

SYLLABUS

CHEM 224 – Organic Chemistry B – 2nd semester
Spring 2016 - LOYOLA UNIVERSITY CHICAGO (LUC)

Lecture:	#1122	Section 001	M + W + F	9:20 – 10:10 AM	Cuneo 109
Discussion:	#1123	Section 002	Fri	10:25 a.m. – 11:15 a.m.	Flanner 007
	#1124	Section 003	Fri	11:30 a.m. – 12:20 p.m.	Flanner 007
Lecture:	#1129	Section 007	M + W + F	1:40 – 2:30 PM	LSB 142
Discussion:	#1777	Section 008	Thur	10:00 a.m. – 10:50 a.m.	Flanner 007
	#1779	Section 009	Thur	8:30 a.m. – 9:20 a.m.	Flanner 007
	#1845	Section 010	Thur	1:00 p.m. – 1:50 p.m.	Flanner 007

Sr. Lecturer: Dr. C. Szpunar
Office: **Flanner Hall 200B** Contact: *best in person*, 773-508-3128, cszguna@luc.edu
Message via Chemistry Dept. Office, 773-508-3100, fax: 773-508-3086
Office Hours: **Mon + Wed:** 11:00 a.m. – 1:00 p.m. and by **prior** appt

Required:

1. Organic Chemistry, Wade 8th ed. (**red**), Prentice Hall, 2013 (ISBN 978-0-321-76841-4) *or* Wade, 7th ed. (**navy blue**), Prentice Hall, 2010 (ISBN 978-0-321-59231-6) *or* 6th ed. (**black**), Prentice Hall, 2003 (ISBN 0-13-147871-0) *or* 5th ed. (white)
2. Study Guide and Solutions Manual, Wade & Simek, 8th ed. (ISBN 978-0-321-77389-0) *or* 7th ed. (ISBN 978-0-321-59871-4) *or* 6th ed. (ISBN 0-13-147882-6) *or* 5th ed.

Suggested / Recommended Materials:

1. Molecular modeling kit, Darling, Prentice-Hall, Freeman (Maruzen), Proteus, or equivalent
2. Spiral or bound notebook for homework problems

*****NO ACCESS CODE NEEDED, NOR DESIRED, NOR SUGGESTED.**

Optional Materials (found helpful by some students, but hold off initially – do not purchase immediately):

1. Organic Chemistry as a Second Language, II, Klein 3rd ed. (2012), Wiley (ISBN 978-1-118-14434-3)
2. Barron's Orgo Cards: Organic Chemistry Review, Wang, Razani, Lee, Wu, and Berkowitz (ISBN 0-7641-7503-3) *or* Organic Chemistry Study Cards, R Van De Graaff, K Van De Graaff, and Prince, Morton Publishing, 2003 (ISBN 0-89582-577-5) *or* equivalent *or* self/hand-made

Grading (weighting below) with approximate curved grade guidelines: > 90% A; 75-90% B; 55-75% C

♪ **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, plane ticket stub, hospital release form, obituary, or other. With proper documentation, religious observance, representing the university, 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%)

*** Please note that because this course, *Organic Chemistry*, is cumulative, comprehensive, and improvement-based, and because the final exam is deemed a culminating measure of a student's progress, any student meriting an F on the final exam may achieve a recorded course grade no higher than D, despite total points; a final-exam score of D may merit a course grade no higher than C, despite total points; and a final-exam score of C may merit a course grade no higher than B, despite student's standing otherwise (i.e., despite total points.)

Course Objective: To guide, encourage, and foster the learning and understanding of Organic Chemistry – nomenclature, structures, properties, stereochemistry, mechanisms, syntheses, and spectroscopy – 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 design / write out multi-step syntheses using known reagents / conditions to transform functional groups in an elegant, efficient, and economical manner and in good yield.
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; be ready to ask questions on assigned homework or yet-unassimilated lecture material.

Cell Phones: 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! NO texting – before class, during class, after class – AT ANY TIME! If you must talk or text, take it outside!!!

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/academics/catalog/undergrad/reg_academicintegrity.shtml.

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 and, hopefully, acquired by the student. Over two semesters, the course will cover: bonding, functional groups, families of aliphatic and aromatic compounds, nomenclature, structures, stereochemistry, reaction mechanisms, multi-step syntheses, and spectroscopic techniques. 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. 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 situations.

Typically, Organic Chemistry is not efficiently self-taught. Overnight cramming will probably not produce success! The student should quickly read the chapter/segment to be covered BEFORE lecture to improve lecture comprehension. After lecture, careful detailed re-reading of the chapter/segment and focused working of the assigned problems are appropriate, necessary, essential, and expected. In addition to student's participation in lecture, discussion, reading, and homework, joining and contributing to a study group is strongly encouraged.

If anticipating a passing grade of C, the minimal time per week devoted to Organic Chemistry is estimated at 4 hr for lecture and discussion, 4-10 hr for reading, and 4-10 hr for homework.

Suggested Homework Assignment (for Wade's red 8th 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: 1-29, 33-35, 37-40, 42-44, 46-52, 54
Chap 18: 1-4, 6-11, 15-30, 33-39, 43-44, 46-51
Chap 19: 1-21, 25-33, 34-37, 39, 42, 44, 47, 51, 53
Chap 20: 1-21, 23-33, 35-40, 45
Chap 21: 1-39, 42-54, 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), 52-53, 55, 58
Chap 24: 1-3, 20, 33
Chap 25: 1-5, 9-13, 15, 30
Chap 26: 17 and as warranted

(Wade's navy blue 7th 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: 1-21, 23-33, 35-40, 45, 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: 17 and as warranted

(Wade's black 6th 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, β -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 α -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 2016, Dr. Szpunar

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

- a) your name
- b) the date
- c) CHEM 224 – MWF am-Sec 001 or pm-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 or on one of its exhibits or proof of admission.

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 time, current fee, and free day!)

Option 2 (max 5%):

Choose a **drug or health care product** with **organic functionalities**, such as those featured in the following articles or in 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, and 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/before Wednesday, March 30, 2016 – but NOT LATER than 2 p.m.**

N.B.: This optional BONUS Report, either option but one option only, is intended for enrichment; points therefrom are only considered as a grade component IF the student's interim/final 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 18	***	<i>Martin Luther King Holiday</i>	** no classes **
	20	12	Review – Spectroscopy - IR, MS	
	22	13	Review – Spectroscopy - NMR	
2	Jan 25	15-1	Conjugated Systems, Dienes, UV Spectroscopy	
	27	15-2		
	29	15-3		
3	Feb 1	16-1	Aromatic Compounds	
	3	16-2		
	5	16-3		
4	Feb 8	17-1	Aromatic Compounds - Reactions	
	10	17-2		
	12	17-3		
5	Feb 15	18-1	Ketones and Aldehydes	
	17	18-2		
	19	18-3		
6	Feb 22	***	*** MONDAY *** EXAM I (Chapters 15-18)	
	24	18-4		
	26	18-5		
7	Feb 29	19-1	Amines	
	Mar 2	19-2		
	4	19-3		
8	<u>Mar 7-12</u>	***	*** SPRING BREAK ***	
9	Mar 14	19-4		
	16	19-5		
	18	20-1	Carboxylic Acids	
10	Mar 21	20-2		
	23	20-3		
	24-28	***	*** Holy Thursday p.m. through Easter Monday - no classes ***	
11	Mar 28	***	*** no classes - last day to withdraw by 5 p.m. ***	
	30	21-1	Carboxylic Acid Derivatives	***optional BONUS report due***
	<u>Apr 1</u>	21-2		
12	Apr 4	***	*** MONDAY *** EXAM II (Chapters 18-21)	
	6	21-3		
	8	22-1	Enols, Enolates, Condensations, Alpha Substns of Carbonyl Cmpds	
13	Apr 11	22-2		
	13	22-3		
	15	22-4		
14	Apr 18	23-1	Carbohydrates and Nucleic Acids	
	20	23-2		
	22	23-3		
15	Apr 25	23-4		
	27	24	Amino Acids, Peptides, and Proteins	
	29	25/26	Lipids / Intro to Polymers	
16	pm Sec 007 - May 5, Thur	***	Cumulative FINAL EXAM, 1–3 pm, LSB 142	
	am Sec 001 - May 7, Sat	***	Cumulative FINAL EXAM, 1–3 pm, Cuneo 109	