TENNESSEE STATE UNIVERSITY
Department of Chemistry

CHEM 2020-80: Organic Chemistry II
SEMESTER:SPRING 2011

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Office Hours: Tuesdays: 4:30PM-5:00PM & Call me for additional time
Textbook: **"Organic Chemistry" by Janice G. Smith, 3rd Edition, 2010**
Reference Books:
1. Organic Chemistry, 6th Ed, 2004, by John McMurry
2. Organic Chemistry; 2nd Ed., 2006 by W. Brown and C. S. Foote
3. Organic Chemistry, 7th Ed, 2006, by G. Solomons and C. Gryhle
4. Fundamentals of Organic Chemistry, 6th Ed, 2007, by McMurry and Simaneck.
5. Introduction to Organic Chemistry, 3rd Ed, 2005, by W. Brown and T. Poon.
6. Writing Reaction Mechanisms in Organic Chemistry, 2nd Ed, 2000, by A. Miller and P. Solomon

Prerequisite: CHEM 1110/1120 (Formerly CHEM 1010/1020)
Course Description: The course involves a systematic study of various classes of organic compounds including their physical and chemical properties, nomenclature, stereochemistry, synthesis and reactions. The course also introduces Mass Spectroscopy, Infra-Red Spectroscopy, Nuclear Magnetic Resonance Spectroscopy and Ultra-Violet Spectroscopy. Basic description of the theories of these spectroscopic techniques and their utilization in structure determination are the key focuses. Radical reactions, aromaticity and structural characteristics of aromatic compounds and their reactions are introduced. Nucleophilic aromatic substitution reactions are discussed in detail. Chemistry of other class of compounds includes: aldehydes, ketones, carboxylic acids and their derivatives. Acidity of alpha hydrogens of carbonyl compounds and their substitution reactions are introduced in detail. Mechanisms of various aldol condensation reactions are presented.

Course Objectives: This course is designed for all chemistry majors, pre-professionals, biology and other scientific areas. Its aims are comprehensive introduction to some of the principles of organic chemistry. The student will learn a realistic approach to the study of reaction mechanisms and be acquainted with a good scientific understanding and working knowledge in Organic Chemistry.

Course Competencies: Upon completion of this course, the student should have obtained the following competencies:

(1) Understand the spectral properties of waves. Gain a general appreciation for wavelength and the relative energy of various regions of the electromagnetic spectrum.
(2) A working knowledge of Infrared Spectroscopy and Mass Spectrometry and their use in organic structure determination.
(3) Understand the meaning of "Chemical Shift", and the use of the terms "Upfield" and "Downfield".
(4) Understand the meaning signal splitting and integration
(5) Know how to interpret spectra
(6) Understand what the molecular ion and base peak are in a mass spectrum.
(7) How to use fragmentation pattern to elucidate structure.
(8) Understand molecular orbital theory to understand UV/VIS spectroscopic absorptions.
(9) Recognize that UV/VIS spectroscopy is an important analytical tool in biochemical and environmental studies
(10) Know the nomenclatures rules for aromatic compounds

(11) Recognize the unique reaction characteristics of aromatic compounds
(12) Be able to apply Huckel 4n+2 rule to characterize aromatic compounds.
(13) Be able to understand aromatic nucleophilic substitution reactions and substituent effects in such a reaction
(14) Understand the reactions of carbonyl compounds with Grignard reagents for the preparation of alcohols
(15) Be able to name simple aldehydes and ketones
(16) Know the various preparations of aldehydes and ketones
(17) Understand the nucleophilic addition reactions of aldehydes and ketones with various nucleophiles, such as: OH-, H_2O, H-, ROH, R_3C-, RO-, CN-, NH_3, RNH_2 etc.
(18) Be able to write the detailed mechanisms of the above nucleophilic addition reactions
(19) Understand the conjugate addition reactions of α,β-unsturated aldehydes and ketones
(20) Be able to understand the differences in acidity of various substituted carboxylic acids
(21) Be able to understand the mechanisms of various nucleophilic substitution reactions of carboxylic acid derivatives
(22) Understand the reactivity differences between various carboxylic acid derivatives
(23) Understand the acidity of alpha hydrogens of aldehydes and ketones and the reactions at the alpha carbon including alpha alkylation, haloform reactions, alpha halogenation reactions, malonic ester synthesis and various aldol condensation reactions
(24) Understand the mechanisms of acid and base-catalyzed aldol condensation reactions.

Course Presentation: Lecture material will be taken from the textbook and supplementary materials will be distributed as needed.

Examination/Quizzes: Tests will account for **75%** of the course grade (60% on Tests and 15% on Quizzes).

Final Examination: 25% of the course grade, and will be a Comprehensive Departmental Final Exam.

TESTS AND EXAMS POLICY:

Four Tests will be given during the semester. Test dates will be announced in class prior to each test at least 5 days ahead of the test date. There will be no make-up test, but the test with lowest grade will be dropped. If you miss a test, it will be considered as your drop test. Quizzes will be given without prior announcements.

Grading Scale: 90-100 = A; 80-89 = B; 70-79 = C; 60-69 = D; below 60 = F

Attendance and Expectations: Students are expected to attend every lecture in its entirety. Students are expected to read and study the material to be discussed prior to the lecture. This includes working in-chapter and end-of-chapter problems and exercises in the text. Students should review the material discussed until comprehension is acquired and seek assistance when necessary. It is also highly recommended that students purchase the following supplementary materials: Study Guide and Solutions Manual; A Molecular Model Set.

TSU Statement of Disability Policy for Students

It is the policy of TSU to accommodate students with disabilities, pursuant to federal law, state law, and the University's commitment to equal educational opportunities. Any student eligible for and requesting academic accommodations due to disability is requested to provide a letter of accommodation from the Office of Disabled Students Services within the first two weeks of the beginning of classes. Students with disabilities are encouraged to contact the Office of Disabled Student Services, which is located in Kean Hall, Room 117, Telephone 963-7400 or 963-7872.

Organic Chemistry II (CHEM 2020): Lecture Schedule
SPRING 2011
Text: Organic Chemistry, By Janice G. Smith, 3rd Edition, 2011

Dates	Chap	Title	Pages	Exercises
Jan 18 & 25	14	**Nuclear Magnet Resonance Spectroscopy:** An Introduction to NMR Spectroscopy, ^{1}H NMR: Number of Signals, ^{1}H NMR: Position of Signals, The Chemical Shift of Protons on sp^2 and *sp* Hybridized Carbons,^{1}H NMR: Intensity of Signals, ^{1}H NMR: Spin-Spin Splitting, More Complex Examples of Splitting, Spin-Spin Splitting in Alkenes, Other Facts About ^{1}H NMR Spectroscopy, Using ^{1}H NMR to Identify an Unknown, ^{13}C NMR Spectroscopy, Magnetic Resonance Imaging (MRI).	494	14.1-14.17
Feb 1	15	**Radical Reactions:** Introduction, General Features of Radical Reactions, Halogenation of Alkanes, The Mechanisms of Halogenation, Chlorination of Other Alkanes, Chlorination versus Bromination, Halogenation as a Toll in Organic Synthesis, The Stereochemistry of Halogenation Reactions, Application: The Ozone Layer and CFCs, Radical Halogenation at an Allylic Carbon, Application: Oxidation of Unsaturated Lipids, Application: Antioxidants, Radical Reactions to Double Bonds, Polymers and Polymerization.	538	15.1-15.30
Feb 8	16	**Conjugation, Resonance, and Dienes:** Conjugation, Resonance and Allylic Carbocations, Common Examples of Resonance, The Resonance Hybrid, Electron Delocalization, Hybridization, and Geometry, Conjugated Dienes, Interesting Dienes and Polyenes, the Carbon-Carbon σ Bond Length in 1,3-Butadiene, Stability of Conjugated Dienes, Electrophilic Addition: 1,2-Versus 1,4-Addition, Kinetic Versus Thermodynamic Products, The Diels-Alder Reaction, Specific Rules Governing the Diels-Alder Reaction, Other Facts About the Diels-Alder Reaction, Conjugated Dienes and Ultraviolet Light.	571	16.1-16.25
Feb 15	17	**Benzene and Aromatic Compounds:** Background, the Structure of Benzene, Nomenclature of Benzene Derivatives, Spectroscopic Properties, Interesting Aromatic Compounds, Benzene's Unusual Stability, the Criteria for Aromaticity-Hückel's Rule, Examples of Aromatic Compounds, What Is the Basis of Hückel's Rule?, The Inscribed Polygon Method for Predicting Aromaticity, Buckminsterfullerene-Is It Aromatic?.	607	17.1-17.22
Feb 22 & March 1	18	**Electophilic Aromatic Substitution:** Electrophilic Aromatic Substitution, The General Mechanism, Halogenation, Nitration and Sulfonation, Friedel-Crafts Alkylation and Friedel-Craft Acylation, Substitution Benzenes, Electrophilic Aromatic Substitution of Substituted Benzenes, Why Substituents Activate or Deactivate a Benzene Ring, Orientation Effects in Substituted Benzenes, Limitations on Electrophilic Substitution Reactions with Substituted Benzenes, Disubstituted Benzenes, Synthesis of Benzene Derivatives, Halogenation of Alkyl Benzenes, Oxidation and Reduction of Substituted Benzenes, Mulitstep Synthesis.	641	18.1-18.33
March 8		**SPRING BREAK – NO CLASSES**		
March 15	19	**Carboxylic Acids and the Acidity of the O-H Bond:** Structure and Bonding, Nomenclature, Physical Properties, Spectroscopic Properties, Interesting Carboxylic Acids, Asprin, Arachidonic Acid, and Prostaglandins, Preparation of Carboxylic Acids, Reactions of	688	19.1-19.27

		Carboxylic Acids-General Features,Carboxylic Acids-Strong Organic Brønsted-Lowry Acids, Inductive Effects in Aliphatic Carboxylic Acids, Substituted Benzoic Acids, Extraction, Sulfonic Acids, Amino Acids.		
March 22	20	**Introduction to Carbonyl Chemistry; Organometallic Reagents; Oxidation and Reduction:** Introduction, Genral Reactions of Carbonyl Compounds, A Preview of Oxidation and Reduction, Reduction of Aldehydes and Ketones, the Stereochemistry of Cabonyl Reduction, Enantioselective Carbonyl Reductions, Reduction of Carboxylic Acids and Their Derivatives, Organometallic Reagents, Reaction of Organometallic Reagents with Aldehydes and Ketones, Retrosynthetic Analysis of Grignard Products, Protecting Groups, Reaction of Organomentallic Reagents with Carboxylic Acid, Reaction of Organometallic Reagents with Other Compounds, α,β-Unsaturated Carbonyl Compounds, Summary, Synthesis.	721	20.1-20.35
March 29	21	**Aldehydes and Ketones Nucleophilic Addition:** Introduction, Nomenclature, Physical Properties, Spectroscopic Properties, Interesting Aldehydes and Ketones, Preparation of Aldehydes and Ketones, Reactions of Aldehydes and Ketones-General Considerations, Nucleophilic Addition of H^- and R^- - A Review, Nucleophilic Addition of ^-CN, The Wittig Reaction, Addition of 1º Amines, Addition of 2º Amines, Addition of H_2O-Hydration, Addition of Alcohols-Acetal Formation, Acetals as Protecting Groups, Cyclic Hemiacetals, An Introduction to Carbohydrates.	774	21.1-21.40
April 5	22	**Carboxylic Acids and Their Derivatives – Nucleophilic Acyl Substitution:** Introduction, Structure and Bonding, Nomenclature, Physical Properties, Spectroscopic Properties, Interesting Esters and Amides, Introduction to Nucleophilic Acyl Substitution, Reactions and Anhydrides, Reactions of Caboxylic Acids, Reactions of Esters, Appication: Lipid Hydroysis, Reactions of Amides, Applications: The Mechanism of Action of β-Lactam Antibiotics, Summary of Nucleophilic Acyl Substitution Reactions, Natural and Synthetic Fibers, Biological Acylation Reactions, Nitriles.	825	22.1-22.36
April 12	23	**Substitution Reactions of Cabonyl Compounds at the α Carbon:** Introduction, Enols, Enolates, Enolates of Unsymmetrical Carbonyl Compounds, Racemization at the α Carbon, A Preview of Reactions at the α Carbon, Halogenation at the α Carbon, Direct Enolate Alkylation, Malonic Ester Synthesis, Acetoacetic Ester Synthesis.	880	23.1-23.28
April 19	24	**Carbonyl Condensation Reactions:** The Aldol Reaction, Crossed Aldol Reactions, Directed Aldol Reactions, Intramolecular Aldol Reactions, the Claisen Reaction, The Crossed Claisen and Related Reactions, The Dieckmann Reaction, The Michael Reaction, The Robinson Annulation.	916	24.1-24.22
April 26	25	**Amines:** Introduction, Structure and Bonding, Nomenclature, Physical Properties, Spectroscopic Properties, Interesting and Useful Amines, Preparation of Amines, Reactions of Amines, Amines as Bases and their Relative Basicity, Amines as Nucleophiles, Hofmann Elimination, Reaction of Amines with Nitrous Acid, Substitution Reactions of Aryl Diazonium Salts and Applications.	949	25.1-25.42
May 3 5:00P-7:00P		Comprehensive Final Exam		

SPRING SEMESTER 2011	
Jan 13	Classes begin
Jan 13-22	Late registration/Schedule Adjustments
Jan 17	Holiday
Feb 28-March 6	Mid-term Examination Week
Mar 7-13	Spring Break
Mar 25	Last day to withdraw from courses-Office of Records
Mar 25	Last day to withdraw from University-Counseling Center
Apr 22	Holiday
Apr 28	Last day of class
April 28-May 6	Final examinations for Spring 2011 semester
May 7	Spring Commencement- see commencement website