CHEM2420 Organic Chemistry II

The University of Toledo
College of Natural Sciences and Mathematics
Department of Chemistry and Biochemistry
CRN: 19275 (section 003) or 18500 (section 093)

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Office Hours: T, R, 11:30 am – 1:30 pm (remote)
Office Location: WO 3265
Instructor Phone: 419-530-1501

Offered: Spring 2021

Course Website: Blackboard Learn or https://blackboard.utdl.edu/webapps/login/
Class Location: Remote/Blackboard Collaborate
Class Day/Time: T, R, 9:35 – 10:55 am
Credit Hours: 3

CATALOG/COURSE DESCRIPTION

CHEM2420, Organic Chemistry II, covers the second half of Organic Chemistry, which includes the structure and reactivity of organometallic compounds, radicals, aldehydes and ketones, carboxylic acids and their derivatives, enolates and related compounds, aromatic systems, amines and heterocyclic compounds. In addition, modern methods and techniques in organic structure elucidation (IR, ^{1}H and ^{13}C NMR spectroscopy, and mass spectrometry) will be introduced and discussed.

TEXTS AND ANCILLARY MATERIALS

Required Materials:

Access to a properly functioning computer with internet access in order to login to Blackboard (https://blackboard.utdl.edu/) From the Blackboard course site you will access:

- An electronic copy of the textbook, *Organic Chemistry: Structure and Function* (8th Edition) by Vollhardt and Schore. Published by W.H. Freeman/Macmillan, ISBN-10: 1-319-07945-8; ISBN-13: 978-1-319-07945-1;
- SAPLINGPLUS Learning online homework

Recommended Materials:

- Preparing for Your ACS Examination in Organic Chemistry: The Official Guide by the Examinations Institute of the American Chemical Society Division of Chemical Education
- Study Guide/Solutions Manual for Organic Chemistry Eighth Edition by Neil E. Schore
  ISBN-13: 978-1319195748/ISBN-10: 1319195741 (this is where you will find the solutions to the end-of-chapter problems)

PREREQUISITES AND COREQUISITES

The prerequisite for this course is a C- in CHEM2410 (Organic Chemistry I). Students not satisfying the prerequisite will be dropped from the course. While it is not required, students are highly recommended to complete CHEM2460 or 2480 before the beginning of this course and take CHEM2470 or 2490 in the same semester.

COURSE STRUCTURE

Lecture: Attend the live streamed lecture at our regularly schedule class time *or* view the lecture, at any time, at your convenience. Note there may be a short time lag before the recorded lecture is available after each live streamed lecture. Take active notes with the provided lecture outline for each lecture.

Participation points you will have a set of participation questions to complete on Blackboard for each chapter. You are welcome to use your notes and textbook to complete these questions. You have unlimited attempts and your highest score will be recorded for credit. There will be several extra points available. The deadline for all participation questions is Friday, 4/30, 11:59pm although it is highly recommended to complete them after each chapter is covered.

Textbook We urge you to read the text before the lecture so you are familiar with concepts before hearing about them during the limited time of each class session.

Online Homework will be assigned most weeks in the form of an online assignment using the program Sapling.

Optional homework: The list of end-of-chapter problems in this syllabus are highly recommended to do for practice. The answers can be found in the solutions manual (under recommended materials)

COMMUNICATION GUIDELINES

As your instructor, I am here to help, and will do my best to respond to email within 24 to 48 hours. Students are expected to check their UT email account and Blackboard frequently for important course information. We want you to be successful in this course, so **let's work together!**

COURSE EXPECTATIONS

1. It is highly recommended to read the textbook before the lecture.
2. You are required to either join the live online lecture or view the recording of it at. Take active notes with the provide lecture outline for each lecture.
3. Complete the participation questions after each chapter.
4. Sapling online homework assignments must be completed before the deadlines as posted.

OVERVIEW OF COURSE GRADE ASSIGNMENT

Homework: There are two types of homework associated with this course: 1) SAPLINGPLUS Learning Homework which will count towards your grade; and 2) problems from the textbook at the end of each chapter which *will not* be handed in or graded.

1) Required: SAPLINGPLUS Learning Homework: There will be an online homework assignment for each chapter. A direct link from Blackboard to SAPLINGPLUS will be available *via* this course's Blackboard site (You will NEED TO REGISTER your information but there is no additional cost). These exercises are not timed, however, you will have unlimited tries with the loss of some credit for each try that is wrong before the due date. **Please do your work well in advance of the due date. Do not wait until the last minute!** You can log in at any time to complete or review your homework assignments. If you have any problems, send an email to support@saplinglearning.com

2) Optional Suggested Homework Problems: Completion and understanding of the suggested end-of-chapter problems in the textbook (p.10 in the syllabus) will be a big step towards achieving a good grade in this course. These questions are not graded but as noted they are HIGHLY RECOMMENDED! The solutions can be found in the recommended solutions manual (see page 1 of syllabus).

Course Points: The following is the distribution of possible points in the course:

Sapling Homework Assignments	150 pts
Midterm Exams 3 @ 100 points each	300 pts
Comprehensive ACS Final Exam	200 pts
Participation questions	50 pts
Practice Exam	5 pts
	Total: 705 pts

Grade Scale: These are the minimum percentages needed to receive the indicated grade:

A	90%	A–	86%	B+	82%	B	78%
B–	74%	C+	70%	C	66%	C–	62%
D+	58%	D	54%	D–	50%		

Drop, Withdrawal and Incomplete Grades Course drop and withdrawal procedures have been set by the University. *Dropped* courses do not appear on your transcript. The deadline for dropping is February 2nd. You may *withdraw* from the course and receive a grade of W. The deadline for withdrawal is March 26th. W's do not affect your GPA.

A course grade of **Incomplete** is given only to those who have completed all but a small percentage of course requirements for an acceptable reason.

Midterm Grading

A midterm grade should be taken seriously with respect to how well you are doing in the course approximately half-way through the semester. Midterm grades will be calculated based on the score on Exam 1 and up-to-date participation and Sapling points and will use the grade scale as listed above.

Final Grading

The course points and grade scale as listed above will be used to assign final grades.

ACADEMIC POLICIES

Examinations Excused absences will only be given based on conditions outlined below. If an excuse is acceptable, your missed exam score will be replaced with a score equal to the average of the other hour exams. The final exam cannot be excused. For all exams you must show a **photo ID card.** On the final exam you may use a ***non-programmable calculator***.

Exam Absence Policies: Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict must provide **written** documentation to verify the conflict. This may occur for students on official university business. The exam will be given at another arranged time before the scheduled test date. *Approval must be obtained in advance.*
Students who unexpectedly miss an exam due to extreme circumstances such as severe illness, death in the family, or car accident should inform their instructor *ASAP*. **Documentation** such as a physician's note, funeral program, an accident report, etc is required. An email to the instructor is expected. In all other cases a missed exam will result in 0 on the exam.

Academic Dishonesty: The academic honesty policies, as stated in the UT Catalogue will be STRICTLY ENFORCED. Any student found violating the UT academic honesty policies will be penalized in

accordance with these policies. You should read the university's policy on Academic Dishonesty found at http://www.utoledo.edu/catalog/2000catalog/admissions/academic_dishonesty.html .

UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA). The University is an equal opportunity educational institution. Please read The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance.

ACADEMIC POLICIES

Undergraduate Academic Policies
Graduate Academic Policies

ACADEMIC ACCOMMODATIONS

The University of Toledo embraces the inclusion of students with disabilities. We are committed to ensuring equal opportunity and seamless access for full participation in all courses. For students who have an accommodations memo from Student Disability Services, I invite you to correspond with me as soon as possible so that we can communicate confidentially about implementing accommodations in this course. For students who have not established affiliation with Student Disability Services and are experiencing disability access barriers or are interested in a referral to healthcare resources for a potential disability or would like information regarding eligibility for academic accommodations, please contact the Student Disability Services Office by calling 419.530.4981 or sending an email to StudentDisability@utoledo.edu.

Policy Statement on Non-Discrimination on the Basis of Disability (ADA)
The University is an equal opportunity educational institution. Please read The University's Policy Statement on Nondiscrimination on the Basis of Disability – Americans with Disabilities Act Compliance.

TECHNOLOGY REQUIREMENTS, SKILLS, AND PRIVACY POLICIES

Please view the technology considerations for this course, including technical skills needed, general technology requirements, and technology privacy policies.

TECHNOLOGY REQUIREMENTS FOR EXAMS

LockDown Browser + Webcam Requirement
This course requires the use of LockDown Browser and a webcam for online exams. The webcam can be the type that's built into your computer or one that plugs in with a USB cable.
Watch this brief video to get a basic understanding of LockDown Browser and the webcam feature.
https://www.respondus.com/products/lockdown-browser/student-movie.shtml

Download Instructions
Download and install LockDown Browser from this link:
https://download.respondus.com/lockdown/download.php?id=213815819

If you have any issues with the Webcam requirement please contact Dr. Cohen asap to arrange for alternate proctoring arrangements for the exams.

GENERAL TECHNOLOGY REQUIREMENTS

Students need to have access to a properly functioning computer throughout the semester. The Browser Check Page http://www.utoledo.edu/dl/helpdesk/browser-check.html will enable you to perform a systems check on your browser, and to ensure that your browser settings are compatible with Blackboard, the learning management system that hosts this course.

Software Student computers need to be capable of running the latest versions of plug-ins, recent software and have the necessary tools to be kept free of viruses and spyware.

This course does contain streaming audio and video content.

Use of Public Computers: If using a public library or other public access computer, please check to ensure that you will have access for the length of time required to complete tasks and tests. A list and schedule for on-campus computer labs is available on the Open Lab for Students webpage.

UT Virtual Labs: Traditionally, on-campus labs have offered students the use of computer hardware and software they might not otherwise have access to. With UT's Virtual Lab, students can now access virtual machines loaded with all of the software they need to be successful using nothing more than a broadband Internet connection and a web browser. The virtual lab is open 24/7 and 365 days a year at VLAB: The University of Toledo's Virtual Labs.

Learner Technical Support can be found here http://www.utoledo.edu/dl/students/learnersupport.html

ACCESSIBILITY OF COURSE TECHNOLOGIES

Please view Accessibility of Course Technologies for information regarding the accessibility of Blackboard and other technologies used in this course.

ACADEMIC AND SUPPORT SERVICES

Please view the Learner Support page for links and descriptions of the technical, academic, and student support services available to UT students.

SAFETY AND HEALTH SERVICES FOR UT STUDENTS

Please use the following link to view a comprehensive list Campus Health and Safety Services available to you as a student.

STUDENT SUPPORT SERVICES

Course scheduling assistance: Chemistry Department Secretary, Ms. Samples, is in Room BO 2022, telephone 419-530-2698. She takes care of all scheduling changes.

Chemistry Help Center, Virtual/Online, is where the teaching assistants hold their office hours so it is a great place to receive assistance. A schedule will be posted early in the term. No appointment is necessary.

Tutoring support. Virtual/Online for all UT students is available through the **Learning Enhancement Center** located in the Carlson Library.

Instructor Office Hours Online are times when you can join Blackboard Collaborate Ultra (no appointment needed) with questions about the course material. My office hour times are listed at the top of the syllabus.

COURSE SCHEDULE

WEEK	DATES	TOPIC	LEARNING OUTCOMES (Listed p.6-7)	ASSIGNMENTS DUE *Note all participation questions are due before Friday, 4/30, 11:59pm
1	1/19 – 1/22	15: Benzene and Aromaticity	1, 2, 3	**Practice Exam Online** Due Sunday, 1/24, 11:59pm
2	1/25 – 1/29	15: Benzene and Aromaticity 16: Electrophilic Attack on Derivatives of Benzene	4, 5, 6	**Participation questions Ch15**: Recommended to finish this week **Sapling Homework Ch15**: Due Sunday, 1/31, 11:59pm
3	2/1 – 2/5	16: Electrophilic Attack on Derivatives of Benzene 17: Aldehydes and Ketones	7, 8, 9	**Participation questions Ch16**: Recommended to finish this week **Sapling Homework Ch 16**: Due Sunday, 2/7, 11:59pm
4	2/8 – 2/12	17: Aldehydes and Ketones	10, 11, 12	**Participation questions Ch17**: Recommended to finish this week **Sapling Homework Ch 17**: Due Sunday, 2/14, 11:59pm
5	2/15 – 2/19	18: Enols, Enolates, and the Aldol Condensation	13, 14, 15	**Exam 1**, Thursday, 2/18, in Lecture 9:35am – 10:30am (Chapters 15, 16, 17)
6	2/22 – 2/26	18: Enols, Enolates, and the Aldol Condensation 19: Carboxylic Acids	16, 17, 18	**Participation questions Ch18**: Recommended to finish this week **Sapling Homework Ch 18**: Due Sunday, 2/28, 11:59pm
7	3/1 – 3/5	19: Carboxylic Acids 20: Carboxylic Acid Derivatives	19, 20, 21	**Participation questions Ch19**: Recommended to finish this week **Sapling Homework Ch 19**: Due Sunday, 3/7, 11:59pm
8	3/8, 3/12	20: Carboxylic Acid Derivatives 21: Amines and Their Derivatives	22, 23, 24	Note: (no class on 3/10) **Participation questions Ch20**: Recommended to finish this week **Sapling Homework Ch 20**: Due Sunday, 3/14, 11:59pm
9	3/15 – 3/19	21: Amines and Their Derivative 22: Chemistry of Benzene Substituents	25, 26, 27	**Exam 2**, Thursday, 3/18, In Lecture 9:35am – 10:30am (Ch 18, 19, 20, 21(partial)) **Participation questions Ch21**: Recommended to finish this week **Sapling Homework Ch 21**: Due Sunday, 3/21, 11:59pm

WEEK	DATES	TOPIC	LEARNING OUTCOMES (Listed p.6-7)	ASSIGNMENTS DUE *Note all participation questions are due before Friday, 4/30, 11:59pm
10	3/22 – 3/26	22: Chemistry of Benzene Substituents 23: Ester Enolates and the Claisen Condensation	28, 29, 30	**Participation questions Ch22**: Recommended to finish this week **Sapling Homework Ch 22**: Due Sunday, 3/28, 11:59pm
11	3/29 – 4/2	23: Ester Enolates and the Claisen Condensation 25: Heterocycles	31, 32	Note: (no class on 3/29) **Participation questions Ch23**: Recommended to finish this week **Sapling Homework 9 Ch 23**: Due Sunday, 4/4, 11:59pm
12	4/5 – 4/9	25: Heterocycles	33, 34	**Participation questions Ch25**: Recommended to finish this week **Sapling Homework Ch 25**: Due Sunday, 4/11, 11:59pm
13	4/12 – 4/16	25: Heterocycles 10: Nuclear Magnetic Resonance (NMR)	35, 36	**Exam 3**, Wednesday, 4/15, In Lecture 9:35am – 10:30am (Ch 21(partial), 22, 23, 25)
14	4/19 – 4/23	10: Nuclear Magnetic Resonance (NMR) 11.8 – 11.10: IR Spectroscopy & Mass Spectrometry	37, 38, 39	**Participation questions Ch10**: Recommended to finish this week **Sapling Homework Ch 10**: Due Sunday, 4/25, 11:59pm
15	4/26 – 4/30	11.8 – 11.10: IR Spectroscopy & Mass Spectrometry	40	**Participation questions Ch11**: Recommended to finish this week **Sapling Homework Ch 11**: Due Sunday, 5/2 11:59pm *Note all participation questions are due before Friday, 4/30, 11:59pm
Finals Week 5/3				**Final Exam**: **Tuesday, 5/4, 10:15 am- 12:15 pm** **The Final Exam includes all material from both Orgo 1 and Orgo 2**

*Note Sapling Homework Deadlines subject to change based on when material is covered in lecture

STUDENT LEARNING OUTCOMES Upon completion of this course, students will be able to:

1. Name substituted benzenes
2. Evaluate the concept of aromaticity by the criteria of structure, thermodynamics, molecular orbitals, and spectral properties
3. Classify cyclic conjugated polyenes (annulenes) as aromatic, nonaromatic, and antiaromatic with the help of Hückel's rule
4. Explain the mechanism of electrophilic aromatic substitution and apply it to halogenation, nitration, sulfonation, and Friedel-Crafts alkylation and acylation
5. Define electron-donating and electron-withdrawing substituents and describe their effect on the benzene ring including inductively and resonance-induced electron donation and withdrawal.
6. Recognize the electronic origin of the ortho-, meta-, and para-directing power of substituents
7. Analyze the composite directing effects of multiple substituents on the position of electrophilic aromatic substitution
8. Draw the structures and formulate the names of aldehydes and ketones
9. Recognize the methods for synthesizing aldehydes and ketones
10. Classify the general mechanisms for addition reactions to aldehydes and ketones
11. Apply the use of acetals as protecting groups in synthesis
12. Illustrate methods for conversions of aldehydes and ketones into alkanes, alkenes, imines, and esters
13. Recognize the α-hydrogens in aldehydes and ketones; understand the reasons for their acidity and the relative stability of their enolate conjugate bases
14. Contrast α-halogenation of aldehydes and ketones under acidic and basic conditions
15. Describe the general mechanisms for aldol reactions of aldehydes and ketones
16. Compare and contrast reagents that prefer 1,2- vs. 1,4-addition to α,β-unsaturated aldehydes and ketones
17. Utilize the Michael addition-Robinson annulation sequence for six-membered ring construction
18. Draw the structures of and name carboxylic acids and describe the structural and physical properties
19. Discuss the general addition–elimination mechanisms for substitution at the carboxylic carbonyl carbon; recognize the role played by Le Châtelier's Principle
20. Illustrate the structures and preparative methods for carboxylic acid derivatives and recognize chemistry at the α-carbon of carboxylic acids and their derivatives
21. Describe the structural features that differentiate the properties and reactivities of carboxylic acids and their derivatives
22. Apply the general addition–elimination mechanism for substitution at the carbonyl carbon atoms of carboxylic acid derivatives and recognize the consequences of the different reactivities of carboxylic acid derivatives

23. Illustrate reactions that transform carboxylic acid derivatives into other functionalized molecules
24. Draw the structures and formulate the names of amines and discuss the acid-base properties
25. Illustrate approaches to the preparation of alkanamines: alkylative methods, reductive amination of aldehydes and ketones, reduction of carboxylic amides, and the Hofmann rearrangement of carboxylic amides
26. Examine three modes of reactivity of amines: elimination reactions of quaternary ammonium salts, α-aminomethylation of aldehydes and ketones, and N-nitrosation
27. Illustrate the concept of benzylic resonance stabilization and describe benzylic reactivity in oxidations and reductions
28. Discuss phenols: naming, preparation, and reactivity
29. Compare the modes of decomposition of arenediazonium salts to give substituted benzenes
30. Describe the steps in the general mechanism of the Claisen condensation of esters including the direction of the equilibria in each mechanistic step and the role played by Le Châtelier's principle in driving the reaction to completion
31. Describe the utility of β-dicarbonyl compounds as nucleophilic building blocks including decarboxylation, the Claisen condensation/alkylation/decarboxylation sequence, and the Michael addition–Robinson annulation sequence
32. Define and name heterocycles and categorize nonaromatic and aromatic heterocycles
33. Discuss the syntheses and reactions of the heterocyclopentadienes, pyrrole, furan, and thiophene
34. Discuss the reactions of the azaaromatics pyridine, quinoline, and isoquinoline
35. Define the various forms of spectroscopy, in particular nuclear magnetic resonance (NMR) spectroscopy
36. Employ proton and carbon NMR spectroscopy in the elucidation of the structure of organic molecules
37. Illustrate how infrared (IR) spectroscopy aids in structure determination
38. Describe the principles of mass spectrometry and the information that it provides
39. Recognize likely pathways of mass-spectrometric fragmentation
40. Combine spectroscopy with molecular formula information for structure determination

The following problems listed below are **suggested** end-of-chapter problems (Independent Homework) to attempt. You should be able to do these problems and they might appear on an in-class examination. These problems will be covered in the recitation course (CHEM2440).

Chapter 15 – Benzene and Aromaticity

36(a-h), 38, 42(a-c), 47 – 49, 55, 56, 69-70

Chapter 16 – Electrophilic Attack on Derivatives of Benzene

30, 32 – 37, 40, 41, 43, 45, 57, 61, 64

Chapter 17 – Aldehydes and Ketones

27-28(a-e), 32-34, 36-37, 39, 48, 51, 55 and 56 (a-f,h,i), 57, 60, 68-69

Chapter 18 – Enols, Enolates, and the Aldol Condensation

32-33, 35, 37, 42-45, 47-52, 55(a-g)

Chapter 19 – Carboxylic Acids

27, 30, 33, 35-37, 40, 41, 45, 59-61

Chapter 20 – Carboxylic Acid Derivatives

30, 34, 36-37, 39-40, 42, 44, 45, 46(a-c), 49, 53, 68, 70, 71

Chapter 21 – Amines and their Derivatives

28, 35, 38(a-e), 39(a-b, d,g,h), 41, 43a, 44, 45, 63, 65, 66

Chapter 22 – Chemistry of Benzene Substituents

37-40, 42, 43(a,b), 46, 47, 53, 56, 57, 62, 68, 69(a-c), 76, 77

Chapter 23 – Ester Enolates and the Claisen Condensation

27, 28(a-g), 29, 30, 33, 37, 44, 53, 54

Chapter 25 – Heterocycles

31, 32(a,b), 35, 36a, 39(a-d), 40(a-c), 47, 53, 62, 63

Chapter 10 – Using NMR Spectroscopy to Deduce Structure

35, 37-39, 41-49, 58(a-c), 65-67

Chapter 11.8 – 11.10 – IR Spectroscopy and Mass Spectrometry

57, 59, 61-63,78