

### Organic Chemistry 330 (Summer 2019)

Meetings: MoTuWeTh 9:00 AM - 11:45AM

Location: Faraday Hall 143

Instructor: Prof. Timothy J. Hagen

Office: FR 350, Office Hours: MoTu 11:45-12:30 PM or by appointment

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Phone: (815) 753-1463

#### Tentative Lecture Schedule 10<sup>th</sup> Edition of textbook

Lecture Dates	Chapters	Subject
6/17-6/20	1.1-1.15	Atomic structure, electron configuration, covalent and ionic bonding, multiple bonds, organic functional groups, formal charge, hydrogen bonding, Bronsted-Lowry acids, Lewis acids, structure of acids, equilibrium in acid/base reactions, Ka and pKa, Nomenclature
	2.1-2.23	Bonding, hybridization (sp <sup>3</sup> , sp <sup>2</sup> , sp), isomeric alkanes, nomenclature, physical properties
6/20		Exam 1
6/24-6/27	3.1-11	Chemistry of alkanes (oxidation, cations/radicals/anion, halogenation); isomers; conformational isomers of alkanes and cycloalkanes.
	4.1-12	Chirality, enantiomers, diastereomers, optical activity, configurations of stereoisomers, cis and trans, stereochemistry in reactions, racemic mixtures, optical purity..
	5.4-15	Alcohol chemistry. Introduction to reaction mechanisms
6/27		Exam 2
7/1-7/3	6.1-10	Sn1 and Sn2 reactions mechanisms, transition state, electrophiles and nucleophiles, energetics of reactions.
	7.2-12,14-20	Structures of alkenes and cycloalkenes; E1 and E2
	8.1-10, 12	Synthesis of alkenes reactions of alkenes
7/3		Exam 3
7/8-7/11	9.5-12	Alkynes
	10.1-5,8	Free radical structures; reactions with alkanes and alkenes; polymers
	11.1-7,10-13	Chemistry of conjugated systems
7/11		Exam 4

#### Suggested homework problems: 10th ed:

Chap. 1: 42, 45a,c, 46, 47, 48, 53a,c, 59, 60, 65, 66 Chap 2: 24, 26, 31, 32, 33, 36, 39, 48 Chap 3: 27, 30, 33, 38, 40a, 48, 50, 52 Chap 4: 28, 31, 35, 38, 39, 41, 47 Chap 5: 20c, 30, 33, 34, 44, 45 Chap 6: 19, 20, 22c, 32a,b, 37, 41, 42 Chap 7: 37b,f, 39a,d, 41b, 43, 45a-d, 49 Chap 8: 28, 31, 34, 58, 61, 64 Chap 9: 24, 27, 27a,d, 30, 34 Chap 10: 16b, 19, 20, 23, 32 Chap 11: 33, 34, 41, 46, 49

**On-Line Course Information:** Blackboard (<https://webcourses.niu.edu>)

**Materials:** Organic Chemistry, 10th Ed by Francis Carey and Robert M. Giuliano McGraw Hill Publishers, 2017. A copy of the text is on reserve in the NIU Founders Memorial library.

Students may also use the 9th edition of the text book. There is considerable overlap between the 9th and 10th editions. The 9th edition textbook has been placed on reserve in the NIU Founders Memorial library.

**Recommended:** Solutions Manual for Organic Chemistry by Francis A Carey  
A copy of the solutions is on reserve in the NIU Founders Memorial library

**Class Format:** The course will be composed of lectures, in-class exams and online learning tools and assessments. **It is important that you attend class.** The in-class lectures need to be supplemented by your reading of the text, working of problems and exams. If you miss a class, it is your responsibility to acquire the lecture notes and any assigned class work from a fellow classmate and you should check Blackboard each day for postings. Solving the problems for each chapter, with a time limit, is good practice for the exams.

**Study Groups:** This will make your organic chemistry experience more enjoyable and you will learn the material better. Research shows that by teaching someone else you will learn the material better and you will get a realistic assessment for how well you know the material.

**BlackBoard Access:** You must know your student id login and password.  
<https://webcourses.niu.edu/webapps/portal/frameset.jsp>

**Exams and Grades:** The course grade will be assigned based on your point totals from the four exams and online quiz. The online quiz is available through Blackboard. The exams will be given in the second-half of the class period on Thursdays. If an exam is missed, a score of zero will be assigned. The point total is as follows:

Exam 1 (6/20)	100 Points
Exam 2 (6/27)	100 Points
Exam 3 (7/3)	100 Points
Exam 4 (7/11)	100 Points
<u>Online quiz</u>	<u>100 Points</u>
Total Points	500 Points

**Approximate Scale:** Average grade: A (100-85%), B (84-70%), C (69-55%), D (54-45%)

**NOTE: by enrolling in this class, you are agreeing to take the exams on the scheduled dates.**

**Optional Study Group Sessions:** I will hold an optional group study session to go over material and work through problems on Wednesday following class.

**Extra Credit:** THERE IS NO EXTRA CREDIT AVAILABLE.

**Learning Outcome Expectations:**

After this course, students should be able to:

- draw Lewis dot structures, calculate formal charge, understand atom electronegativity and how it creates dipoles in bonds, determine the shape of a molecule from its Lewis dot structure, identify different functional groups, and know common bonding situation for 1st and 2nd row elements.
- identify  $\sigma$  and  $\pi$  bonds, identify the hybridization of any given atom in a molecule, identify the molecular orbital occupied by electron pairs, and identify the orbitals involved in a given bond.
- know trends in bond strengths and lengths for common bonds, recognize constitutional isomers and be able to generate them from a given empirical formula, calculate degree of unsaturation, recognize and produce organic molecules drawn in shorthand, examine the structure of a compound and determine the intermolecular forces that are operating, and understand relative physical properties and how they relate to intermolecular forces.
- name simple organic molecules using the IUPAC system.

- recognize compounds that exist as cis-trans isomers and compare stabilities, use *Z* and *E* descriptors, determine the conformations about a C-C single bond and estimate relative energies, determine types and relative amounts of strain present in cyclic molecules, draw the two chair conformations of cyclohexane derivatives, and determine and compare stability of these two conformational isomers.
- identify chiral compounds and stereocenters, designate chiral center as *R* or *S*, understand the relative properties of enantiomers, recognize *meso*-stereoisomers, determine the stereochemical relationship between two compounds, understand chiral separation techniques, and draw and use Fischer projections.
- draw important resonance structures for any molecule and assign the relative importance of such structures.
- understand Bronsted acid-base theory, write an acid-base reaction, recognize Lewis acids and Lewis bases, understand the meaning of  $K_a$  and  $pK_a$  values and use them to predict equilibrium of an acid-base reaction, and understand how structure affects acidity.
- draw the mechanisms for the  $S_N1$  and  $S_N2$  reactions, recognize various nucleophiles and leaving groups and understand the factors that control their reactivity, understand the factors that control the rates of the two substitution reactions, understand the importance of stereochemistry in the substitution reactions, and apply this knowledge to predict products from a reaction mixture.
- draw the mechanisms for the  $E1$  and  $E2$  reactions, understand the factors that control the rates of the two elimination reactions, understand the implications of stereochemistry in elimination reactions, and apply this knowledge to predict products (resulting from either substitution or elimination) from a reaction mixture.
- using substitution and elimination chemistry understand how to interconvert a variety of functional groups, including alcohols, ethers, esters, alkyl halides, amines, hydrocarbons, nitriles, phosphorous and sulfur compounds, alkenes, alkynes, ketones, aldehydes, epoxides, and cyclopropanes.
- understand aromaticity, know the conditions and mechanisms for functionalizing benzenes using electrophilic aromatic substitution, nucleophilic aromatic substitution, and benzyne chemistry, understand how substituents on the benzene ring affects its reactivity, and use this knowledge to predict products of reactions and synthesize desired products.

**Notification Of Services For Students With Documented Disabilities** NIU abides by Section 504 of the Rehabilitation Act of 1973 which mandates reasonable accommodations be provided for qualified students with disabilities. If you have a disability and may require some type of instructional and/or examination accommodation, you will need to register with the Center for Access-Ability Resources (CAAR), the designated office on campus to provide services and administer exams with accommodations for students with disabilities. The CAAR office is located on the 4th floor of the University Health Services building (815-753-1303). Accommodations are not retroactive. Please contact me early in the semester so that I can provide or facilitate in providing accommodations you may need. You must for each exam have a form filled out about 10 business days in advance to be sure to have a CAAR test time appointment.

**Preferred Gender Pronoun Statement** This course affirms people of all gender expressions and gender identities. If you prefer to be called a different name than what is on the class roster, please let me know. Please also inform me and feel free to correct me and your classmates on your preferred gender pronouns. If you have any questions or concerns, please do not hesitate to speak with me in person, or email me. The Gender and Sexuality Resource Center also has a webpage designed to help support people of all genders as they navigate NIU's system: <http://niu.edu/gsrc/audience/trans.shtml> .

**Multilingual Student Statement** I am committed to making course content accessible to all students. If English is not your first language and this causes you concern about the course, please speak with me.

**Student Sexual Misconduct Policy** Title IX prohibits sex discrimination to include sexual misconduct: harassment, domestic and dating violence, sexual assault, and stalking. If you or someone you know has

been harassed or assaulted, you can receive confidential support and advocacy at the Counseling & Consultation Service's Advocacy Services, which can be contacted on at 815-753-1206, or in Campus Life Building-room 200. Alleged violations can be reported non-confidentially to the Affirmative Action & Equity Compliance Office in Lowden Hall-room 101, at 815-753-1118, or online at <http://www.niu.edu/sexualmisconduct/help/form.shtml>. Reports to law enforcement can be made to NIU Police & Public Safety at 815-753-1212. For an emergency, call 911. For more information about Sexual Misconduct Prevention & Resources, visit <http://niu.edu/sexualmisconduct/index.shtml>. Note: As an instructor, one of my responsibilities is to help create a safe learning environment on our campus. I also have a mandatory reporting responsibility related to my role as an instructor and a faculty advisor to a student organization. I am required to share information regarding sexual misconduct or information about a crime that may have occurred on NIU's campus with the University. Students may speak to someone confidentially by contacting Counseling & Consultation Service's Advocacy Services at 815-753-1206, or in Campus Life Building-room 200.

\*See Northern Illinois University Catalog for all other policies and guideline

***For comparison purposes only:  
9th Edition***

<b>Chapters and Sections</b>	<b>Subjects</b>
1.1-17 2.1, 2.6-18	Atomic structure, electron configuration, covalent and ionic bonding, multiple bonds, organic functional groups, formal charge, hydrogen bonding, hybridization (sp <sup>3</sup> , sp <sup>2</sup> , sp), Bronsted-Lowry acids, Lewis acids, structure of acids, equilibrium in acid/base reactions, K <sub>a</sub> and pK <sub>a</sub> , Nomenclature
2.19-22, 4.13-17, 3.1-11	Chemistry of alkanes (oxidation, cations/radicals/anion, halogenation); isomers; conformational isomers of alkanes and cycloalkanes
7.1-13 (skip 10)	Chirality, enantiomers, diastereomers, optical activity, configurations of stereoisomers, cis and trans, stereochemistry in reactions, racemic mixtures, optical purity.
4.4-13, 8.1-12	Alcohol chemistry, S <sub>N</sub> 1 and S <sub>N</sub> 2 reactions mechanisms, transition state, electrophiles and nucleophiles, energetics of reactions.
5.2-4,6,8-16,18 6.1-20, 22	Structures of alkenes and cycloalkenes; E1 and E2 (synthesis of alkenes); addition reactions (reactions of alkenes)
9.5-13	Preparation and reactions of alkynes
10.1-7,10-13	Chemistry of conjugated systems

**Suggested homework problems:** 9th ed:

Chap. 1: 40, 43, 44, 47, 50a,c, 53c, 56, 57, 63, 65. Chap 2: 24, 27, 28, 29, 30, 35, 43, 45. Chap 3: 21, 27, 28, 34a, 40, 44, 46, 48 Chap 4: 25a, 36, 39, 40, 43, 44, 49a Chap 5: 33b,f, 35a,d, 37b, 39, 41a-d, 43  
Chap 6: 27, 34a-j, 39a-i, 47c,d, 58, 61 Chap 7: 33, 36, 38, 42, 44, 47, 51 Chap 8: 21, 23, 32c, 33a,b, 34b-d, 49, 50 Chap 9: 22c,d, 25a-e and g-k, 29d, 31 Chap 10: 28, 32a-e, 43,