****** This is a tentative syllabus, subject to minor changes. ******

CHEM 0310: Organic Chemistry 1
Fall 2025

Instructor: Prof. Kabirul Islam
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Lecture: Monday & Wednesday at 6 PM – 7:15 PM in Chevron 152
Recitation: Wednesday at 7.20 PM – 8.10 PM in Chevron 152

Office Hours: Office hours schedule will be announced later

COURSE OBJECTIVES:

The goal of the course (CHEM 0310) will be to develop an understanding of contemporary organic chemistry; an informational framework that will enable you to predict the function of an organic compound based upon its electronic and three-dimensional structure.

COURSE MATERIALS:

- Organic Chemistry: Structure and Functions, 8th Edition by Vollhardt and Schore
- Study Guide and Solutions Manual for Vollhardt and Schore Text Book (optional)
- Molecular Model Set (optional)

STUDY MATERIALS:

- Lecture slides will be available through Canvas. Lectures will not be recorded and made available for asynchronous use
- Some office hours may be recorded for asynchronous use
- Free tutoring is available. (https://www.chem.pitt.edu/undergraduate/bachelor-science-chemistry/tutoring)
- Each chapter will accompany a set of representative problems and answer keys
- A study guide will be provided before each exam to help with your preparation. The answer key will be made available separately.

OVERVIEW OF THE SYLLABUS:

Chapter 1: Bonding, Octate rule, ionic and covalent bonds, electronegativity and polar covalent bonds, dipole moments, resonance, atomic orbitals, electronic configurations, molecular orbitals and covalent bonds, hybridization and shape of molecules.

Chapter 2: Equilibrium constants, free energy, transition state (activation energy), arrow pushing

mechanisms, acids-bases, pKa, acidity order, selected functional groups, Alkanes, conformations and Newman projections of alkanes, IUPAC naming.

Chapter 3: Radical, hemolytic and heterolytic cleavages, bond strength, hyperconjugation and radical stability, chlorination of methane and mechanisms, other halogenation of methane, halogenation of higher alkanes and their selectivity ratio, early and late transition sates, IUPAC naming.

Chapter 4: Stability: heat of combustion, ring strain: bond angle and eclipsing strains, bond strength of cyclopropane and cyclobutane, Conformational analyses of un-, mono- and di-substituted cyclohexanes, chair conformation of bicyclic structures (*cis* vs *trans* decalin and stability order), IUPAC naming.

Chapter 5: Definition of stereoisomers, diastereomers and enantiomers; chiral center, Fisher projections, *meso* compound, determine R/S configuration, calculation of specific rotation and enantiomeric excess, relationship between two structures by determining their R/S (identical/enantiomers/diastereomers/structural isomer/etc.), stereochemical outcome of bromination (racemization)

Chapter 6: properties of C-X bond, S_N2 reaction: kinetics and mechanism, various example of S_N2 reaction, stereochemical outcome of S_N2 reaction (inversion of configuration), Effect of nucleophiles and leaving groups on S_N2 reaction, nucleophiles in different conditions (protic/aprotic solvents), steric hindrance in the substrate

Chapter 7: S_N1 reaction: kinetics and mechanism, stability order of carbocation, stereochemical outcome of S_N1 reaction (racemization), knowledge about transition states of S_N2 and S_N1 reactions, writing reaction mechanism (arrow pushing) and naming reagents for a given transformation, Knowledge about E1 and E2 reactions, their kinetics and mechanisms, stereochemical requirement for E2 reaction (*anti* elimination), conditions that favor S_N2 over S_N1, S_N1 over E1, E1 over E2 and S_N2 over E2

Chapter 8: Alcohols as acids and bases, synthesis of alcohols by substitution, familiarity with reduction and oxidation of organic compounds. Chemistry of reducing agents ($NaBH_4$, $LiAlH_4$), Grignard reagents and associated chemistry (C-C bond formation, alcohol synthesis), alkyllithium reagents and its chemistry, IUPAC naming.

Chapter 9: Reaction of alcohols with base, with strong acids (HX and H_2SO_4), carbocation rearrangement, haloalkane synthesis: reactions of alcohols with PBr_3, alkyl sulfonate synthesis, naming of ether, cyclic ether (epoxide) and its synthesis from halo-alcohol by Williamson synthesis, stereochemical requirements for Williamson reaction, reaction of epoxide: ring opening reaction in presence of acid (HX) and base (OH^-, CH_3S^-)

Chapter 10: Basics of proton (^1H) NMR spectroscopy

Chapter 11: cis-trans and E/Z, structure and bonding of alkenes, strength of pi bond by thermal isomerization, determination of stability of alkenes by heat of hydrogenation, internal and terminal

alkenes (less or more substituted alkenes), stability of alkenes by hyperconjugation, synthesis of alkenes from haloalkane using base (Saytzev and Hoffman rues), IUPAC naming.

Chapter 12: Hydrogenation alkenes and stereochemistry (No chiral hydrogenation), electrophilic additions of HX, H_2SO_4 to alkenes in presence/absence of H_2O, CH_3OH, etc. Markovnikov rule, alkene isomerization, addition of halogen (Br_2) to alkenes in presence/absence of H_2O, CH_3OH; cyclic bromonium ion, stereochemistry of bromination; reaction of bromohydrins with base, Hybroboration-oxidation (HBO) sequence, anti-Markovnikov rule, Epoxide synthesis by peroxyacid: mechanism and stereochemistry; acid hydrolysis to give *trans* di-alcohol, Reaction of OsO_4 to alkene to give *cis* di-alcohol, IUPAC naming.

Chapter 13: Naming of alkynes in combination with alkene and alcohols, Hybridizations, bond length, bond strength, acidity and stability order (internal vs terminal alkynes); comparison of these properties with those of alkanes and alkenes, Synthesis of alkynes from alkenes via dibromo alkanes, Reactions of terminal alkynes with Grignard reagents, alkyllithium and then reacting with alkylhalides, carbonyl compounds and expoxides, hydrogenation of alkynes: cis and trans hydrogenation, addition of HX, X_2 to alkynes, addition of acid to alkynes and tautomerization to ketone, HBO reaction of alkynes

EXAM SCHEDULE:

- Midterm Exam 1 (October 8)
- Midterm Exam 2 (November 12)
- Final Exam (*Date will be announced later*)

Syllabi for the exams will be announced in class. Details of exam policies and procedures will be in class. This course allows the use of a ***non-programmable calculator*** *during exams.*

EXAM EVALUATION AND SCORING:

• 2 Midterms:	200 points (Each 100 points)
• Final Exam (semi-cumulative):	150 points
• Take-home exam:	50 points
• "Feel-good" exam:	Will be announced later
• Attendance:	1 point for each in-person lecture class

You are expected to attend classes regularly. You are responsible for all material discussed and announcements made in your absence. A re-grading process for the mid-term exams is available. To make it fair, **entire exam will be re-graded**, and your score may increase, remain the same, or decrease. Final grades will be assigned based on the two midterm exams, the final exam, assignment, Fee-good exam, and attendance. The class is typically curved, the extent of curve will depend on the class average after considering all the scores.

WORKING PROBLEMS:

Solving problems is an excellent way to learn organic chemistry. During each chapter, I will provide a list of the problems from the textbook that I think are most important for reinforcing the concepts we will emphasize in class. I strongly encourage you to work through these problems on your own. We will use recitation sessions each week to work through these and other problems together. You should do all the in-chapter problems that deal with topics we cover in class. In addition, the following problems in end of specified chapters are highly recommended. *The question numbers in parenthesis correspond to those in 8th edition.*

Chapter 1: 25-31, 35 (36), 38-42 (39-43), 45 (46)
Chapter 2: 28-30 (33-36), 32-35 (38-41), 40 (48), 42 (50), 44 (52), 47 (55),
Chapter 3: 15-16, 20-22, 27 (28), 29-30 (30-31), 32 (33)
Chapter 4: 26-27, 29, 30 (31), 32 (34), 35 (37), 37-38 (40-41)
Chapter 5: 32-34, 36-38, 39 (40), 41 (42), 43-45 (44-46)
Chapter 6: 38-39, 41-49 (41-50), 54-56 (56-58)
Chapter 7: 25-28, 30-36, 40-50 (43-54), 53 (57)
Chapter 8: 27-31, 34, 36, 38-40, 42-48, 50-54, 56
Chapter 9: 28-31 (32-37), 34 (40), 36-41 (42-47), 43-44 (49-50), 47-51 (53-57), 53-54 (59-60), 56-57 (62, 64), 59 (67), 61 (69)
Chapter 11: 31 (35), 37 (41), 39-41 (43-45), 46 (50), 48-50 (52-54)
Chapter 12: 34-35 (38-39), 37-40 (41-44), 42-46 (46-50), 51 (55), 57 961), 64-66 (68-70), 70-71 (74-75)
Chapter 13: 29-33 (31-35), 36-41 (38-43), 43-44 (45-46), 49 (51)

ACADEMIC INTEGRITY:

Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity (http://www.as.pitt.edu/fac/policies/academic-integrity). Any student suspected of violating this obligation for any reason during the semester will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University Guidelines on Academic Integrity. This may include, but is not limited to, the confiscation of the examination of any individual suspected of violating University Policy. Furthermore, no student may bring any unauthorized materials to an exam, including dictionaries and programmable calculators.

DISABILITY SERVICES:

If you have a disability that requires special testing accommodations or other classroom modifications, you need to notify both the instructor and Disability Resources and Services (http://www.studentaffairs.pitt.edu/drswelcome) no later than the second week of the term. You may be asked to provide documentation of your disability to determine the appropriateness of accommodations. To notify Disability Resources and Services, call (412) 648-7890 (Voice or

TTD) to schedule an appointment. The Disability Resources and Services office is located in 140 William Pitt Union on the Oakland campus.

DIVERSITY STATEMENT:

This course encourages free and critical thinking. I desire to facilitate an open and safe learning environment. Everyone should feel welcomed to share his/her views and questions. I am a firm believer in the importance of diversity in all scholarly activities such as education, teaching and research. It is my goal that students from all backgrounds and identities feel welcomed and well-served by this course. If you experience otherwise, please bring it to my attention as soon as possible so that we take proper steps. Additionally, please remember that the University of Pittsburgh does not tolerate any form of discrimination, harassment, or retaliation based on disability, race, color, religion, national origin, ancestry, genetic information, marital status, familial status, sex, age, sexual orientation, veteran status or gender identity or other factors as stated in the University's Title IX policy. The University is committed to taking prompt action to end a hostile environment that interferes with the University's mission. For more information about policies, procedures, and practices, see: https://www.diversity.pitt.edu/civil- rights-title-ix-compliyance/policies-procedures-and-practices.