

**SYLLABUS - CHEM 224 – ACCELERATED**  
**Organic Chemistry B – 2<sup>nd</sup> semester**  
 Summer 2017 - LOYOLA UNIVERSITY CHICAGO

**Lecture/Discussion:** #1074 CHEM 224-001 *MTuWTh: 8:15 – 10:15 am* Inst Envl Sus 110  
 #1075 CHEM 224-002 *MTuWTh: 12:10 – 2:10 pm* Inst Envl Sus 110

**Sr. Lecturer:** Dr. C. Szpunar

Office: Flanner Hall **200B** Contact: in person (preferred), 773-508-3128, cszpuna@luc.edu  
 Emergency Message via Chemistry Dept. Office: 773-508-3100, fax: 773-508-3086

Student Office Hours: - *directly after the MTuWTh morning lecture*  
 - *directly after the MTuWTh afternoon lecture*  
 - *Mon, Tues, Wed 10:45 - 11:45 am – Flanner 200B*

**N.B.:** Answer keys will be posted in the glass case outside Flanner 200B. No photographing pls!

**Required:**

1. Organic Chemistry, Wade 8<sup>th</sup> ed. (**red**), Prentice Hall, 2013 (ISBN 978-0-321-76841-4) \*or\*  
 Wade 7<sup>th</sup> ed. (**navy blue**), Prentice Hall, 2010 (ISBN 978-0-321-59231-6) \*or\*  
 Wade 6<sup>th</sup> ed. (**black**), Prentice Hall, 2003 (ISBN 0-13-147871-0)
2. Study Guide and Solutions Manual, Wade & Simek, 8<sup>th</sup> ed. (ISBN 978-0-321-77389-0) \*or\*  
 7<sup>th</sup> ed. (ISBN 978-0-321-59871-4) \*or\* 6th ed. (ISBN 0-13-147882-6), as appropriate to accompany text

**Suggested / Recommended Materials:**

1. Molecular modeling kit, Darling, Duluth, 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):

1. Organic Chemistry as a Second Language, II, Klein (2006), 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** (*weighting below*) with approximate curved grade guidelines: > 90% A; 75-90% B; 55-75% C

♪ **MID-TERM EXAM** – date scheduled and announced (subject to change, although unlikely) **30%**

**!!! NO MAKE UPS !!!**

- 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 appropriate documentation**, religious observance, official representation of the university, or personal emergency may constitute an Excused Absence.

♪ ♪ **QUIZZES** – 4 – dates announced (subject to change, although unlikely), **NO MAKE UPS !!!** **35%**

♪ ♪ ♪ **FINAL** – date announced (scheduled by CAS), **no alternative date/time, NO MAKE UPS !!!** **30%**

♪ ♪ ♪ ♪ **Homework** - assigned per topic/chapter; feel free to work any/all problems to apply and master concepts and due at each next lecture, in person, see below. **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.)

\*\*\* Please note that once an overall course grade has been posted officially on LOCUS, any subsequent requests for an INCOMPLETE or any additional extra credit with NOT be considered.

**Course Objective:** To guide, encourage, and foster the learning and understanding of Organic Chemistry – nomenclature, structures, properties, 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 write out multi-step syntheses using known reagents / conditions to transform functional groups.
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, Attention, and Participation: *Important and required.*** Feel free to bring your books and models 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 as yet-unassimilated lecture material!

**Cell Phones: NONE.** 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!!!

**Photography: NONE.** No photography of posted quiz/exam keys. No photography of discussion/lecture blackboard/whiteboard.

**Recording: NONE.** No recording of lectures.

**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](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 with others 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 scan the chapter/segment to be covered BEFORE lecture to improve lecture comprehension. After lecture, careful detailed 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.

*In anticipation of an acceptable/passing grade of C, the minimal time per week in the summer devoted to Organic Chemistry is estimated at 8 hr for classroom lecture/discussion, 6-12 hr for reading, and 6-12 hr for homework. For a higher course grade, more study time need be expended. Experience dictates that a summer job may not allow for a dedicated effort.*

**Homework:** Students are required personally to hand in **AT LECTURE** – attendance required – at least 5 completed, assigned problems (or parts of problems) from the previous day's lecture to earn full participation credit. For each missed assignment, students will be assessed **0.25%** from their homework/participation points. Each day's homework may NOT be turned in late, will NOT be accepted late, and may NOT be turned in by another. No exceptions!

**Suggested Homework Assignment (for Wade's [red] 8<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: 1-29, 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

**Suggested Homework Assignment (Wade 7<sup>th</sup> edition, [navy blue]):**

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: FYI, 21-29

**Suggested Homework Assignment (Wade 6<sup>th</sup> edition, [black])**

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.

**Lecture Outline** (tentative, subject to change, but unlikely due to time constraints)

<u>Wk-Lecture</u>	<u>Date</u>	<u>Chapters</u>	<u>Topic</u>	<u>*** EVENT ***</u>
	M-July 3	***	***** <b>Independence Day Holiday - observed</b> *****	
	Tu-July 4	***	*****	
1-1	W-July 5	12/13	Review – IR, MS, NMR - Spectroscopy	
1-2	Th-July 6	15	Conjugated Systems, UV Spectroscopy, take-home package to be distributed	
2-3	M-July 10	15/16	... / Aromatic Compounds	
2-4	Tu-July 11	16	... *** Take-Home counted as Quiz 1 DUE (Spectroscopy Package) (DUE at the beginning of lecture, to be handed directly to the lecturer, at lecture or in Flanner 200B only, but not later than 2:30 pm Tues, July 11)	
2-5	W-July 12	16/17	... / Aromatic Reactions	
2-6	Th-July 13	17	... ***** Quiz 2 (Chapters 15-17)	
3-7	M-July 17	18	Aldehydes and Ketones	
3-8	Tu-July 18	18	...	
3-9	W-July 19	18	...	
3-10	<b>Th-July 20</b>	19 ***	Amines ***** <b>MID-TERM EXAM</b> (Chapters 12-13, 15-18) *****	
4-11	M-July 24	19	...	
4-12	Tu-July 25	19	...	
4-13	W-July 26	20	Carboxylic Acids	
4-14	Th-July 27	20	... ***** Quiz 3 (Chapters 18-19)	
5-15	M-July 31	21	Carboxylic Acid Derivatives	
5-16	Tu-Aug 1	21	...	
5-17	W-Aug 2	21	...	
5-18	Th-Aug 3	22	Condensations, Alpha Substitutions, Enolates ***** Quiz 4 (Chapters 20-21) ***** last day to withdraw with W *****	
6-19	M-Aug 7	22/23	... / Carbohydrates	
6-20	Tu-Aug 8	23	...	
6-21	W-Aug 9	23/24/25	... / Amino Acids and Peptides / Lipids	
6-22	<b>Th-Aug 10</b>	***	***** <b>Cumulative FINAL EXAM (focus: Chapters 18-23)</b> *****	

**Daily Schedule – Mornings** (tentative, approximate, flexible, may adjust order):

<u>Regular Day</u>	<u>Quiz Day</u>	<u>Exam Day</u>
08:15 – 08:30 am - Q/A, admin	08:15 – 08:30 am - Q/A	08:15 – 08:30 - Q/A
08:30 – 09:20 <b>lecture – 1</b>	08:30 – 09:20 <b>lecture - 1</b>	08:30 – 9:20 <b>lecture</b>
09:20 – 09:25 ***break***	09:20 – 09:25 ***break***	09:20 – 09:25 ***break***
09:25 – 10:15 <b>lecture – 2</b>	09:25 – 09:55 <b>lecture – 2</b>	09:25 – 10:15 <b>EXAM</b>
	09:55 – 10:15 <b>QUIZ</b>	
		*****
		08:15 – 10:15 <b>FINAL EXAM</b>

**Daily Schedule – Afternoons** (tentative, approximate, flexible, subject to adjustment):

<u>Regular Day</u>	<u>Quiz Day</u>	<u>Exam Day</u>
12:10 – 12:25 am - Q/A, admin	12:10 – 12:25 am - Q/A	12:10 – 12:25 - Q/A
12:25 – 01:15 <b>lecture – 1</b>	12:25 – 01:15 <b>lecture - 1</b>	12:25 – 01:15 <b>lecture</b>
01:15 – 01:20 ***break***	01:15 – 01:20 ***break***	01:15 – 01:20 ***break***
01:20 – 02:10 <b>lecture – 2</b>	01:20 – 01:50 <b>lecture – 2</b>	01:20 – 02:10 <b>EXAM</b>
	01:50 – 02:10 <b>QUIZ</b>	
		*****
		12:10 – 02:10 <b>FINAL EXAM</b>

**Chemistry and Biochemistry Department CAUTION** (effective Aug. 4, 2016):

A student who opts to withdraw from CHEM 224 lecture after midterm may be permitted to remain in CHEM 226 – the co-requisite laboratory, **ONLY** if his/her midterm grade, as posted in LOCUS, is a D or better. If a student plans to continue with the laboratory portion of the sequence, that student must continue to attend all of the lectures until the week of the official drop date, to gain as much background knowledge as possible in preparation for each laboratory assignment and in order to work safely in the laboratory amongst the other students. If a student is considering withdrawing from lecture, but remaining in the lab, the student may seek assistance from the Department of Chemistry and Biochemistry Office in the week prior to the deadline for withdrawing, beginning Monday at 9:00 am through Friday at 4:00 pm. **However, students with a midterm grade of F are required to drop the co-required laboratory along with the lecture without exception.**