# ORGANIC CHEMISTRY II (CH 324)
# COURSE OUTLINE
## SPRING SEMESTER 1999

**Bülent** Terem

Required Textbook: Brown, *W.H. Organic Chemistry*, Saunders College Publishing, 1995.

Supplementary Books:
Iverson, B.L. and Iverson, S.A. *Student Guide and Problems Book for Organic Chemistry by William H. Brown, Vol. 1* and Vol. 2, Saunders College Publishing, 1995.
Bruice, *P.Y. Organic Chemistry*, Prentice-Hall, Inc., 1995.

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

Supplementary Materials:
Molecular Models

Exams and Grading: Three 70-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)

Office Hours: TR 12:30 -1:00 and/or by arrangement

Review Sessions: Saturday mornings

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General Comments:

During Chem 323 the focus was on understanding the basic concepts of organic reaction mechanisms. With a sound grasp of introductory principles, it will be much easier, and more fulfilling, to follow the rationale of the second semester's organic chemistry course. In the next fifteen weeks we will start with topics in physical organic chemistry and gradually move into biological organic chemistry. The chemistry of aromatic compounds will provide a framework where structure-reactivity relationships are clearly laid out. An introduction to spectroscopic techniques will show how physical methods can illustrate the properties of organic compounds. As we go into the chemistry of carbonyl compounds, and sample in-depth analyses of certain reactions, comparisons with biological pathways will stand out. Meanwhile, multi-step syntheses will elucidate common logical strategies. Finally, the chemistry of carbohydrates, amino acids and proteins will give the course a biological flavor.

As far as study habits are concerned, any effort to understand the material as it is presented, or shortly after, is the key to success in this course. Overlaps between lab and lecture, as well as review sessions, are designed to emphasize this point. A "diligent" student is also expected to attempt most of the problems in the relevant sections of the textbook. It is hoped that at the end of the spring semester, each student will possess a sound molecular background to help him/her interpret what goes on in biological systems.

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| 1 | 1/12 | 12 | A general look into spectroscopy: an organic chemist's perspective... Mass spectrometry... Instrumental features... Analysis of mass spectra: Resolution; Isotopes; Molecular ion peaks... |
| 1 | 1/14 | 12<br>15 | Fragmentation in mass spectrometry... Stable fragments... Rearrangements... Structure determination using mass spectral data...<br>A review of organic reactions... Benzene derivatives and aromatic compounds... The concept of aromatici |
| 2 | 1/19 | 15 | Annulenes... Heterocyclic aromatic compounds... Aromatic ions... Fused ring aromatic compounds... Phenols... Side chain reactions of aromatic compounds... Mass spectrometry of benzene derivatives... |
| 2 | 1/21 | 16 | General mechanism of electrophilic aromatic substitution reactions... Halogenation; Nitration; Sulfonation... |
| 3 | 1/26 | 16 | Friedel Craft's alkylation and acylation reactions... Substituent effects in electro hilic aromatic substitution... |
| 3 | 1/28 | 16 | Substituent effects in electro hilic aromatic substitution cont. ... |
| 4 | 2/2 | | **FIRST** MIDTERM EXAM |
| 4 | 2/4 | 13 | Nuclear Magnetic Resonance (NMR) Spectroscopy: The origin of NMR absorptions; 'H NMR... |
| 5 | 2/9 | 13 | Equivalence in NMR Spectroscopy... Integration... Chemical shifts... |
| 5 | 2/11 | 13 | Sin-sin coupling... C NMR... Interpretation of NMR spectra... |
| 6 | 2/16 | 13 | Magnetic induction in a π-system... NMR Spectroscopy of benzene derivatives 15 .4B ... Structure determination using spectroscopic data... |
| 6 | 2/18 | 17 | Aldehydes and ketones: Classification and their spectroscopic properties... Preparation... |
| 7 | 2/23 | 17 | Addition of nucleophiles to aldehydes and ketones: General mechanism (acid and base catalyzed)... Carbon nucleophiles: Grignard reagents; Organolithium reagents; Ace lides; Cyanide... |
| 7 | 2/25 | 17 | The Wittig Reaction...' Oxygen Nucleophiles: Hydrates; Acetals... Acetals as protecting groups... Thioacetals... 1,3-dithiane anions... |
| 8 | 3/2 | 17 | Nitrogen nucleophiles... Oxidation of aldehydes and ketones... Baeyer-Villiger oxidation... Reduction of aldeh des and ketones... |
| 8 | 3/4 | 17 | Keto-enol tautomerism... Reactions at the a-carbon: Racemization; H-D exchange; Aldol Reaction... |
| 9 | 3/9 | | **SECOND MIDTERM EXAM** |

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| 9 | **3/11** | 18 | Carbohydrates: Structural classifications; **hemiacetal** formation (cyclization) of monosaccharides... Conformations of **monosaccharides…** Reactions of monosaccharides: oxidation; reduction; acetal formation... N-glycosides: Nucleosides, nucleotides; linkages in nucleic acids (25.1-25.2)... |
| 10 | 3/16 | 18 | **Fischer's** roof of glucose structure... **Disaccharides…** |
| 10 | 3/18 | 18<br>19 | Biologically active carbohydrates... Polysaccharides...<br>Carboxylic acids: Structural features; Effects of substituents on acidity |
| 11 | 3/22<br>-3/26 | | SPRING BREAK |
| 12 | 3/30 | 19 | Preparation of carboxylic acids: Hydrolysis of nitriles; Carbonation of Grignard rea ents; Oxidation reactions... |
| 12 | 4/1 | 19<br><br>20 | Reactions of carboxylic acids: Reduction; Esterification; Thermal decarboxylation of **β-ketoacids…**<br>Carboxylic acid functional derivatives: Esters, Amides, Anhydrides, Acid halides, Nitriles... |
| 13 | 4/6 | 20 | Reactions of carboxylic acid derivatives: Mechanism of nucleophilic acyl substitution... Hydrolysis... Comparison of the reactivities of carboxylic acid derivatives... Interconversion of carboxylic acid derivatives... |
| 13 | 4/8 | 20 | The Hofinann Rearrangement... Condensation of Esters: Claisen Condensation; Hydrolysis and decarboxylation of **β-ketoesters…** Carboxylic acid derivatives of **biolo ical** interest... Sulfonamides... |
| 14 | 4/13 | 21 | Enolate anions: directed **aldol** reactions... **Acetoacetic** and **malonic** ester syntheses... a, -unsaturated **aldeh des** and **ketones…** The Michael reaction... |
| 14 | 4/15 | 21 | Enamine reactions... Robinson Annulation Reaction... Review... |
| 15 | 4/20 | | THIRD MIDTERM EXAM |
| 15 | 4/22 | 22 | Amines: Nomenclature; structure and bonding; basicity... Syntheses of amines: Gabriel Synthesis; Reductive routes; Hofinann (and Curtius) Rearrangements... Reactions of amines: Hinsber Test; Hofinann Elimination... |
| 16 | 4/27 | 22 | **lamines:** Nitrosation reactions... 1 diazonium salts: **Sandme er** reactions... |
| 16 | 4/29 | 24 | Amino acids: Structural-stereochemical features; acid-base properties... Peptides and proteins... Peptide structure determination: End group analyses; partial hydrolyses... S thetic strategies in **peptide** syntheses ... |
| | 515 | | FINAL EXAM (Wednesday; 08:00) |