CHEM 246 Organic Chemistry for Majors I
(Proposed Course Syllabus)
Fall Term 2013-2014
6.5 Credit Hours

Instructors: Lectures & Recitations, **Frank Ji**. Office: Disque 508. Telephone: 215-895-2562. e-mail: hj56@drexel.edu

Office hours: Mon 1:00-2:00pm; Thur 1:00-2:00 pm.

Contact Information: Your Drexel e-mail address will be used for messages from the instructors.

Drexel Learn: Check for lectures, assigned problems, and scheduled events (calendar tool).

Required Texts: 1) "Organic Chemistry"; L. G. Wade, Jr., *8th edition*, Prentice-Hall. 2) "Organic Chemistry Lab Manual for Majors" First Edition, by P. A. Wade & V. Braz (This manual is currently being prepared).

Required Supplemental Materials: 1) chemical model kit (good for inorganic too and available at moderate price) or Prentice Hall model kit or any other model set with at least 7 carbon atoms. 2) Safety goggles for lab. 3) a lab coat. 4) a hardbound (not loose-leaf or spiral) lab notebook (a composition book works well).

Recommended Supplement: "Solutions Manual" to accompany the textbook; *8th edition*; J. W. Simek. If you don't personally buy this item, please arrange access to someone else's copy.

Catalog Description: This course offers a basic foundation for modern organic chemistry. Lecture topics include: the chemistry of alkanes, cycloalkanes, alkyl halides, alkenes, cycloalkenes, and alkynes, free radical substitution, nucleophilic substitution, elimination, ionic addition, and free radical addition reactions. Lab topics include recrystallization, distillation, chromatography, liquid-liquid extraction, and simple chemical reactions, including an elimination reaction to prepare an alkene and several substitution reactions to prepare alkyl halides. Introduction to the use of IR and ^{1}H NMR as structure identification tools.

Extended Description: This 6.5 credit course consists of lecture (4 hours), recitation (0.5 hour), and lab (4 hours, 2 credits). The course provides the basic foundation for modern organic chemistry including theory and experimental practice. Here you will learn about the structure of organic compounds and its relation to properties. You will study the chemistry of alkanes, cycloalkanes, alkyl halides, alkenes, cycloalkenes, and alkynes. In lab you will learn basic lab skills including recrystallization, distillation, chromatography, and liquid-liquid extraction. You will also learn how to set up simple chemical reactions. In lecture you will learn about free radical substitution, nucleophilic substitution, elimination, ionic addition, and free radical addition reactions. You will learn the mechanisms of these reactions and will be able to use learned principles to predict reaction outcomes. In lab you will get to carry out an elimination reaction to prepare an alkene and several substitution reactions to prepare alkyl halides. You will be introduced to the use of IR and ^{1}H NMR as structure identification tools.

Recitations: Problems from the textbook will be assigned by chapter in lecture. Selected problems will be worked during recitations. Additional questions arising from lectures will be answered in recitations. You should be prepared for recitation by doing announced problems and determining questions that you wish answered **before** attending recitation.

Lab: Meetings will occur twice per week for 3 hours each meeting. Lab *will* meet weeks 4-10 of the term but *will not* meet weeks 1-3 of the term.

Course Purpose: This course provides a good foundation for the second organic course, CHEM 248. Together with CHEM 248, this course provides a foundation for CHEM 249. CHEM 246, 248, and 249 provide a basic modern understanding of the principles of organic chemistry essential for a career in chemistry and/or related fields. These courses provide sufficient lab training for most bench chemistry work done by practicing chemists.

Expected Learning: By the end of the course, you should:

1) Be able to draw simple organic structures
2) Understand bonding in hydrocarbons
3) Know several ways to make alkenes and alkynes
4) Know many addition reactions of alkenes and alkynes
5) Understand the theory of S_N1, S_N2, E1 and E2 reactions
6) Be able to carry out substitution and elimination reactions in the lab
7) Understand basic concepts of stereochemistry
8) Be able to carry out recrystallizations, distillations, extractions, and simple chromatographies
9) Be able to experimentally determine a melting point and a boiling point

Grading: a total of 700 pts. total divided as follows (dates listed were used in 2012 for a related course):

1) four quizzes given in lecture (dates may be announced): each quiz is worth 50 pts. The two low grades are thrown out: 50 pts. each, 100 pts. maximum total. Make-ups are **not** given for missed quizzes: if you miss 3 or all 4 quizzes, 0 grades will be counted for one or two of the quizzes, respectively.
2) three unannounced quizzes given in lab at the beginning of the meeting. These quizzes cover the experiment to be performed at that meeting. Each is worth 10 pts. and the low grade will be thrown out, 20 pts. maximum total. Make-ups are **not** given for missed quizzes: if you miss 2 or all 3 lab quizzes, 0 grades will be counted for one or two of the quizzes, respectively
3) 3 midterm exams - 100 pts. each, the lowest grade is thrown out. No make-up test, however, the one you miss will be considered as the lowest. The dates will be announced; 200 pts. total.
4) Lab notebooks will be collected at the end of week 7 and again at the end of week 10. The experiments to be graded will be announced and must be completed with assigned questions answered. Notebooks that are late will be penalized 5% of the grade per day. Exceptions may be granted at the discretion of the lab instructor for labs being made up late. The maximum grade for notebooks will be 40 pts. for each collection, 80 pts. total.
5) Lab products will be collected with notebooks and will be graded concurrently with notebooks. Product purity and quantity will be assessed. The maximum grade for products will be 20 pts. for each collection, 40 pts. total.
6) Lab technique will be assessed by the lab instructor. A grade will be assigned at the time notebooks are graded. The maximum grade for technique will be 15 pts. for each assessment, 30 pts. total.
7) Comprehensive final - 230 pts.

Assigned problems are not graded but do show up on exams. Some of these problems will be worked at recitations. You need to do **all** of the assigned problems and understand the answers. Exams are based on lecture material and the assigned problems. You need to get to lecture every day or get the notes on any day that you miss class. Grades are curved so you need a minimum of 350 pts. to pass the course. For a C- > 450 pts. are required. For a B- > 520 pts. and for an A- > 600 pts. are required. However, these are subject to change.

Recitations

Selected assigned problems will be worked. Do the problems before each recitation and be ready with questions. Additional problems will be worked with class participation because these problems may also show up on exams.

Lecture Coverage

Chapter 1. Basic Concepts. Classical bonding concepts; octet rule and common valence; formal charges; resonance hybrids; structural formulas; Lowry-Bronsted acids and bases; Lewis acids and bases, electron-pushing and curved arrows.

Chapter 2. Structure and Properties. AOs and MOs; SP, SP_2, SP_3 hybridization; molecular shapes; conformations; double bond rigidity; constitutional isomers; stereoisomers; polarity concepts; H-bonding; solubility; boiling points; classes of compounds based on functional groups.

Chapter 3. Alkanes. IUPAC and common nomenclature of alkanes, cycloallkanes, and bicycloalkanes; Sci-Finder scholar chemical nomenclature; petroleum and natural gas as chemical feedstocks; alternative chemical feedstocks; cracking; conformations of ethane and butane; *cis-trans* ring isomers; angle strain; ring conformations; axial and equatorial positions; bicyclic structures.

Chapter 4. Chemical Reactions. Halogenation of alkanes; the free radical chain substitution mechanism; 1-electron arrows ("fishhooks"); enthalpy and entropy of reactions; E_a; transition states; isotope effects; reactive intermediates: free radicals, carbocations, and carbanions; hyperconjugation; Hammond postulate; early and late TS; number of NMR signals for determination of structure.

Chapter 5. Stereochemistry. Stereoisomers; chirality; asymmetric carbon atoms; enantiomers; CIP-designations; optical activity; [α]; racemic mixtures; optical purity; enantiomer excess; Fischer projections; diastereomers; *meso*-isomers; absolute and relative configurations; chiral recognition; resolution of enantiomers.

Chapter 6. Alkyl Halides. Nomenclature of alkyl halides; properties of alkyl halides; S_N2 reactions: mechanism, kinetics, stereochemistry, structural effects, nucleophilicity, and solvent effects; S_N1 reactions: mechanism, kinetics, stereochemistry, structural effects, and solvent effects; carbocation rearrangements; E1 reactions: mechanism and relation to S_N1 reactions; E2 reactions: dehydrohalogenation, mechanism, Zaitsev orientation, *anti*-elimination; stereochemistry of substitution reactions; stereospecific reactions.

Chapter 7. Alkenes. Alkene structure and nomenclature; alkene IR bands; *cis*-, *trans*-isomers; nomenclature; elements of unsaturation; CIP-designations; heat of hydrogenation; alkene stability; cycloalkene stability; physical properties; standard preparations via E1 dehydration reactions; industrial preparations

Chapter 8. Reactions of Alkenes. Alkene reactivity; electrophilic addition of HX; Markovnikov and anti-Markovnikov products; direct hydration; oxymercuration-demercuration; hydroboration-oxidation; halocarbene cyclopropanation; Simmons-Smith reaction; addition of halogens; bromonium ions; halohydrin formation; heterogenous catalytic hydrogenation; homogenous catalytic hydrogenation; enantioselective reactions; epoxidation; *syn*- and *anti*-dihydroxylation; ozonolysis.

Chapter 9. Alkynes. Alkyne structure and nomenclature; acetylene and its industrial sources; alkyne acidity; acetylides; acetylide syntheses; Glaser reaction; *bis*-dehydrohalogenation; catalytic hydrogenation of alkynes; metal-ammonia reduction; addition of halogen and HX; hydration; hydroboration-oxidation.

Projected List of Lab Experiments

Experiment 1. Purification of Solids – Recrystallization and Sublimation

Experiment 2. Distillation

Experiment 3. Extraction of Caffeine from Tea

Experiment 4. Separation of a Mixture by Acid - Base Extractions

Experiment 5. Chromatography

Experiment 6. Steam Distillation of a Naphthalene / Salicylic Acid Mixture

Experiment 7. Preparation of Alkyl Halides by the S_N2 Reaction

Experiment 8. Carbocations I. Preparation of Cyclohexene from Cyclohexanol

Academic Policies

Plagiarism, cheating, fabrication and other acts of academic misconduct will not be tolerated. For more information, see material in "academic dishonesty" under the "academic policies" tab at the following link:
http://drexel.edu/studentaffairs/community_standards/studentHandbook/

Students with disabilities should see material under the "health and disability services" tab at the following link:
http://drexel.edu/studentaffairs/community_standards/studentHandbook/

If you are registered and wish to drop or withdraw from this course, see the following link:
http://www.drexel.edu/provost/policies/course_drop.asp

The list of topics and/or lab experiments may be modified after the term begins. If such changes are made, your instructor will inform you during class. The list of quiz dates, test dates, and lab notebook collections may be altered owing to unforeseen circumstances. If such changes are made, your instructor will inform you during class and will post the changes on Drexel Learn in the calendar tool.

Week	Component	Monday	Tuesday	Wednesday	Thursday	Friday
1	Date	9/23/2013	9/24/2013	9/25/2013	9/26/2013	9/27/2013
	Lecture topic	Ch1	Ch. 1			Ch1
	Recitation	Ch1: ??, ??, Ch 2: ??, ??				
	Lab	No lab this week				
2	Date	9/30/2013	10/1/2013	10/2/2013	10/3/2013	10/4/2013
	Lecture topic	Ch2	Ch 2			Ch2
	Recitation					
	Lab	No lab this week				
3	Date	10/7/2013	10/8/2013	10/9/2013	10/10/2013	10/11/2013
	Lecture topic	**EXAM 1**	Ch3			Ch3
	Recitation					
	Lab	No lab this week				
4	Date	10/14/2013	10/15/2013	10/16/2013	10/17/2013	10/18/2013
	Lecture topic	**NO CLASS**	Ch4			Ch4
	Recitation					
	Lab	Exp. 1-2				
5	Date	10/21/2013	10/22/2013	10/23/2013	10/24/2013	10/25/2013
	Lecture topic	Exam2	Ch5			Ch5
	Recitation					
	Lab	Exp. 3-4				
6	Date	10/28/2013	10/29/2013	10/30/2013	10/31/2013	11/1/2013
	Lecture topic	**EXAM 2**	Ch6			Ch6
	Recitation					
	Lab	Exp. 5-6				
7	Date	11/4/2013	11/5/2013	11/6/2013	11/7/2013	11/8/2013
	Lecture topic		Ch7			Ch7
	Recitation					
	Lab	Exp. 7-8				
8	Date	11/11/2013	11/12/2013	11/13/2013	11/14/2013	11/15/2013
	Lecture topic	**EXAM 3**		Ch8		Ch8
	Recitation					
	Lab	Exp. 7-8				
9	Date	11/18/2013	11/19/2013	11/20/2013	11/21/2013	11/22/2013
	Lecture topic	Ch9	Ch9			Ch9
	Recitation					
	Lab	Exp 7-8				
10	Date	11/25/2013	11/26/2013	11/27/2013	11/28/2013	11/29/2013
	Lecture topic			No class		No class
	Recitation	**NO CLASSES Wednesday-Friday**				
	Lab					
11	Date	12/2/2013	12/3/2013	12/4/2013	12/5/2013	12/6/2013
	Lecture topic	Ch9 and review				
	Recitation					
	Lab					
12	Date	12/9/2013	12/10/2013	12/11/2013	12/12/2013	12/13/2013
		FINAL EXAM WEEK				