UNIVERSITI TEKNOLOGI MARA

CHM457: FUNDAMENTAL ORGANIC CHEMISTRY

Course Name (English)	FUNDAMENTAL ORGANIC CHEMISTRY APPROVED
Course Code	CHM457
MQF Credit	4
Course Description	This course is an introduction to the structures and physical properties of carbon compounds namely hydrocarbons, aromatic compounds, alkyl halides, alcohols and ethers. Basic aspects of bonding, conformational analysis, structure and stereochemistry, nomenclature and acid-base chemistry of organic compounds are presented. Chemical reactions and mechanisms pathways of addition, electrophilic substitution, nucleophilic substitution and elimination reactions will be discussed.
Transferable Skills	Knowledge in Specific Area -Content Practical Skills Thinking and Scientific Skills
Teaching Methodologies	Lectures, Lab Work
CLO	CLO1 To explain the concepts of structure and bonding, HOMO-LUMO orbital interactions, chemical reactivity and acid-base involved in chemistry of carbon compounds. (PLO1) CLO2 To apply the concepts of structure and stereochemistry and its relationship to the reactivity of carbon compounds and to write chemical reactions for the interconversions of functional groups and the reaction mechanisms of addition, elimination, radical substitution, nucleophilic substitution and electrophilic substitution reactions. (PLO3) CLO3 To conduct scientific experiments related to acid-base, alkenes, alky halides, benzene, and alcohols and derivatives. (PLO2) CLO4 To report the scientific experiments in scientific manner related to acid-base, alkenes, alky halides, benzene, and alcohols and derivatives. (PLO4)
Pre-Requisite Courses	No course recommendations

Topics
1. 1.0 Carbon Compounds and Chemical Bonds 1.1) 1.1 Structure of carbon compounds: characteristic features, composition, atomic structure of carbon 1.2) 1.2 Hybridization, atomic and molecular orbitals 1.3) 1.3 Chemical bonds: ionic and covalent bonds 1.4) 1.4 Polar and nonpolar molecules: formal charge and resonance 1.5) 1.5 Intermolecular forces
2. 2.0 Introduction to Organic Reactions 2.1) 2.1 Reactions and mechanisms: substitution, elimination, addition and rearrangement 2.2) 2.2 Homolysis and heterolysis of covalent bonds, homogenic and heterogenic of bonds 2.3) 2.3 Acid-base reactions: 2.4) 2.3.1 Carbocations and carbanions 2.5) 2.3.2 Acids and bases: definitions (Lewis, Bronsted-Lowry), strenght (Ka and pKa), nucleophile, electrophile 2.6) 2.3.3 Structure and acidity: resonance and inductive effects
3. 3.0 Stereochemistry 3.1) 3.1 Isomerism: 3.2) 3.1.1 Structural and geometric isomers: chain, position, functional groups, Cis-Trans, E-Z isomers 3.3) 3.1.2 Optical isomers: chirality, racemic mixture, enantiomer, diastereomer, specific rotation and configuration (R,S) 3.4) 3.2 Molecules with more than one stereocenter: Fisher projection, meso compound

4. 4.0 Alkanes and Cycloalkanes
4.1) 4.1 Structure, HOMO-LUMO interaction of orbitals and nomenclature
4.2) 4.2 Physical properties
4.3) 4.3 Bond rotation and conformational analysis of butane
4.4) 4.4 Stability of cycloalkanes: ring strain and conformation of cyclohexane
4.5) 4.5 Synthesis of alkanes: hydrogenation of alkenes and alkynes, reduction of alkyl halide
4.6) 4.6 Reaction of alkanes
4.7) 4.6.1 Combustion of alkanes
4.8) 4.6.2 Halogenation of alkanes: chlorination of methane with mechanism

5. 5.0 Alkyl Halides
5.1) 5.1 Structure, HOMO-LUMO interaction of orbital and physical properties of alkyl halides
5.2) 5.2 Nucleophilic substitution reactions
5.3) 5.2.1 Nucleophiles and leaving groups
5.4) 5.2.2 SN2 Reaction: kinetics, mechanism and stereochemistry
5.5) 5.2.3 SN1 Reaction: kinetics, mechanism and stereochemistry
5.6) 5.2.4 Factors affecting SN2 and SN1 reactions
5.7) 5.3 Elimination reactions of alkyl halides
5.8) 5.3.1 E2 Reactions
5.9) 5.3.2 E1 Reactions
5.10) 5.4 Substitution versus Elimination

6. 6.0 Alkenes and Alkynes
6.1) 6.1 Alkenes: nomenclature, structure, HOMO-LUMO interaction of orbital and physical properties
6.2) 6.2 Reactions and mechanisms (alkene)
6.3) 6.2.1 Synthesis: Elimination reactions: dehydrohalogenation, dehydration, dehalogenation
6.4) 6.2.2 Addition reactions: Markovnikov's and anti Markovnikov's rules: hydrohalogenation, halogenation, hydrogenation, hydration (acid catalysed, oxymercuration-demercuration, hydroboration-oxidation), epoxidation, dihydroxylation and oxidative cleavage.
6.5) 6.3 Alkynes: nomenclature, structure and physical properties
6.6) 6.4 Reactions and mechanisms (alkyne)
6.7) 6.4.1 Synthesis: dehydrohalogenation of vicinal dihalide
6.8) 6.4.2 Reactions: addition of hydrogen halides and halogens, hydrogenation, hydration (mercuric catalysed, hydroboration-oxidation), reaction of terminal alkynes

7. 7.0 Alcohols and Ethers
7.1) 7.1 Structure, nomenclature and physical properties
7.2) 7.2 Reactions and mechanisms (alcohol)
7.3) 7.2.1 Synthesis: hydration of alkenes, hydrolysis of haloalkanes
7.4) 7.2.2 Reactions: alcohols as acids (formation of alkoxides); dehydration (elimination), conversion to alkyl halides (nucleophilic substitution); esterification and oxidation to carbonyl compounds
7.5) 7.3 Reactions and mechanisms (ether)
7.6) 7.3.1 Synthesis: dehydration of alkenes, Williamson ether synthesis
7.7) 7.3.2 Reaction: ether cleavage by acid, hydrolysis of epoxide
7.8) 7.4 Phenols: structure and nomenclature; synthesis and reactions

8. 8.0 Benzene and Aromaticity
8.1) 8.1 Introduction: nomenclature; structure and stability; Huckel's Rule
8.2) 8.2 Other Aromatic compounds and heterocyclic aromatic compounds
8.3) 8.3 Reactions of aromatic compounds
8.4) 8.3.1 Electrophilic aromatic substitution and reaction mechanisms: halogenation, nitration, sulfonation, Friedel-Craft's alkylation and acylation
8.5) 8.3.2 Effect of substituents groups on the benzene ring
8.6) 8.3.3 Reactions of side chain of benzene: oxidation of substituted benzene, reduction of nitro group, halogenation of alkyl benzene

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment

Assessment Type	Assessment Description	% of Total Mark	CLO
Assignment	Assignment	20%	CLO2
Practical	Practical Skills	5%	CLO3
Practical	Lab Report	15%	CLO4
Test	Mid Sem Test	20%	CLO1

Reading List

Recommended Text

- **McMurry, J 2011, *Organic Chemistry*, 9th ed Ed., Brooks and Cole**
- **Solomons and Fryhle 2016, *Organic Chemistry*, 12th ed Ed.**

Reference Book Resources

- **Smith, J. G. 2017, *Organic Chemistry*, 5th ed. Ed., McGraw Hill**
- **Wade, L. G 2010, *Organic Chemistry*, 7th Edition Ed.**
- **Seyhan Ege, *Organic Chemistry: Structure and Reactivity*, 5th Edition Ed., Houghton Mifflin**
- **Pavia, Lampman, Kriz and Engel 201, *Introduction to Organic Laboratory Techniques*, 3rd Edition Ed., Thomsom Brooks/Cole**

Article/Paper List: This Course does not have any article/paper resources

Other References: This Course does not have any other resources