**TENNESSEE STATE UNIVERSITY**

**COLLEGE OF LIFE AND PHYSICAL SCIENCES**

**DEPARTMENT OF CHEMISTRY**

**CHEM 2010-01: Organic Chemistry I**

**Fall 2019**

**Instructor’s Name:** *Cosmas Okoro, Ph.D.*

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**Office Hours:** M (11-12 PM, Boswell 106); T (2-4 PM); R (2-4 PM)

**Lecture Time: 8:00 – 9:25 AM**

**Required Textbook: Organic Chemistry” by Janice G. Smith, 2019, 6th edition**

**Connect:** (optional)

**Reference Books**: 1. Organic Chemistry, 9th Ed, 2016, by John McMurry

2. Organic Chemistry; 7th Ed., 2016 by W. Brown and C. S. Foote

3. Organic Chemistry, 12th Ed, 2017, by G. Solomons and C. Gryhle

4. Organic Chemistry, 3rd Ed, 2017, by David Klein

5. Organic Chemistry, 5th Ed, 2016, by J. Flemming

**Prerequisites:** CHEM 1110/1120 (Formerly CHEM 1010/1020)

**Class days and location: MW Boswell 112**

**Number of credit hours:** 3

**Course Description:** A systematic study of various class of organic compounds including their physical and chemical properties, nomenclature, stereochemistry, synthesis and reactions. The course starts with a detailed description of Structure and bonding in organic molecules. The concept of organic acids/bases and an overview of organic reactions are discussed in detail. Class of compounds include: alkanes, alkenes, alkynes, alkyl halides, alcohols, ethers, and epoxides. Nucleophilic substitution reactions, Elimination reactions and their mechanisms and stereochemistry are emphasized.

**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. A thorough understanding of the fundamental aspects of structure and bonding in organic compounds
2. A clear understanding of formal charge, bond polarity, electronegativity, and resonance
3. Be able to write and explain hybridization of atoms for organic molecules.
4. Be able to draw and interpret Lewis structures, condensed structures and skeletal structures for organic molecules.
5. A thorough understanding of the correlation between physical properties, chemical reactivity and molecular structure
6. Understand the concept of Brønsted-Lowry and Lewis acids and bases
7. Explain the factors that determine acid strength including element effects, inductive effects, resonance effects and hybridization effects
8. Know how to draw the products of Lewis acid-base reactions.
9. Be able to identify functional groups and explain reactivity of organic molecules based on functional groups
10. Understand the meaning of aliphatic and aromatic hydrocarbons
11. Explain the intermolecular forces including van der Waals forces, dipole-dipole interactions and hydrogen bonding
12. Explain the physical properties of organic compounds and the factors affecting boiling point, melting point and solubility of organic molecules
13. Understand constitutional isomers and classification of hydrogen and carbon atoms
14. Know the nomenclature of aliphatic and alicyclic alkanes using IUPAC rules. Know the nomenclature of compounds containing a functional group.
15. Understand the conformational analysis of alkanes and cycloalkanes
16. Explain the stereochemistry of organic molecules and assign absolute configuration using Cahn–Ingold–Prelog priority rules
17. Understand the concepts of chirality, enantiomers, diastereomers, meso compounds, optical activity, enantiomeric excess, specific rotation and racemic mixtures
18. Know the various kinds of organic reactions including substitution, elimination and addition reactions and use of curved arrows in organic reactions and mechanisms
19. Explain the hemolytic and heterolytic bond breaking and bond dissociation energy
20. Be able to understand the kinetics, thermodynamics, free energy, entropy and interpret energy diagram for reactions.
21. Be able to explain rate law rate-determining step in a multistep reaction
22. Understand the mechanism of the reaction of alkyl halides and different factors that affect substitution and elimination reaction of alkyl halides and stereochemistry of such reactions
23. Be able to predict alkyl halide’s reactions mechanism based on various factors.
24. Understand the naming, reaction and properties of alcohols, ethers and epoxides.
25. Explain the structure of alkenes, their reactivity and cis-trans vs. E,Z-designation
26. Understand various reactions of alkenes and alkynes including Markovnikov’s reaction, various hydration, oxidation and reduction reactions
27. Be able to explain retrosynthetic analysis for organic reactions
28. Understand wavelength and the relative energy of various regions of the electromagnetic spectrum.
29. Be able to understand the basic principles of IR and Mass Spectroscopy and interpret IR and Mass spectra
30. Understand the base peak, molecular ion peak, isotopic peaks and fragments peaks in mass spectra
31. Be able to understand SN1 and SN2reactions and their mechanisms
32. Be able to draw transition state structures
33. Be able to interpret E1, E2 and E1cb reaction mechanisms.
34. Be able to draw keto-enol tautomers
35. Be able to recognize Nu- and E+ and their relative reactivities

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

**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.

**GRADING:**

**Tests, /Quizzes 70%**

**Homework 10%**

**Comprehensive Final Exam 20%**

**Total 100%**

**Grading Scale**

Grade Score Range Significance

A 90 - 100% Excellent, work of exceptional quality

B 80 - 89% Good, work above average

C 70 - 79% Work of average quality

D 60 - 69% Poor, representing passing work

F 0 - 59% Failure, representing unacceptable performance

#### TESTS AND EXAMS POLICY:

Four tests including final exam will be given during the semester, and the dates will be announced one week prior to each test. Some questions in the tests will require extensive writing, such as description, explanation etc. The final will be a comprehensive examination consisting of the entire semester's work.

**MAKE-UP** **POLICY ON STUDENT MAKE-UP EXAMS WITH A *VALID* EXCUSE:**

* One exam absence: Student must provide a proper University excuse or an excuse that has been validated by the “One-Stop Shop” in 133 Kean Hall; the make-up exam will be given by instructor as soon as student returns on campus.
* Two or more exam absences: A grade of ZERO will be assigned for 2nd and further missed exams.
* Comprehensive final exam: A grade of ZERO will be assigned for missed final exam.

**ACADEMIC MISCONDUCT, CHEATING & PLAGIARISM**: In accordance with the university’s policy on academic and classroom misconduct found in the catalog, cheating will not be tolerated in this course and a zero-tolerance policy regarding cheating will be followed throughout the course. A student who is caught cheating or attempting to cheat will be given a zero “(F)” for that particular assignment/test/quiz for the first offense. If a student is caught cheating a second time, that student will be given an overall grade of “(F)” for the course. To this end, the following classroom policies will be in effect and enforced.

1. Cell phones and any other electronic devices (including smart watches) that connect to wireless networks will not be permitted during any exam or quiz. These devices may not be on your desk during an exam or quiz and must be stored in your bag or purse and/or turned off. Calculators may be used, only if the questions on the exam or quiz warrant their use.
2. Once an exam or quiz period has started, you will not be permitted to leave to go to the restroom during the exam period. Please be sure to use the restroom before coming to class. Exceptions will only be made for those with documented medical needs.
3. No outside materials may be used during an exam or quiz. Any necessary materials (*i.e.* periodic table, equations & constants, scratch paper, *etc.*) will be provided for you.
4. Sunglasses and hats may not be worn during an exam or quiz period.
5. The use of headphones and/or earbuds during an exam or quiz is strictly prohibited.
6. Duplication or copying of homework assignments will result in a score of zero (F) for each student submitting a copied homework assignment.

**DISABILITY ACCOMODATIONSTATEMENT**

TSU is committed to creating inclusive learning environments and providing all students with opportunities to learn and excel in their course of study. Any student with a disability or condition which might interfere with his/her class performance or attendance may arrange for reasonable accommodations by visiting the Office of Disability Services (ODS). ODS is located in Kean Hall, room 131 and can be reached at 963-7400 or [www.tnstate.edu/disabilityservices](http://www.tnstate.edu/disabilityservices) .  You will be required to speak with ODS staff and provide documentation of the need for an accommodation.  If you qualify for an accommodation you will be provided with a document stating what type of classroom accommodations are to be made by the instructor.  It is your responsibility to give a copy of this document to the instructor **as soon as you receive it**.  Accommodations will only be provided **AFTER** the instructor receives the accommodation instructions from ODS; accommodations are not retroactive.  You must follow this process for each semester that you require accommodations.

**SEXUAL MISCONDUCT, DOMESTIC/DATING VIOLENCE, STALKING**

TSU recognizes the importance of providing an environment free of all forms of discrimination and sexual harassment, including sexual assault, domestic violence, dating violence, and stalking.  If you (or someone you know) has experienced or is experiencing any of these incidents, there are resources to assist you in the areas of accessing health and counseling services, providing academic and housing accommodations, and making referrals for assistance with legal protective orders and more.

Please be aware that most TSU employees, including faculty and instructors, are “responsible employees”, meaning that they are required to report incidents of sexual violence, domestic/dating violence or stalking.   **This means that if you tell me about a situation involving sexual harassment, sexual assault, dating violence, domestic violence, or stalking, I must report the information to the Title IX Coordinator.**  Although I have to report thesituation, you will still have options about how your situation will be handled, includingwhether or not you wish to pursue a formal complaint.  Our goal is to make sure you areaware of the range of options available to you and have access to the resources youneed.

You are encouraged to contact TSU’s Title IX Coordinator to report any incidents of sexual harassment, sexual violence, domestic/dating violence or stalking.  The Title IX coordinator is located in the Office of Equity and Inclusion, General Services Building, Room 210 and can be reached at 963-7494 or 963-7438.  For more information about Title IX and TSU’s SART or policies and procedures regarding sexual, domestic/dating violence and stalking please visit:  [www.tnstate.edu/equity](http://www.tnstate.edu/equity).

If you wish to speak to someone confidentially, who is not required to report, you can contact the TSU Counseling Center, located in the basement of Wilson Hall, at 963-5611 or TSU Student Health Services, located in the Floyd Payne Campus Center room 304, at 963-5084.  You may also contact the following off campus resources:  Sexual Assault Center of Nashville at 1-800-879-1999 or [www.sacenter.org](http://www.sacenter.org) or the Tennessee Coalition to End Domestic & Sexual Violence at 615-386-9406 or [www.tncoalition.org](http://www.tncoalition.org).

**HARRASSMENT & DISCRIMINATION**

Tennessee State University is firmly committed to compliance with all federal, state and local laws that prohibit harassment and discrimination based on race, color, national origin, gender, age, disability, religion, retaliation, veteran status and other protected categories.  TSU will not subject any student to discrimination or harassment and no student shall be excluded from participation in nor denied the benefits of any educational program based on their protected class.  If a student believes they have been discriminated against or harassed because of a protected class, they are encouraged to contact the Office of Equity and Inclusion at General Services Building, Room 210, 615-963-7494 or 963-7438, [www.tnstate.edu/equity](http://www.tnstate.edu/equity).

**Organic Chemistry I (CHEM 2010 and 2012)**

**Tentative Lecture Schedule**

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| --- | --- | --- | --- |
| **Session** | **Chap** | **Title** | **Page** |
| Week 1 | 1 | **Structure and Bonding**: The Periodic Table, Bonding, Lewis Structure, Resonance, Determining Molecular Shape, Drawing Organic Structures, Hybridization, Electronegativity and Bond Polarity, Polarity of Molecules | 7 |
| Week 2 | 2 | **Acids and Bases:** Bronsted-Lowry Acids and Bases, Reactions of Bronsted-Lowry Acids and Bases, Acid Strength and pKa, Predicting the outcome of Acid-Base Reactions, Factors that determine Acid Strength. Common Acids and Bases, Lewis Acids and Bases. | 59 |
| Week 3 | 3 | **Introduction to Organic Molecules and Functional Groups:** Functional Groups, An Overview of Functional Groups, Biomolecules, Intermolecular Forces, Physical Properties, Application: Vitamins, Applications of Solubility: Soaps, Application: The Cell Membrane, Functional Groups and Reactivity. Key Concepts-Introduction to Organic Molecules and Functional Groups | 93 |
| Week 4-5 | 4 | **Test 1**  **Alkanes:** Alkanes – An Introduction, Cycloalkanes, An Introduction to Nomenclature, Naming Alkanes, Naming Cycloalkanes, Common Names, Fossil Fuels, Physical Properties of Alkanes, Conformations of Acyclic Alkanes- Ethane, Conformations of Butane, An Introduction to Cycloalkanes, Cyclohexane, Substituted Cycloalkanes, Oxidation of Alkanes | 131 |
| Week 6 | 5 | **Stereochemistry:** Starch and Cellulose, The Two Major Classes of Isomers, Looking Glass Chemistry-Chiral and Achiral Molecules, Stereogenic Centers, Stereogenic Center in Cyclic Compounds, labeling Stereogenic Centers with *R* or *S,* Diastereomers, Meso Compounds, *R* and *S* Assignments in Compounds with Two or More Stereogenic Centers, Isomers-A Summary, Physical Properties of Stereoisomers, Chemical Properties of Enantiomers | 179 |
| Week 7 | 6 | **Understanding Organic Reactions:** Writing Equations for Organic Reactions, Kinds of Organic Reactions, Bond Breaking and Bond Making, Bond Dissociation Energy, Thermodynamics, Enthalpy and Entropy, Energy Diagrams, Energy Diagrams for a Two-Step Reaction Mechanism, Kinetics, Catalysts, Enzymes. | 222 |
| Week 8 | 7 | **Test 2**  **Alkyl Halides and Nucleophilic Substitution:** Introduction to Alkyl Halides, Nomenclature, Physical Properties, Interesting Alkyl Halides, the Polar Carbon-Halogen Bond, General Features of Nucleophilic Substitution, The Leaving Group, The Nucleophile, Possible Mechanisms for Nucleophilic Substitution, Two Mechanisms for Nucleophilic Substitution, The SN2 Mechanism, Application: Useful SN2 Reactions, The SN1 Mechanism, Carbocation Stability, The Hammond Postulate, Application: SN1 Reactions, Nitrosamines, and Cancer, When Is the Mechanism SN1 or SN2?, Vinyl Halides and Aryl Halides | 256 |
| Week 9 | 8 | **Alkyl Halides and Elimination Reactions:** General Features of Elimination, Alkenes-The Products of Elimination Reactions, The Mechanisms of Elimination, The E2 Mechanism, The Zaitsev Rule, The E1 Mechanism, SN1 Reactions, Stereochemistry of the E2 Reaction, When Is the Mechanism E1 or E2, E2 Reactions and Alkyl Synthesis, When Is the Reaction SN1, SN2, E1, or E2 | 308 |
| Week 10 | 9 | **Alcohols, Ethers, and Epoxides:** Introduction, Structure and Bonding, Nomenclature, Physical Properties, Interesting Alcohols, Ethers, and Epoxides, Preparation of Alcohols, Ethers, and Epoxides, General Features-Reactions of Alcohols, Ethers, and Epoxides, Dehydration of Alcohols to Alkenes, Carbocation Rearrangements, Dehydration Using POC13 and Pyridine, Conversion of Alcohols to Alkyl Halides with HX, Conversion of Alcohols to Alkyl Halides with SOC12 and PBr3,  Tosylate-Another Good Leaving Group, Reaction of Ethers with Strong Acid, Reaction of Epoxides, Application: Epoxides | 345 |
| Week 11 | 10 | **Alkenes and Addition Reactions:** Introduction, Calculating Degrees of Unsaturation, Nomenclature, Physical Properties, Interesting Alkenes, Lipids-Part 2, Preparation of Alkenes, Introduction to Addition Reactions, Hydrohalogenation- Electrophilic Addition of HX, Markovnikov’s Rule, Stereochemistry of Electrophilic Addition of HX, Hydration-Electrophilic Addition of Water, Halogenation-Addition of Halogen, Stereochemistry of Halogenation, Halohydrin Formation, Hydroboration-Oxidation, Keeping Track of Reactions, Alkenes in Organic Synthesis. | 397 |
| Week 12 | 11 | **Test 3**  **Alkynes and Synthesis:** Introduction, Nomenclature, Physical Properties, Interesting Alkynes, Preparation of Alkynes, Introduction to Alkyne Reactions, Addition of Hydrogen Halides, Addition of Halogen, Addition of Water, Hydroboration-Oxidation, Reaction of Acetylene Anions, Synthesis | 441 |
| Week 13 | 12 | **Oxidation and Reduction:** Introduction, Reducing Agents, Reduction of Alkenes, Application: Hydrogenation of Oils, Reduction of Alkynes, The Reduction of Polar C-X σ Bonds, Oxidizing Agents, Epoxidation, Dihydroxylation, Oxidative Cleavage of Alkenes, Oxidative Cleavage of Alkynes, Oxidation of Alcohols, Application: The Oxidation of Ethanol, Sharpless Epoxidation, Key Concepts-Oxidation and Reduction | 455 |
| Week 14 | A, B | **Spectroscopy A: Mass Spectrometry:** Mass Spectrometry, Alkyl Halides and the M+2 Peak, Other Types of Mass Spectrometry, Electromagnetic Radiation.  **Spectroscopy B: Infrared Spectroscopy:** Infrared Spectroscopy, IR Absorptions, IR and Structure Determination. | 512  354 |
|  | | **Final Exam Comprehensive: Chap 1-12 plus Spectroscopy A and B, TBA** |  |

**Important University Dates - Fall 2019**

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| Aug 19 | Classes begin |
| Aug 19- Aug 23 | Late registration/Schedule Adjustment |
| Aug 30 | Campus Wide Assembly – First Year Students 9:00 am – Kean Hall |
| Sept 2 | Holiday-Labor Day |
| Sept 17 | Recognition of Constitution Day |
| Sept 22-28 | Student Study Week – No Activities Scheduled |
| Sept 30 – Oct 4 | Mid-term Examination Week-all classes meet as scheduled |
| Oct 11 | Last day to withdraw from a course and/or the University |
| Oct 15 | Founders Day (9:00 a.m. – Kean Hall) |
| Oct 19 | Homecoming |
| Oct 28 – Jan 17 | Registration for Spring 2020 |
| Nov 11 | Veterans’ Day |
| Nov 25-29 | Fall Break/Thanksgiving Holiday- No Classes |
| Nov 30 | Last Day of Class |
| Dec 2-6 | Final examinations |
| Dec 7 | Commencement – Gentry Complex |

*All scheduled classes meet during mid-term examination week.*

*Final examination schedules will be posted via MyTSU and on TSU web page*