CHEM2410 Organic Chemistry I
The University of Toledo
Department of Chemistry and Biochemistry
College of Natural Sciences and Mathematics
CRN: 11107 - CHEM 2410 – 001

Instructor: Dr. Wei Li
Class Location: Wolfe Hall 1205

E-Mail: Wei.Li@utoledo.edu

Class Day/Time: Mon, Wed, Fri
2:30 pm – 3:25 pm

Office Hours: Tues. 10:30 am – 1:00 pm
Thurs. 10:30 am – 1:00 pm
and/or by appointment

Office: WO3269

Phone: 419-530-1507

Term: Spring 2019

REQUIRED INSTRUCTIONAL MATERIALS (TEXTS AND ANCILLARY MATERIALS)

A. Required Materials: “SAPLINGPLUS FOR ORG.CHEM (12 MONTHS)” through UT Barnes and Nobel Bookstore - $114.30. What it includes is:


• Account for SAPLINGPLUS Learning: please access SAPLINGPLUS Learning from Blackboard. The access code comes as part of the “SAPLINGPLUS FOR ORG.CHEM (12 MONTHS)” through UT Barnes and Nobel Bookstore

• iClicker Cloud: please install the iClicker Cloud APP (REEF) on your cell-phone. We will be using Clicker responses in class this year for points. This already comes as part of the “SAPLINGPLUS FOR ORG.CHEM (12 MONTHS)” through UT Barnes and Nobel Bookstore

B. Recommended Materials:


COURSE DESCRIPTION

CHEM 2410, Organic Chemistry I, covers the first half of Organic Chemistry, which includes a review of relevant topics from General Chemistry, a study of the structure and bonding of organic compounds, the nomenclature of organic molecules, an introduction to writing reaction mechanisms, and the reaction chemistry of alkenes, alkynes, alkyl halides, alcohols, ethers, and epoxides.

PREREQUISITES AND COREQUISITES

Prerequisites: CHEM 1240 with a minimum grade of C-. While it is not required, students are highly recommended to take CHEM 2460 or 2480 in the same semester. Students not satisfying the prerequisite will be dropped from the course.

COURSE STRUCTURE

Lecture:

- Lecture sessions are designed to clarify the concepts covered in this course and provide examples of what is expected of you.
- Attendance is expected and you are responsible for all material and problems covered in class.
- It is recommended that you read the text before the lecture.
- Lecture notes will be available on Blackboard for each chapter.
- Please be considerate of your fellow students during the lecture period. Disruptions of any kind will not be tolerated and may result in expulsion from the classroom.

Grades:

1. 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.

SAPLINGPLUS Learning Homework:

Thirteen homework assignments (Chapters 1-9, 11 (alkene material only), and 12-14 totaling 150 points) will be administered and graded. In addition, there will be training assignments/videos. You WILL NEED to purchase an access code (Purchase “SAPLINGPLUS FOR ORG.CHEM (12 MONTHS)” through UT Barnes and Nobel Bookstore) and will NEED TO REGISTER with the correct Lecture class. A direct link from Blackboard to SAPLINGPLUS will be available via this course’s Blackboard site. 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. The start date/time and due date/time for each assignment can be found within the SAPLINGPLUS homework system. Please do your work well in advance of the due date. Do not wait until the last minute! Technical problems with your computer, SAPLINGPLUS, or your internet connection will not be grounds for an extension. 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 explaining your issue.

Suggested Homework Problems: There are suggested homework problems assigned from the end-of-chapters in the textbook (p.7 of syllabus). Completion and understanding of these problems will be a big step towards achieving a good grade in this course. It is recommended that you use the problems in the textbook for study and review in your efforts to master the material covered in each chapter. The chapter questions are not graded but as noted they are HIGHLY RECOMMENDED!
Blackboard:
• Blackboard is a course management system provided by the University of Toledo and can be accessed at https://blackboard.utdl.edu/. Your access code is your UTAD user name and password.
• You should consult the site regularly for news and announcements. Handouts, lecture notes, practice exams, and exam solutions will be posted. The system also permits you to check your grades at any time and to email your instructor or other students in the class.

2. Examinations:
The exam schedule is listed below. Make-up exams will not be given for any circumstance. Excused absences will be given only to students who miss a midterm exam under the conditions listed below. If an excuse is acceptable, your final course grade will be computed accordingly. The final exam cannot be excused. For all exams you must show a UT photo identification card*. You will not be permitted to use a calculator nor have a cell phone on your desk.
*A UT photo identification card is mandatory in order for you to take the exam (http://www.utoledo.edu/orientation/new/StudentID.html).

• There will be three mid-term examinations (100 points each). Exams will be held during the normal class period on Wednesdays during the semester, scheduled as follows: February 13th, March 13th, and April 17th, 2019.

• The comprehensive final exam (200 points) for the course will be administered in FH 2100 on Monday, April 29th 2:45-4:45 pm. This is the time scheduled by the University.

Exam Absence Policies
Refer to UT Missed Class Policy (https://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-14%20Missed%20class%20policy.pdf). Students who will not be able to take an exam at the scheduled time due to an irresolvable conflict with a major responsibility must provide some written documentation to verify the conflict. This situation may occur for students on official university business, including athletes. Approval must be obtained before the scheduled test date.

Students who do not take an exam due to illness, car accident, and death in the family or similar extreme circumstance should inform their instructor of their difficulties within 24 hours of the exam. These difficulties must also be documented by a physician's note, an accident report, pastor’s note, etc. Contact information for the police department, pastor, etc. must be included on the note or report. In all other circumstances, a missed exam will result in a grade of 0. Exams cannot be excused for personal reasons. Examples of missing an exam due to personal issues include, but are not limited to: oversleeping, transportation problems, vacation plans, work schedule conflicts, child care issues, sick children, fire alarms in adjacent buildings, etc. Please plan accordingly.

1. iClicker Cloud (REEF):
Students will use an electronic device (cell-phones) to enter “real-time” in class responses to questions that are asked in lecture (questions will appear on the screen).

Communication:
You are urged to communicate with the instructor about any aspect of the course which concerns you or which might limit your success. We want you to be successful in this course, so let’s work together!
OVERVIEW OF COURSE GRADE ASSIGNMENT

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

- Sapling Homework Assignments: 150 pts (21.4%)
- Midterm Exams 3 @ 100 points each: 300 pts (42.9%)
- Comprehensive Final Exam: 200 pts (28.6%)
- iClicker Response and Attendance: 50 pts (7.1%)

Total: 700 pts (100%)

Midterm Grading
Midterm grading serves as a point in the term where the instructor of record may provide a midterm grade assessment and may identify any student who has never attended, has stopped attending, or who is not actively participating in the course. In addition, students may use midterm grade to help make a decision in regards to withdrawing from the course.

The U.S. Department of Education requires the University to document both active participation and satisfactory academic progress as part of the compliance with federal financial aid regulations. Students receiving Title IV Federal Aid funds are required to have regular attendance and satisfactory academic progress in their courses to receive federal aid.

Final Grading
Your final grades will be calculated based on a total of 700 points.

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

- A 90%
- A- 87%
- B+ 84%
- B 80%
- B- 77%
- C+ 75%
- C 70%
- C- 68%
- D+ 65%
- D 60%
- D- 55%

Drop, Withdrawal and Incomplete Grades:

- Course drop and withdrawal procedures have been set by the University faculty. Dropped courses do not appear on your transcript. The deadline for dropping is January 28th. If you are in a course after that date, there will be a grade on your transcript (A-F, W, or Incomplete).
- You may withdraw from the course and receive a grade of W. W’s do not affect your GPA. For both dropping the course or withdrawing you should go to the Registrar's Office in Rocket Hall. You do not need your instructor’s permission for either process. Please note that course registration changes might change your financial aid. The deadline for withdrawal is March 29th.
- If you drop or withdraw from this CHEM 2410, you must also drop/withdraw from the lab course CHEM 2460 because you need to know the lecture material to be in lab.
- 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.

Academic Dishonesty:
The academic honesty policies, as stated in the 2013-2014 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. There is also an academic honesty policy for the Chemistry Department posted on Blackboard. The academic honesty policy for the Department will also be STRICTLY ENFORCED.
Chemistry Help Center:
The Chemistry Help Center, BO 2043, is where the teaching assistants hold their office hours so it is a great place to receive assistance. It is generally open all day Monday through Friday and evenings Monday through Thursday. A schedule will be posted on Blackboard early in the term. No appointment is necessary.

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

Recitation (CHEM 2430):
These sessions are a supplemental portion of the course. They are not required, but are highly recommended. During these small classes the recitation leader will answer questions and get you to the board to work practice problems from the lecture text and the ACS study guide. You should go to recitation prepared, having worked or tried to work the assigned problems so bring your solved homework.

Special Needs:
If you have special needs with respect to your participation in this course, please make an appointment to discuss this matter with your instructor. The instructor will work with you and the Student Disability Services to make appropriate accommodations for your needs.

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 ACCOMMODATIONS
The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the Student Disability Services Office.
# COURSE SCHEDULE

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Chapter: Topic</th>
<th>Notes</th>
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| 1    | Jan 14 - Jan 18| 1: Structure and Bonding in Organic Molecules  
2: Structure and Reactivity |                                                                       |
| 2    | Jan 21 - 25    | 2: Continued                                                                 | 1/21 is MLK Day. Class is cancelled.                                  |
| 3    | Jan 28 – Feb 1  | 2: Continued  
3: Reactions of Alkanes  
4: Cycloalkanes | Last day to Drop via the web is Mon 1/28                                |
| 4    | Feb 4 – 8      | 4: Continued  
5: Stereoisomers |                                                                       |
| 5    | Feb 11 – 15    | 5: Continued                                                                 | Exam 1, Wed 2/13, Ch 1-4, 5 (partial)                                |
| 6    | Feb 18 – 22    | 6: Properties and Reactions of Haloalkanes (S<sub>N</sub>2)  
7: Further Reactions of Haloalkanes (S<sub>N</sub>1 and E<sub>X</sub> Reactivity) |                                                                       |
| 7    | Feb 25 – Mar 1  | 7: Continued  
8: Hydroxy Functional Group: Alcohols |                                                                       |
| 8    | Mar 4 – 8      | 8: Continued                                                                 | 3/4 – 3/8 is Fall Break. Classes are cancelled.                       |
| 9    | Mar 11 – 15    | 8: Continued  
9: Further Reactions of Alcohols and the Chemistry of Ethers | Exam 2, Wed 3/13  
Ch 5 (partial), 6, 7, 8                                           |
| 10   | Mar 18 – 22    | 9: Continued  
11: Alkenes |                                                                       |
| 11   | Mar 25 – 29    | 11: Continued  
12: Reactions of Alkenes | Last day to Withdraw via the web is Friday 3/29                      |
| 12   | Apr 1 - 5      | 12: Continued  
13: Alkynes |                                                                       |
| T-Week | Apr 8 - 12    | 13: Continued                                                                 |                                                                       |
| 13   | Apr 15 - 19    | 13: Continued                                                                 | Exam 3, Wed 4/17,  
Ch 9, 11, 12, 13                                               |
| 14   | Apr 22 - 26    | 14: Delocalized Pi Systems                                                   |                                                                       |
| Finals Week | April 29 – May 3 |                                                                              | ***Final Exam*****  
Monday, 4/29, 2:45pm – 4:45pm  
You must take the final at this time! |
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. Many of the solutions to these problems are found in SAPLINGPLUS.

**Unit I: Chapters 1-5**
Chapter 1 – Structure and Bonding in Organic Molecules
25-31, 33-34, 37, 39-46, 49, 52, 53, 58

Chapter 2 – Structure and Reactivity

Chapter 3 – Reactions of Alkanes
15-16, 22-23, 27-29, 48

Chapter 4 – Cycloalkanes
21-22, 25, 27, 31-32, 34, 37, 44, 58-59

Chapter 5 – Stereoisomers
32-42, 44-47, 50-52, 54-56, 65, 68-71

**Unit II: Chapters 6-8**
Chapter 6 – Properties and Reactions of Haloalkanes (S\textsubscript{N}2)
31-39, 41, 43-47, 49-50, 56, 61, 65

Chapter 7 – Further Reactions of Haloalkanes (S\textsubscript{N}1 and E\textsubscript{X} Reactivity)
25-28, 30, 32-36, 43-52, 61, 67-70

Chapter 8 – Hydroxy Functional Group: Alcohols
24-25, 29-31, 34-36, 40, 42-46, 48, 53, 55-56, 64-65

**Unit III: Chapters 9, 11-13**
Chapter 9 – Further Reactions of Alcohols and the Chemistry of Ethers
34-40, 42-44, 49-51, 56, 60, 65-66, 84-86

Chapter 11 – Alkenes
33-35, 42-43, 45, 54, 74, 76

Chapter 12 – Reactions of Alkenes
41-43, 46, 48-53, 55, 58, 61, 67-68, 70, 81, 83-85

Chapter 13 – Alkynes
29-30, 38-52, 61-63

**Unit IV: Chapter 14**
Chapter 14 – Delocalized Pi Systems
32-33, 39-42, 46, 49-52, 54, 58, 60, 63, 76, 79
Course Learning Objectives

Chapter 1 - Learning Objectives
• Relate your knowledge of beginning general chemistry to organic molecules: ionic and covalent bonding, shape, the octet rule, and Lewis structures
• Recognize the importance of the spreading out of electron density
• Relate the valence electron count to the stabilization of the elements through bond formation
• Learn to write resonance forms for structures that exhibit delocalization
• Review the orbital picture of electrons around the nucleus
• Apply hybridization to describe bonding in simple organic systems, such as methane
• Illustrate the drawing of three-dimensional structures of organic molecules

Chapter 2 - Learning Objectives
• Relate your knowledge of kinetics and thermodynamics from general chemistry to organic reactions: enthalpy and entropy; activation energies and transition states; potential-energy diagrams
• Apply curved-arrow representation of electron-pair movement to reaction mechanisms
• Define and identify electrophiles and nucleophiles
• Relate acid-base and electrophile-nucleophile processes to each other
• Estimate relative strengths of acids and bases from their structures
• Recognize functional groups and predict the expected reactivity of their carbons
• Name organic molecules using systematic nomenclature
• Describe the properties of alkanes, including conformational mobility

Chapter 3 - Learning Objectives
• Distinguish heterolytic from homolytic bond dissociation and understand the reaction pathways available to non-functionalized molecules such as alkanes
• Define radicals and radical reactions
• Use bond dissociation energies to address thermodynamic and kinetic features of radical reactions
• Define hyperconjugation and recognize its influence on radical stabilities and the relative ease of radical formation
• Recognize the interrelationships between the three stages of radical chain reaction mechanisms: initiation, propagation, and termination
• Predict results of alkane halogenation reactions on the basis of concepts of reactivity and selectivity
• Analyze reactions for practical synthetic utility

Chapter 4 - Learning Objectives
• Expand the rules for naming acyclic alkanes to include cyclic alkanes
• Describe the structural and thermodynamic differences between cis and trans isomers of substituted cycloalkanes
• Discuss the effect of ring strain on the heats of combustion of cycloalkanes
• Analyze the various conformations of cyclohexane and its substituted derivatives

Chapter 5 - Learning Objectives
• Differentiate constitutional isomers from stereoisomers
• Recognize the property of chirality in a molecule, including the presence of stereocenters
• Apply optical rotation measurements to the determination of enantiomeric excess
• Employ rules to assign the absolute configurations of chiral structures
• Draw stereoisomers in the form of Fischer projections
• Learn to recognize the occurrence of diastereoisomerism in molecules with several stereocenters
• Apply the principles of stereoisomerism to the stereochemical outcome of chemical reactions

Chapter 6 - Learning Objectives
• Recognize nucleophiles
• Identify the site of nucleophilic attack in a molecule
• Use electron-pair arrows to draw the likely product of reaction between a nucleophile and a substrate
• Deduce the transition state structure of nucleophilic substitution $S_{N2}$ by following the stereochemical changes during the course of the reaction
• Summarize the relationship between basicity and leaving group ability
• Define the factors that govern nucleophilicity
• Distinguish protic from aprotic solvents
• Recognize steric hindrance as a controlling element in $S_{N2}$ reactivity

Chapter 7 - Learning Objectives
• Define solvolysis
• Describe the mechanism of the $S_{N1}$ reaction and its variables: solvent, leaving group, nucleophile, and alkyl substituents
• Compare the \( \text{S} \text{N}1 \) and \( \text{S} \text{N}2 \) processes
• Summarize the factors that determine carbocation stabilization through hyperconjugation
• Discuss the stereochemical consequences of the \( \text{S} \text{N}1 \) reaction
• Define elimination and distinguish between the \( \text{E}1 \) and \( \text{E}2 \) mechanisms
• Predict the dominant course of the reaction of haloalkanes with nucleophiles/bases (elimination or substitution) and the underlying mechanism (\( \text{S} \text{N}1, \text{S} \text{N}2, \text{E}1, \text{or E}2 \))

Chapter 8 - Learning Objectives
• Draw the structures of and name alcohols
• Recognize the property of hydrogen bonding in alcohols
• Review the concepts of acidity and basicity as they apply to alcohols
• Employ nucleophilic substitution for the preparation of alcohols
• Formulate the redox relationships between alcohols and aldehydes and ketones
• Recognize the electrophilicity of the carbonyl carbon in additions of hydride and organometallic reagents to aldehydes and ketones as a route to alcohols
• Apply retrosynthetic analysis to synthesis problems

Chapter 9 - Learning Objectives
• Use the acidity of alcohols to make alkoxides
• Use the basicity of alcohols to effect substitution and elimination reactions
• Demonstrate the capacity of carbocations for rearrangements
• Illustrate the ability of inorganic reagents to effect substitution of the hydroxy group in alcohols
• Introduce ethers as alkylated derivatives of alcohols: naming, preparation, and reactivity
• Describe thiols and alkylthioalkanes as analogs of alcohols and ethers

Chapter 11 - Learning Objectives
• Draw the structures of and name alkenes
• Recognize the presence of stereochemistry in alkenes
• Review the relationship between sigma and pi bonds
• Relate relative stability with structure in alkenes
• Apply basic energetic principles to predict isomeric products in elimination reactions

Chapter 12 - Learning Objectives
• Describe why alkenes undergo addition reactions
• Recognize the need for a catalyst for hydrogenation
• Correlate mechanisms of addition with stereochemical outcomes
• Rationalize electrophilic addition to the \( \pi \) bond
• Relate carbocation stability to regiochemistry of addition: Markovnikov’s rule
• Write mechanisms for HX addition and acid-catalyzed hydration
• Mechanistically distinguish halogen addition from protonation
• Contrast alcohol syntheses by hydration, oxymercuration-demercuration, and hydroboration-oxidation
• Identify reagents for conversion of alkenes to cyclopropanes, oxacyclopropanes, and 1,2-diols
• Describe the results of alkene ozonolysis
• Recognize situations in which radical addition may occur, and delineate the consequences
• Formulate alkene polymerization

Chapter 13 - Learning Objectives
• Illustrate the names of alkynes according to the IUPAC rules
• Define the orbital makeup and carbon hybridization of the alkyne triple bond
• Relate the pK\(_a\) of terminal alkynes to their structure
• Recognize the spectroscopic features associated with the alkyne triple bond
• Identify plausible routes for synthesizing alkynes
• Compare addition reactions of alkynes to those of alkenes
• Distinguish processes that lead to single versus double addition
• Write mechanisms for electrophilic addition reactions to alkynes
• Compare Markovnikov to anti-Markovnikov alkyne hydrations
• Relate alkenols to their carbonyl tautomers
• Describe some organometallic chemistry of alkenyl halides

Chapter 14 - Learning Objectives
• Demonstrate the concept of \( \pi \) delocalization in the 2-propenyl (allyl) system through a description of structure and reactivity
• Expand the concept of delocalization from 2-propenyl to conjugated dienes
• Describe the consequences of delocalization in electrophilic attack on conjugated dienes: kinetic versus thermodynamic product formation
• Introduce a new mode of reactivity unique to conjugated double bonds: the concerted Diels-Alder cycloaddition and its stereochemistry
• Introduce a second new mode of reactivity unique to conjugated double bonds: concerted ring openings and closures named electrocyclic reactions