ORGANIC CHEMISTRY I (CH 323)
COURSE OUTLINE
FALL SEMESTER 2000

Bülent Terem

Required Textbook: Carey, Francis A. *Organic Chemistry,* McGraw-Hill, 4th Ed., 2000.

Supplementary Books:

Carey, Francis A. and Atkins, Robert C. *Student Study Guide /Solutions Manual to Accompany Organic Chemistry by Francis A. Carey,* McGraw-Hill, 2000.
Bruice, P.Y. *Organic Chemistry,* Prentice-Hall, Inc., 1995.

Software: ChernDraw (for Windows); Chem 3-D, Cambridge Soft Corp.

Supplementary Materials: Molecular Models

Web Pages: http://bterem.pageout.net
Announcements; lecture highlights; exam solutions; sample exams
www.mhhe.com/carev
Carey Organic Chemistry Online Learning Center

Course Objectives:
This is the first part of a two-semester course in organic chemistry, where carbon compounds are studied on the basis of their functional groups. Following a review of the basic principles in general chemistry, acid-base reactions will be investigated with an emphasis on electron pair transfers and the way these can be illustrated using curly arrows. Chemistry of alkenes will be the most important topic of the semester, since a mechanistic approach to functional group interconversions will enhance a fuller understanding of the subject and minimize memorization. Throughout the semester students will be encouraged to view organic molecules in three dimensions. A comprehensive study of stereochemistry based on thermodynamic principles will be very helpful in spatial analyses. To summarize the course objectives in more tangible terms, at the end of the semester the students should be able to carry out the following tasks:

- Identify and classify organic molecules according to their functional groups
- Carry out functional group interconversions of the classes of compounds studied
- Illustrate the mechanism of each of the functional group interconversions identifying intermediates and transition states where appropriate
- Identify thermodynamically favorable conformations for acyclic and cyclic molecules
- Use principles of stereochemistry to explain stereoselective reactions
- Distinguish mechanisms on the basis of stereochemical outcome

The depth of organic chemistry is beyond that of a basic science; at times it can be perceived as a philosophy, or an art, or architectural design. It can also help to answer questions which start with "why?" In a liberal arts college with a student population from different backgrounds and with different career interests, the multi-dimensionality of this discipline can be demonstrated much more easily. It is hoped that at the end of the semester, the student will be fulfilled intellectually, in addition to accumulating the knowledge which is essential for his/her studies in molecular and/or biomedical sciences.

Exams and Grading: Three 60-minute midterms, quizzes and homework assignments, and a ninety minute comprehensive final.

Course Grade (all grades in percentages)
+ .26 (average of the three midterms)
+ .26 (average of the two highest midterms)
+ .10 (average of the quizzes and assignments)
+.38 (final)

Make-up exams will be given only under exceptional circumstances on the basis of a written request accompanied by a written verification.

Office Hours: TF 12:30 - 2:00; R 12:30 - 1:00 and/or by arrangement

Review Sessions: To be arranged

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General Comments!

The prescribed method for organic chemistry is "active learning", which means that students should think about and reformulate the concepts presented. This aspect will be emphasized during lecture periods and will be reinforced with appropriate assignments. Active learning will also require solving problems presented within each chapter of the textbook, as well as redoing the exams and quizzes already taken.

Week	Date	Chapter in Text	Subject
1	8/29	1	Introduction to Organic Chemistry: Historical perspectives; Organic Chemistry in the hierarchy of other scientific disciplines... Electronic structure of atoms... Chemical bonding: Lewis model; Ionic, covalent, and polar covalent bonds... Multiple bonds... Lewis Structures; The Octet Rule; Formal Charges; Exception to the Octet Rule...
1	8/31	1	Structural formulas of Organic Molecules... Constitutional Isomers... VSEPR Model and shapes of molecules... Comparison of Valence Bond and Molecular Orbital Theories... Hybridization ... Constitutional isomerism...
2	9/5	2	Classification of carbon compounds based on Functional Groups... Alkanes: Structures and Molecular Formulas... Nomenclature of alkanes: IUPAC naming; Common Names... Physical Properties of Alkanes... Equivalent carbons and h dro ens…
2	9/7	2 3	Combustion of alkanes... Oxidation-reduction in Organic Chemistry... Free rotation in alkanes: Conformational analysis... Newman Projections and Saw-Horse Representations... Cycloalkanes: Structure and Nomenclature... Conformations of C cloalkanes: Chair and Boat conformations of c clohexanes…
3	9/12	3	Strained cycloalkanes... Disubstituted cycloalkanes: Cis-Trans isomerism in cycloalkanes... Bic clic and S iroalkanes… Heteroc clic compounds...
3	9/14	4	Alcohols and Alkyl Halides: Structural features; physical properties... Acids and Bases: Arrhenius and Brønsted-Lowry definitions... Electron and proton transfer representations: Curly arrows... Conversion of alcohols into alkyl halides...
4	9/19	4	Conversion of alcohols into alkyl halides (cont.): Analysis of Mechanism... Reactive intermediates... Rates of substitution reactions... Halogenation of alkanes: Mechanism of free radical halogenation; Bond Dissociation Energies (BDE)...
4	9/21		FIRST MIDTERM EXAM
5	9/26	5	Alkenes: Nomenclature and orbital representations... Stereoisomerism in alkenes: Cis-Trans isomers... Relative stabilities measured by heats of combustion... Preparation of alkenes: Elimination reactions... Dehydration of Alcohols: Regio- and stereoselectivity...
5	9/28	5 6	Mechanism of acid catalyzed alcohol dehydration... Carbocation rearrangements... Dehydrohalogenation: E2 and El reactions... Reactions of alkenes: Catalytic hydrogenation –stereochemical considerations...
6	10/3	6	Reactions of alkenes (cont.): Electrophilic addition reactions of alkenes: General mechanism; regioselectivity... Free radical addition... Acid catalyzed hydration... H droboration…
6	10/5	6 7	Reactions of alkenes (cont.): Halogen addition -stereochemical considerations... Epoxidation... Ozonolysis... Multi-step syntheses with alkenes... Chirality... A survey of isomerism... Tetrahedral molecules with stereogenic centers... Optical Activity... Enantiomers... Racemic mixtures... Absolute and Relative Configuration... R/S Configuration...
7	10/10	7	Representation of chirality: 3-D drawings; Fischer Projection Formulas... Reactions which create chiral centers... Molecules with multi-stereocenters (can they be achiral?)... *Meso*-compounds…
7	10/12	7 8	Reactions which create diastereomers... Chirality in biological systems... The lock and key concept... Nucleophilic Substitution Reactions: Mechanism and stereochemistry of S N2 reactions...
8	10/17	8	Steric effects in SN2 reactions... Factors which favor SN2 reactions: nucleophilicity; leavin rou ability...
8	10/19	8	Alkynes: Nomenclature and orbital representations... Acidity of terminal alkynes... Preparation of alkynes: Alkylation of acetylides (S N2 reactions); Double deh drohalo enation reactions... Reduction of al nes…
9	10/24		SECOND MIDTERM EXAM

Week	Date	Chapter	Subject
9	10/26	9 15	Reaction of alkynes: Hydrogen halide addition; Halogenation; Hydration. Alcohols: Preparation of alcohols and diols (review; Sect. 15.2, 15.3 will not be covered at this stage)... Reactions of alcohols: Conversions into ethers (Sect. 15.8, 15.9 to be covered later); Oxidation of alcohols...
10	10/31	15 16	Thiols (Sect. 15.15 to be covered later)... Ethers: Nomenclature and physical properties... Crown ethers (host-guest complexing)... Preparation of ethers: Williamson ether synthesis... Reactions of ethers...
10	11/2	16	Epoxides: Preparation of epoxides... Reactions of epoxides: Acid and Base catalyzed ring-opening reactions... Stereochemist of e oxide ring-opening reactions...
11	11/7	16	Preparation of Sulfides... Oxidations of sulfides... Sulfonium salts (in biological al lation reactions)... (Sect. 16.18 to be covered later)
11	11/9	10	Conjugated Systems: Allylic carbocations; Allylic free radicals... Allylic halogenation... Conjugated dienes: 1,3-dienes; allenes (chiral molecules without a stereogenic center)... Electrophilic addition to conjugated dienes: 1,2- and 1,4-additions: kinetic and thermodynamic consideration...
12	11/14	10	The Diels-Alder Reaction... MO analysis of Diels-Alder Reaction...
12	11/16	11	Arenes and Aromaticity... Structure of benzene... Stability of benzene (supported by heat of hydrogenation data)... Nomenclature of benzene derivatives... Polycyclic aromatic compounds... Birch Reduction...
13	11/21	11	Side-chain reactions of alkyl benzenes: Benzylic radicals; Benzylic carbocations; Alken t benzenes; Polystyrene...
13	11/23		No class: Thanksgiving
14	11/28		THIRD MIDTERM EXAM
14	11/30	11	Further criteria for aromaticity… Hückel's rule of aromaticity... Annulenes... Aromatic ions... Heteroaromatic compounds...
15	12/5	13 (in part)	A general look into spectroscopy: an organic chemist's perspective... Ultraviolet and visible spectroscopy (Sect. 13.20)... Mass spectrometry (Sect. 13.21)... Instrumental features...
15	1217	13	Analysis of mass spectra; Resolution; Isotopes; Molecular ion peaks ... Fragmentation in mass spectrometry...
	12/13		FINAL EXAM (Wednesday; 08:00)