the lecture is appreciated and encouraged, however, if time is a limitation, I may ask you to see me after lecture. It is vital that you read the material prior to coming to class. Do not bring your text to class. Why? Focus your attention on the lecture notes and the discussion going on in class. Don't bother trying to flip through the text to see how my presentation differs. I will extensively utilize assorted visual

aids during the lectures as learning aids, most not from the book. BE PREPARED TO TAKE YOUR OWN NOTES! I suggest a loose-leaf notebook for taking your notes.

**Course Website:** We will be using Blackboard, the university's internet utility, to post emails, old exams, helpful websites, and assignments for the class. The handouts for the laboratory will be posted here and you will be expected to print these off before you come to that week's lab. The first week of class, **you will be given 10 extra credit points if you log on by Friday Jan. 13<sup>th</sup>, and email me using the Blackboard email tool on the CH226 Home Page.** You will find these materials at the following website for the LSSU Blackboard server:

**<http://my.lssu.edu> go to Blackboard**

Once you log on to this website, you may be asked for a username and password. Your courses that have Blackboard sites set up should appear on your Blackboard page.

**Assigned Problems:** You are expected to solve **ALL** of the in chapter and end of chapter problems for each chapter that we cover in this class. You should expect to see similar or even identical problems on exams and/or quizzes. Office hours are the times you should come seek help on these problems. These are really the only way to master Organic Chemistry. You will also be given a set of **Spectroscopy Problems**, that will be due the date of our 1<sup>st</sup> exam.

#### **Study Habits:**

1. Read the material before coming to lecture, preferably the night before, not in the car on your way to lecture.
2. **Recopy your notes** after the lecture, preferably before the next lecture. When doing this, have the text open and expand your notes with points I may have glanced over or that you find of interest. Try to keep your notes in an outline format. Chemistry is a logical science, your notes should reflect that. Why recopy your notes? By recopying your notes you have actually written out the material 2 times. This is the best way I have found to learn material. In addition, you now have an excellent set of notes from which to study for exams.
3. **Do Problems.** Lots of them, preferably just after rewriting your notes. I suggest trying all of the problems yourself without looking at the answers. Then go back and convince yourself that you actually understand a particular problem. Do not be passive when doing problems. Seek human help before resorting to the study guide.
4. Study groups are fine but be cautious. Don't rely on some one else to do the problems that you should be doing. Instead, I suggest that you talk about chemistry with your classmates and quiz each other with questions of your own origin.
5. By scheduling approx. 2 hr every night after lecture (that's 6 hr/week) to do the above things, you will undoubtedly realize significant results.

**Attendance/Absences:** This course will cover material quickly and my notes often will stray from the book; it is very important that you attend class **every** period. No formal record of lecture attendance is maintained, however, you are responsible for information presented in class. It is your responsibility to get any missed material from another student. Attendance for exams is expected.

**Exams:** Four exams each worth 100 points will be given during the semester. **NO MAKEUP EXAMS WILL BE GIVEN, for simply missing the test. If you have a problem with a scheduled exam, see me by Friday January 13<sup>th</sup>** A special test may be scheduled due to death in the immediately family, however you must inform me of the absence prior to the exam. In the case of scheduled conflicts (i.e. university sanctioned events), you must make arrangements beforehand to take the exam prior to the event.

**Quizzes:** There will be quizzes throughout the semester (see lab syllabus for dates). Your top four quiz grades will be counted toward your final quiz grade (20 pts. each). There will be 5 quizzes given; therefore, **no make-ups** will be given for missed quizzes. Quizzes will be given in your laboratory section and will last 10 minutes.

**Extra Credit:** Each exam, except the final, will have an extra credit question. In addition, if you email me in the first week of class by **Friday Jan. 13<sup>th</sup> on the Blackboard site**, you will get 10 extra credit points. This will also allow me to make sure that everyone can access the course website.

**Active Learning:** A group poster project will be assigned in the third week of laboratory. **This project will be worth 30 points for each student and must be displayed by April 13<sup>th</sup>.** More details will be provided in a handout. We will view the posters during our last week of lab.

**Lab:** The purpose of the laboratory in CHEM 226 is to expose you to some of the basic techniques involved in organic research. As seen in the grading scheme below, a major emphasis will be placed on your laboratory participation. Organic Chemistry is a “hands on science”, and the labs are designed to expand what is presented in the lecture. See lab syllabus for more details.

**Grading:**

		Point range	Course grade
Laboratory	300 points	900 – 920 / 921 – 980 / 981 – 1000	A- / A / A+
4 of 5 Quizzes	80 points	800 – 820 / 821 – 880 / 881 – 899	B- / B / B+
4 Exams	400 points	700 – 720 / 721 – 780 / 781 – 799	C- / C / C+
Active Learning	30 points	590 – 620 / 621 – 680 / 681 – 699	D- / D / D+
Final Exam	<u>190 points</u>	0 – 589	F
Total	1000 points		

\*I reserve the right to curve the grading scale as I deem necessary.

**Regrade Policy:** Laboratory reports will *never* be regraded. See me before turning them in if you have questions. Quizzes and exams can be regraded, however, understand that the regrading will consist of a complete regrade, meaning if I find something else wrong, your grade may go down. So be sure that everything else is right before you give it to me. Make sure your exam is unaltered as I often copy exams before handing them back. If you have a question concerning an exam question but don't want it regraded, please see me during office hours or schedule an appointment. Finally, I would request that your regrade requests be of a substantial nature.

**Online resources:** Here is a brief list of resources you can find on the web. I also suggest you do your own search to find other sites of interest.

-homework.chem.uic.edu/NEXT.HTM (General Organic Review and Tutorial)

-www.wfu.edu/~ylwong/chem/nmr/h1/ (Proton NMR Tutorial)

-www.chemistry.ohio-state.edu/organic/flashcards/ (Electronic Flash Cards)

-www.ups.edu/faculty/hanson/chemwebsites/organicwebsites.htm (list of general Organic Sites)

**University Policies and Statements:**

**The Americans with Disabilities Act & Accommodations**

In compliance with Lake Superior State University policies and equal access laws, disability-related accommodations or services are available to students with documented disabilities.

If you are a student with a disability and you think you may require accommodations you must register with Disability Services (DS), which is located in the KJS Library, Room 130, (906) 635-2355 or x2355 on campus. DS will provide you with a letter of confirmation of your verified disability and authorize recommended accommodations. This authorization must be presented to your instructor before any accommodations can be made.

Students who desire such services should meet with instructors in a timely manner, preferably during the first week of class, to discuss individual disability related needs. Any student who feels that an accommodation is needed – based on the impact of a disability – should meet with instructors privately to discuss specific needs.

**IPASS (Individual Plan for Academic Student Success)**

If at mid-term your grades reflect that you are at risk for failing some or all of your classes, you will be contacted by a representative of IPASS. The IPASS program is designed to help you gain control over your learning through pro-active communication and goal-setting, the development of intentional learning skills and study habits, and

personal accountability. You may contact 635-2887 or email ipass@lssu.edu if you would like to sign up early in the semester or if you have any questions or concerns.

### **HONOR PLEDGE**

**As a student of Lake Superior State University, you have pledged to support the Student Honor Code of the College of Engineering & Technology. You will refrain from any form of academic dishonesty or deception such as cheating, stealing, plagiarism or lying on take-home assignments, homework, computer programs, lab reports, quizzes, tests or exams which are Honor Code violations. Furthermore, you understand and accept the potential consequences of punishable behavior.**

**I have failed students for the course before if cheating occurs. Please do not threaten your future by making a bad choice.**

\*I retain the right to change this syllabus, as I deem necessary at any time during the semester.

# CHEM 226 Spring 2012

# Organic Chemistry II Laboratory

Lab Mon. (sect. A) 2-5PM, Lab Wed. (sect. B) 2-5PM Crawford Hall 335

Dr. M. Werner office: CRW 327, phone: 635- 2281

email: mwerner@lssu.edu

**Required Lab text:** *Multiscale (or Microscale) Operational Organic Chemistry, Lehman, 1<sup>st</sup> or 2<sup>nd</sup> ed. 2002*

**Required Lab Extras:** Lab Notebook with gridded carbon copy pages (available in the book store), Safety goggles or glasses, and a lab apron or coat (optional). No shorts or open toe shoes.

The purpose of the laboratory in CHEM 226 is to acquaint you with laboratory techniques encountered in organic research and to give you practical experience in performing organic experiments. The experiments were selected based on the techniques used, the molecules assayed and to some extent application to lecture material.

**You will need to purchase a lab notebook with gridded duplicate pages. Goggles or safety glasses and lab apron are required and your must have them *prior* to the beginning of the lab.** Both notebooks and safety goggles are available at the book store. Other materials needed: several permanent marking pens (Sharpies are the best)

Week of:	Experiment Name	pts	Exp. # Multiscale 2 <sup>nd</sup> Ed.
<b>Jan. 9</b>	<b>Lab Check-in, Review</b>	-	<b>None</b>
Jan. 16 ☉	Reduction of Vanillin, IR Analysis	25	29
Jan. 23	NMR <sup>13</sup> C and <sup>1</sup> H Review, Diels-Alder Rxn.	25	Pg.757-772, Mini 27
Jan. 30	Diels-Alder Reaction	25	Mini 27
Feb. 6 ☉	Mech. Of Nitration of Arenes / GC Anal.	25	36
Feb. 13	Preparation of DEET	25	46
Feb. 20 ☉	Purif. of DEET, NMR, GC/MS Anal.	25	46
<b>Feb. 27</b>	<b>Spring Break- NO LAB</b>	-	<b>None</b>
Mar. 5	Wittig Reaction: trans-cinnamaldehyde	25	42
Mar. 12	Synthesis of Dimedone	25	47
Mar. 19 ☉	Purification/ NMR analysis of Dimedone	25	47
Mar. 26	Library Research Project, Multistep Synth.	25	Handout, 57
Apr. 2	Qualitative Organic Analysis	50	Part IV
Apr. 9 ☉	Qualitative Organic Analysis		Part IV
Apr. 16	<b>View Group Posters</b>	-	<b>None</b>
<b>Apr. 23</b>	<b>Finals Week</b>	-	<b>None</b>

**Note:** The symbol ☉ weeks that a quiz will be given on lecture material. The weeks of Apr. 2 – Apr. 9 involve the identification of an unknown organic compound and may or may not require all three lab periods.

In order to complete the labs in the allotted time, you must be familiar with the lab procedure *before the start of the lab period*. Read the complete experiment and associated operations sections before coming to lab. There are no prelab questions, yet you are expected to understand what you will be doing in lab. It will be obvious if you are not prepared. For the last two labs, keep in mind that the results of one week will be used during subsequent weeks. Therefore, it is important that you understand what you are doing at each step and why you are doing it. An error in step 4 of a 6 step procedure means that the previous 4 steps, no matter how well they were done, are for naught. If you are in doubt about what to do, ask, and remember that old lab axiom, "Never throw anything away."

**Lab attendance/absences:** Attendance is mandatory, and remember, "Don't be on time, be early!" Tardiness will result in loss of points (every 5 min late equals 2 pts) and you may miss important last minute instructions for the experiment. You will work with a partner for **some** experiments, make sure it is a team effort. If you do miss a lab, make sure that you talk to me to find out what you missed. **THERE ARE NO MAKEUP LABS. If you have an approved reason for missing a lab see me by Friday January 13th.**

**Lab Notebook:** It is imperative that you maintain a complete notebook. *This note book is to be separate from the lab report sheets.* Anyone should be able to take your notebook and understand what was done, what results were obtained, and repeat the experiment. Write in the lab notebook with ballpoint pen, crossing through errors. Do not remove original pages from the notebook. I will collect the duplicate pages when you turn in your lab report. The lab notebook is to contain:

1. Your name, course name, and section number on the cover.
2. A table of contents on the first few pages.
3. A general outline of :Introduction, Material and Methods, Data and Results, and Discussion should be followed.
4. All your data, calculations, last minute modifications to the protocols, graphs, results, and conclusions must be in the notebook. Do not use scraps of paper to record any of these items.
5. Results should describe the results obtained (i.e. raw data and all calculations used to obtain "processed" data, tables and rough graphs). Final graphs, to be turned in, should be done on either a computer or with 10 mm x 10 mm graph paper.

- Safety:**
1. **Safety goggles or glasses must be worn at all times!!**
  2. Appropriate dress is required including protective apron or coat. No shorts or open toe shoes.
  3. Report all injuries to me.
  4. No smoking, eating, or drinking in the laboratory.
  5. All chemicals, sharps, etc. must be disposed of properly. If you are not sure, ask.
  6. Women who are pregnant need to discuss the course with me because of potential and known mutagenic and teratogenic chemicals involved in some experiments.
  7. **Come to lab prepared!**

**Clean-up:** At the end of the lab period, all reusable labware needs to be cleaned, rinsed with dH<sub>2</sub>O and placed back in your LOCKED drawer.. All equipment should be returned to their designated location.

**Water:** We will be using lots of purified H<sub>2</sub>O this semester. In general you should always use distilled water except for external cooling baths.

**Glassware:** You have the privilege of being given your own set of micro-scale organic glassware. You will have two glassware drawers for the semester. The first drawer will contain general equipment while the second will contain the micro-scale glassware. **THESE DRAWERS SHOULD BE LOCKED.** Broken items will be replaced when you inform the lab instructor (Dr. Werner). **Lost items will be charged to your LSSU account at the end of the semester.**

**Assignments to be turned in:** Lab assignments will consist of the following:

1. **The laboratory work sheets that will be posted on the course web site the week prior to a lab being preformed. You need to print these out before you come to lab. These need to be completely filled out and any assigned problems need to be completed.**
2. The lab report on your notebook pages (including calculations, results, and any discussion) for that weeks lab will be stapled to the lab report sheet.
3. If required, you may need to turn in your product at the end of lab or the beginning of the next lab. Make sure that you are turning in the compound that you say you are.
4. **If you do not hand in assignments at the beginning of the lab, it is late and it will be assessed a late penalty. Late labs after one week will not be graded and recorded as a zero.**

\* I retain the right to change this syllabus, as I deem necessary at any time during the semester.

**One final note:** I have been in the lab long enough to know that things do not always go as planned when performing an experiment (i.e. you drop the test tube containing your precious sample, etc.). I will allow for unforeseeable error, however, if your errors are due to an obvious lack of preparation, leniency will not be forthcoming.