

**SYLLABUS**  
**CHEM 224 – Organic Chemistry B – 2<sup>nd</sup> semester**  
Spring 2011 - LOYOLA UNIVERSITY CHICAGO (LUC)

**Lecture:** #1239 Section 007 **M+W+F** **10:25 a.m. – 11:15 a.m.** Flanner Auditorium 133

**Discussion:** #1240 Section 008 Wed 11:30 a.m. – 12:20 p.m. Flanner 007  
#1241 Section 009 Fri 11:30 a.m. – 12:20 p.m. Flanner 007

**Sr. Lecturer:** Dr. C. Szpunar  
Office: Flanner Hall 213 Contact: in person (preferred), 773-508-3128, cszpuna@luc.edu  
Emergency Message: Chemistry Dept. Office, 773-508-3100, fax: 773-508-3086  
Student Office Hours: Mon: 11:45-1:30, Tues: 11:45-1:00, Thur: 8:30-9am, and by **prior** appt

**Required:** Organic Chemistry, Wade, 7<sup>th</sup> ed., Prentice Hall, 2009 (ISBN 9780321592316)  
\*or\* Wade, 6<sup>th</sup> ed., Prentice Hall, 2003 (ISBN 0-13-147871-0)

**Suggested / Recommended Materials:**

1. Study Guide and Solutions Manual, Wade & Simek, 7<sup>th</sup> ed. (ISBN 9780321598714) or 6<sup>th</sup> ed. (ISBN 0-13-147882-6).
2. Molecular modeling kit, Darling, Prentice-Hall, Freeman (Maruzen), Proteus, or equivalent.
3. Loose-leaf binder with tabs or tabbed notebook, spiral or bound, for homework problems.

**Optional Materials** (found helpful by some students):

1. Organic Chemistry as a Second Language II, Klein, Wiley (ISBN 978-0-471-73808-4).
2. Barron's Orgo Cards: Organic Chemistry Review, Wang, Razani, Lee, Wu, and Berkowitz (ISBN 0-7641-7503-3).

**Grading** (approx weight below) with grade guidelines: > 90% A; 75-90% B; 55-75% C; grading may be curved

♪ **EXAMS** – 2 – dates announced (subject to change, although unlikely) – **NO MAKE UPS** 40%

- UNEXCUSED ABSENCES merit a zero score.
- EXCUSED ABSENCES are handled on a case-by-case basis; grade weighting may be adjusted, depending on the circumstance(s); however, an excused absence **MUST BE CORROBORATED and DOCUMENTED**, e.g., accompanied by a note from the doctor, dentist, hospital rep, or funeral director; by a court summons; or by a plane ticket stub. With documentation, religious observance, university representation, or personal emergency constitutes an Excused Absence.

♪ **QUIZZES** – TBD – **UNANNOUNCED** (during lecture, discussion period, as take-home) 20%

♪ **FINAL** – date announced (scheduled by CAS), **no alternative date/time, NO MAKE UPS** 40%

♪ **Homework** - assigned per chapter; feel free to work any/all problems to apply and master concepts.

♪♪♪ **Optional Short Report** (as detailed below, one option ONLY) \*\*\* **BONUS** (maximum of 3 - 5%)

**Course Objective:** To guide, encourage, and foster the learning and understanding of Organic Chemistry – nomenclature, structures, properties, reactions, mechanisms, and syntheses – by the individual student, helping him/her to connect, extrapolate, integrate, and apply the many different aspects learned.

**Student Outcomes:** If successful, the student will learn how to ...

1. identify the various classes of organic compounds, their methods of preparation, and typical reactions.
2. name and draw specific organic compounds.
3. postulate a *logical* reaction mechanism for simple organic reactions.
4. discriminate amongst relative stabilities of reaction intermediates.
5. plan and write out multi-step syntheses using known functional group transformations.
6. prepare for basic purification/separation techniques of organic compounds required in the laboratory
7. analyze and interpret data from various instruments used in separating and identifying organic compounds: IR, NMR, and UV-vis spectrophotometers and mass spectrograph.

**Lecture and Discussion – Attendance and Attention:** Important and required. Feel free to bring your books and modeling kit to class. Better yet, use them. Prepare for lecture by prior scanning of new material. Come prepared for discussion, ready to ask questions on assigned homework or yet unassimilated lecture material.

**Phones and Pagers:** Please be courteous and respectful of others. *Silent mode* during lecture and discussion. **Not allowed in sight or within hearing during exams, subject to confiscation.** NO phone conversations in lecture hall or in discussion class – before class, during class, after class – AT ANY TIME!

**Academic Honesty:** Essential, expected, and enforced. Dishonesty dictates consequences which may include: (1) notification of Chemistry Department Chair, student's Department Chair, and CAS Dean, (2) documentation in the student's official university record, and (3) dismissal from the university. Immediate consequences will include a **ZERO** on any item in question (quiz or exam). Please refer to the LUC Undergraduate Handbook on policies or the CAS website: [http://www.luc.edu/cas/pdfs/CAS\\_Academic\\_Integrity\\_Statement\\_December\\_07.pdf](http://www.luc.edu/cas/pdfs/CAS_Academic_Integrity_Statement_December_07.pdf).

**Study Strategies and Suggestions:** One may approach the study of Organic Chemistry in a manner similar to tackling a new foreign language. Its study will provide a basis to understanding future material – building constantly, incessantly, and relentlessly on the structural and mechanistic information presented previously. Over two semesters, the course will cover functional groups, aliphatic and aromatic compounds, bonding, nomenclature, stereochemistry, conformational analysis, reaction mechanisms, multi-step syntheses, and spectroscopy. Because the course is cumulative and builds heavily on prior material, the best plan is to study Organic Chemistry regularly, every day, similar to practicing the piano. Collaboration on homework problems is encouraged, especially in a timely fashion. Feel free to join or initiate a study group. Experience dictates that positive outcomes (for exam and course grades) are directly proportional to working and understanding the assigned problems on a regular basis, i.e., applying the concepts learned to non-generic compounds.

Typically, Organic Chemistry is not efficiently self-taught. Overnight cramming will probably not produce success. The student should quickly scan the chapter or segment to be covered BEFORE lecture to improve lecture comprehension. After lecture, careful detailed reading of the chapter or segment and focused working of the assigned problems are expected. *If anticipating a passing grade of C, the minimal time per week devoted to Organic Chemistry is estimated at 4 hr for lecture/discussion, 4-10 hr for reading, and 4-10 hr for homework.*

#### **Suggested Homework Assignment (Wade 7<sup>th</sup> edition):**

- Chap 15: 1, 4-18, 22-27, 30, 33
- Chap 16: 3-4, 7-8, 9 (a,b), 12-29, 31-32, 38-39, 45
- Chap 17: 1-2, 4-27, 29-32, 34-35, 38, 40-52, 54
- Chap 18: 1-4, 6-12, 16-31, 34-40, 43-44, 47-51
- Chap 19: 1-21, 25-32, 34-42, 44, 47, 56, 58
- Chap 20: 1-33, 35-40, 45, 47, 50
- Chap 21: 1-39, 43-54, 62, 64-65
- Chap 22: 1-47
- Chap 23: 1-14, 16-17, 21-22, 24-26, 28-31, 32 (a), 33-36, 40, 41 (a,b), 52-55, 63
- Chap 24: 1-3, 20, 32, 33
- Chap 25: 1-5, 9-15, 30
- Chap 26: 21-29

#### Wade 6<sup>th</sup> edition

- Chap 15: 1, 4-18, 22-27, 30
- Chap 16: 3-4, 7-8, 9 (a,b), 12-29, 32, 38-39, 45
- Chap 17: 1-2, 4-22, 24-27, 30-32, 38, 40-52
- Chap 18: 1-4, 6-12, 16-31, 34-40, 43-44, 47, 49, 51
- Chap 19: 1-21, 25-32, 34-42, 44, 47, 56, 58
- Chap 20: 1-33, 35-40, 45, 47, 50
- Chap 21: 1-39, 43-48, 50-54, 66
- Chap 22: 1-47, 59-65, 67-69
- Chap 23: 1-14, 16-17, 21-22, 24-26, 28-31, 32 (a), 33-36, 40, 41 (a,b), 52-55, 63
- Chap 24: 3-6, 20, 32, 33
- Chap 25: 1, 4, 8-9, 11-15, 32
- Chap 26: 21-29

**Topics:** to be covered this semester:

12/13. Spectroscopy: Methods of Structure Determination (Review)

Electromagnetic spectrum, molecular vibrations, infrared spectroscopy, characteristic IR absorptions, IR spectra interpretation, mass spectrometry (MS), terminology associated with MS, nuclear spin, magnetic shielding, NMR spectrometer, chemical shift, chemical nonequivalence, peak integration, spin-spin splitting, time dependence, interpreting NMR spectra, combined spectroscopy problems.

15. Dienes, Conjugated Systems, UV Spectroscopy

Molecular orbital theory, 1,3-butadienes, electrophilic addition (1,2 and 1,4), NBS, Diels Alder rxn.

16/17. Aromatic Compounds

Benzene, Kekule structure, resonance, annulenes, MO theory, aromaticity, Huckel's Rule, heterocyclic aromatics, electrophilic aromatic substitution, directing effects on electrophilic aromatic substitution, Friedel-Crafts alkylation and acylation, nucleophilic aromatic substitution, side-chain reactions of benzene derivatives, reactions of phenols.

18. Aldehydes and Ketones

Structure of the carbonyl group; nomenclature, physical properties, and spectroscopic properties of aldehydes and ketones; syntheses of aldehydes and ketones; addition reactions; Wittig reaction; condensation reactions; acetals; oxidation and reduction.

19. Amines

Nomenclature, structure, physical properties, basicity, salts of amines, phase transfer catalysis, spectroscopic properties, reactions of amines, sulfonamides, Hofmann elimination, Cope Elimination, arenediazonium salts, synthesis of amines.

20. Carboxylic Acids

Structure and nomenclature, physical properties, acidity, salts of carboxylic acids, spectroscopy, synthesis of carboxylic acids, nucleophilic acyl substitution, Fischer esterification, synthesis and use of acid chlorides, diazomethane, condensations of carboxylic acids, reduction, alkylation of carboxylic acids.

21. Carboxylic Acid Derivatives

Structure and nomenclature, physical properties, and spectroscopic properties of carboxylic acid derivatives, nucleophilic acyl substitution, hydrolysis of acid derivatives, reduction of acid derivatives, organometallic reactions, thioesters, carbonic acid derivatives.

22. Enols and Enolates

Enols, enolates, alpha halogenation, alkylation of enolates, formation and alkylation enamines, aldol condensation, dehydration of aldol products, crossed aldol condensation, aldol cyclizations, Claisen condensation, Dieckmann condensation, crossed Claisen condensation,  $\beta$ -dicarbonyl compounds, Malonic ester synthesis, acetoacetic ester synthesis, conjugate addition, Michael reaction, Robinson annulation.

23. Carbohydrates

Classification of carbohydrates, monosaccharides, erythro and threo diastereomers, epimers, nomenclature, cyclic structures of monosaccharides, anomers, mutarotation, reactions of monosaccharides, oxidation and reduction of monosaccharides, non-reducing sugars, formation of glycosides, ether and ester formation, osazone formation, Ruff degradation, Kiliani-Fischer synthesis, Fischer's proof of configuration, determination of ring size, periodic acid cleavage, disaccharides, polysaccharides.

24. Amino Acids and Peptides

Structure and stereochemistry of the  $\alpha$ -amino acids, synthesis of amino acids, resolution, structure and nomenclature of peptides and proteins, peptide structure determination, peptide synthesis.

25. Lipids

Miscellaneous category, classification by solubility: waxes, triglycerides, soaps and detergents, phospholipids, steroids, prostaglandins, terpenes.

**Optional BONUS Report**

CHEM 224, Spring 2011, Dr. Szpunar

**\*\*\*BE SURE to include on the cover sheet OR top right of p1:**

- a) your name
- b) the date
- c) CHEM 224 – Mon-Wed-Fri – Sec 007
- d) lecturer's name

\*\*\*\*\*

**Option 1** (max of 3%):

Visit the **International Museum of Surgical Science** and write a 3 pp. report (of 12-pt type, 1-in margins, double-spaced, and stapled) highlighting at least 2 of its exhibits. Neatly, attach a pamphlet from the museum on one of its exhibits.

You may wish to check to see if the # 151 Sheridan Bus (or equivalent) is more efficient than the CTA el; the bus may drop you closer to the museum, located just south of North Avenue Beach near the Polish Consulate (red-and-white flag, Polish eagle) on inner Lake Shore Drive.

1524 N. Lake Shore Drive  
Chicago, IL 60610 USA  
312.642.6502, fax 312.642.9516, info@imss.org  
HOURS: May - September: Tuesday through Sunday 10 am – 4 pm  
October - April: Tuesday through Saturday 10 am – 4 pm  
ADMISSION: Adults \$6, Students & Seniors \$3  
(Be sure to check the website for updates on the current fee and free day!)

---

**Option 2** (min 3%, max 5%):

Choose a **drug or health care product** with organic functionalities featured in the following articles, or any similar publication:

- *Chemical & Engineering News (C&E News)*, June 20, 2005, whole issue – “Top Pharmaceuticals, from aspirin to Viagra and more,” approx. 50 pharmaceuticals.
- *C&E News*, Sept. 25, 2006, cover story – “Addiction ... smoking, drug, and alcohol abuse,” pp. 21-44.
- *C&E News*, Oct. 30, 2006, cover story – “Biotechs ...,” pp. 14-20.
- *C&E News*, Nov. 13, 2006, cover story – “RNA ...,” pp. 16-23.
- *C&E News*, Oct. 2, 2006, cover story – “Mass Spectrometry ... proteins ...,” pp. 17-25.
- *C&E News*, Oct. 23, 2006, cover story – “Bacterial Banter ...,” pp. 17-26.
- *C&E News*, Dec. 4, 2006, cover story – “Pharm Year in Review,” pp. 17-28.

Write a 4-6 pp. report (of 12-pt type, 1-in margins, double-spaced, stapled, with at least 3 pertinent references or citations at the end of the report). Include the following:

- Explain why the drug or health care product is of importance or interest to you.
- **Identify all the functional groups from an organic perspective.**
- **Propose how you might verify the various functionalities spectroscopically**, esp. via IR and NMR. Mention other methods, as applicable, i.e., via UV and MS.
- Suggest hypothetically how you might change the molecule synthetically, at one functional site minimally, and state what you hope to achieve efficaciously by doing so.

**\*\*\* due on or before Wednesday, April 6, by noon \*\*\***

**N.B.:** This optional Bonus Report, either option, is intended for enrichment; points therefrom are only considered as a grade component IF student's interim grade is a C or better (i.e., >55% approx weighting).

**Mon-Wed-Fri Lecture Outline** (tentative, subject to change)

<u>Week</u>	<u>Date</u>	<u>Chapter-Lec</u>	<u>Topic</u>	<u>***EVENT***</u>
1	Jan 17	***	***** <i>Martin Luther King Holiday</i> *****	<i>no class</i> *****
	19	<b>*12 + 13*</b>	Review – IR, MS, NMR	
	<u>21</u>		15-1 Conjugated Systems, UV Spectroscopy	
2	Jan 24		15-2	
	26		15-3	
	<u>28</u>		15-4	
3	Jan 31		16-1 Aromatic Compounds	
	Feb 2		16-2	
	<u>4</u>		16-3	
4	Feb 7		17-1 Aromatic Compounds - Reactions	
	9		17-2	
	<u>11</u>		17-3	
5	Feb 14		18-1 Ketones and Aldehydes	
	16		18-2	
	<u>18</u>		18-3	
6	<b>Feb 21</b>	***	***** <b>MONDAY</b> *****	<b>EXAM I (Chapters 15-18)</b>
	23		18-4	
	<u>25</u>		18-5	
7	Feb 28		19-1 Amines	
	Mar 2		19-2	
	<u>4</u>		19-3	
8	<u>Mar 7-12</u>	***	*****	<b>SPRING BREAK</b> ***
9	Mar 14		19-4	
	Mar 16		19-5	
	<u>Mar 18</u>		20-1 Carboxylic Acids	
10	Mar 21		20-2	
	Mar 23		20-3	
	<u>Mar 25</u>		21-1 Carboxylic Acid Derivatives	
11	<b>Mar 28</b>	***	***** <b>MONDAY</b> *****	<b>EXAM II (Chapters 18-21)</b> ***** <i>last day to withdraw</i> *****
	Mar 30		21-2	
	<u>Apr 1</u>		21-3	
12	Apr 4		22-1 Condensations and Alpha Substitutions of Carbonyl Compounds	
	Apr 6		22-2	*** <b>Optional BONUS report due</b> ***
	<u>Apr 8</u>		22-3	
13	Apr 11		23-1 Carbohydrates and Nucleic Acids	
	Apr 13		23-2	
	<u>Apr 15</u>		23-3	
14	Apr 18		24-1 Amino Acids, Peptides, and Proteins	
	Apr 20		24-2	
	<u>Apr 21-25</u>	***	***** <b>Holy Thursday p.m. through Easter Monday</b> *****	
15	Apr 27		25/26 Lipids / Intro to Polymers	
	<u>Apr 29</u>		Q/A (as lecture schedule permits)	
16	<b>MAY 2</b>	*****	<b>Cumulative FINAL EXAM, Monday, 9 – 11 a.m., FH-133</b>	