



UNIVERSITI TEKNOLOGI MARA

CHM257: ORGANIC CHEMISTRY I

Course Name (English)	ORGANIC CHEMISTRY I APPROVED
Course Code	CHM257
MQF Credit	4
Course Description	This course is an introductory course on the structure and physical properties of hydrocarbons namely alkanes, alkenes, alkynes, aromatic compounds and alkyl halides. This course also covers the nomenclature, preparations, reactions, chemical tests and uses of organic compounds.
Transferable Skills	Knowledge, practical skills, critical thinking and scientific skills
Teaching Methodologies	Lectures, Blended Learning, Lab Work, Tutorial
CLO	<p>CLO1 Explain the basic concept of atomic structure, chemical bonding, chemical formula, isomerism, acid-base, functional group, nomenclatures, physical properties, usage and chemical reaction in aliphatic, cyclic, aromatic hydrocarbons and alkyl halides.</p> <p>CLO2 Construct scientific experiments in areas of organic chemistry.</p> <p>CLO3 Outline the written report on scientific experiments in areas of organic chemistry.</p> <p>CLO4 Predict the names, structural formula, properties, chemical reagents, reactants and products for aliphatic, cyclic, aromatic hydrocarbons and alkyl halides in organic chemistry related problem.</p>
Pre-Requisite Courses	No course recommendations
Topics	
1. Introduction to organic chemistry 1.1) 1.1 Characteristic features of organic compounds 1.2) 1.1.1 Composition 1.3) 1.1.2 Electronic structure 1.4) 1.1.3 Bonding: Lewis model, electronegativity, polarity, formal charge, valence bond theory 1.5) 1.1.4 Chemical formula: Molecular formula, full structural formula, condensed structural formula, line angle formula and fisher projection. 1.6) 1.7) 1.2 Definition of some common terms used in organic chemistry such as electrophiles, nucleophiles, Lewis acids and Lewis bases. 1.8) 1.9) 1.3 Isomerism 1.10) 1.3.1 Structural isomerism 1.11) 1.3.2 Geometrical isomerism 1.12) 1.3.3 Optical isomerism 1.13) 1.14) 1.4 Homologous series- alkanes, alkenes, alkynes, cyclic hydrocarbons, aromatic hydrocarbons etc.	
2. Alkanes 2.1) 2.1 General formula: C_nH_{2n+2} 2.2) 2.3) 2.2 Structure and Nomenclature: IUPAC and common names 2.4) 2.5) 2.3 Physical properties: boiling points and solubility 2.6) 2.7) 2.4 Methods of preparation: 2.8) 2.4.1 Hydrogenation of alkenes 2.9) 2.4.2 Reduction of alkyl halides 2.10) 2.4.3 Wurtz reaction	

- 2.11) 2.4.4 Hydrolysis of Grignard reagent
- 2.12)
- 2.13) 2.5 Reactions of alkanes
- 2.14) 2.5.1 Halogenation (discuss mechanism)
- 2.15) 2.5.2 Combustion
- 2.16) 2.5.3 Cracking and reforming of petroleum
- 2.17)
- 2.18) 2.6 Natural resources and uses of alkanes (petroleum)

3. Alkenes

- 3.1) 3.1 General formula: C_nH_{2n}
- 3.2)
- 3.3) 3.2 Structure and nomenclature: IUPAC and common names
- 3.4)
- 3.5) 3.3 Physical properties: boiling points and solubility
- 3.6)
- 3.7) 3.4 Methods of preparation:
- 3.8) 3.4.1 Dehydration of alcohols
- 3.9) 3.4.2 Dehydrohalogenation of alkyl halides
- 3.10) 3.4.3 Dehalogenation of dihalides
- 3.11) 3.4.4 Reduction of alkynes
- 3.12)
- 3.13) 3.5 Reactions of alkenes:
- 3.14) 3.5.1 Addition of symmetric reagents (H_2 and halogens) (Discuss mechanism).
- 3.15) 3.5.2 Addition of unsymmetrical reagents (hydrogen halides and water, H_2O/H_2SO_4) (Discuss mechanism). Discuss Markovnikov and anti-Markovnikov rule.
- 3.16) 3.5.3 Oxidation
- 3.17) 3.5.3.1 Combustion, epoxide formation, ozonolysis and diol hydroxylation ($KMnO_4/H^+$ cold only).
- 3.18) 3.5.4 Simple test of alkenes
- 3.19)
- 3.20) 3.6 Sources and uses of alkenes

4. Alkynes

- 4.1) 4.1 General formula: C_nH_{2n-2}
- 4.2)
- 4.3) 4.2 Structure and nomenclature: IUPAC and common names
- 4.4)
- 4.5) 4.3 Physical properties: boiling points and solubility
- 4.6)
- 4.7) 4.4 Industrial source of acetylene
- 4.8)
- 4.9) 4.5 Preparation of alkynes
- 4.10) 4.5.1 Dehydrohalogenation of alkyl dihalides
- 4.11) 4.5.2 Alkylation of salt of terminal alkynes
- 4.12)
- 4.13) 4.6 Reactions of alkynes
- 4.14) 4.6.1 Addition of H_2 , halogens, hydrogen halides and water ($H_2O, H_2SO_4, HgSO_4$).
- 4.15) 4.6.2 Formation of salt of terminal alkynes (e.g.: metal acetylides)
- 4.16)
- 4.17) 4.7 Sources and uses of alkynes

5. Cyclic Aliphatic Hydrocarbons (cycloalkanes and cycloalkenes)

- 5.1) 5.1 Nomenclature and structure: IUPAC and common names
- 5.2)
- 5.3) 5.2 Physical properties: boiling points and solubility
- 5.4)
- 5.5) 5.3 Reactions
- 5.6) 5.3.1 Ring opening reactions - for small ring
- 5.7) 5.3.2 Other reactions of cyclic hydrocarbons that is similar to straight-chained hydrocarbon
- 5.8)
- 5.9) 5.4 Baeyer Strain Theory (without calculation)

6. Aromatic Hydrocarbon

- 6.1) 6.1 Structure and aromaticity, structure of benzene, benzene ring stabilization, Kekule' structure, resonance structure and energy
- 6.2)
- 6.3) 6.2 Nomenclature of aromatic hydrocarbon
- 6.4)
- 6.5) 6.3 Physical properties of benzene
- 6.6)
- 6.7) 6.4 Reaction and mechanism: Electrophilic aromatic substitution
- 6.8) 6.4.1 Halogenations
- 6.9) 6.4.2 Nitration
- 6.10) 6.4.3 Sulphonation
- 6.11) 6.4.4 Friedel-Crafts alkylation and acylation
- 6.12)
- 6.13) 6.5 Effect of substituents on the reactivity and orientation

- 6.14) 6.5.1 Activating group: ortho-para directing effect
- 6.15) 6.5.2 Deactivating group: meta directing effect
- 6.16)
- 6.17) 6.6 Reaction of benzene derivatives
- 6.18) 6.6.1 Disubstitution reactions on benzene ring
- 6.19)
- 6.20) 6.7 Reaction of side chain on arenes
- 6.21) 6.7.1 Substitution
- 6.22) 6.7.2 Oxidation
- 6.23)
- 6.24) 6.8 Uses, importance and toxicity of benzene

7. Alkyl Halides and Aryl Halides (RX and ArX)

- 7.1) 7.1 Nomenclature – common and IUPAC names
- 7.2)
- 7.3) 7.2 Physical properties
- 7.4)
- 7.5) 7.3 Methods of preparation of alkyl halides
- 7.6) 7.3.1 Reaction of alcohols with HX, PX₃ and PX₅
- 7.7) 7.3.2 Halogenation of alkanes
- 7.8) 7.3.3 Addition of HX to alkenes
- 7.9)
- 7.10) 7.4 Reactions of alkyl halides
- 7.11) 7.4.1 Substitution (mechanism, stereochemistry, rate of reaction, steric hindrance)
- 7.12) 7.4.1.1 SN₂ reaction
- 7.13) 7.4.1.2 SN₁ reaction
- 7.14) 7.4.2 Elimination (mechanism, rate of reaction)
- 7.15) 7.4.2.1 E₁ reaction
- 7.16) 7.4.2.2 E₂ reaction
- 7.17) 7.4.3 Substitution versus elimination reaction-basicity versus nucleophilicity
- 7.18) 7.4.4 Reduction
- 7.19) 7.4.5 Formation of Grignard reagent- properties of Grignard reagent.
- 7.20)
- 7.21) 7.5 Uses of alkyl halide

Assessment Breakdown	%
Continuous Assessment	50.00%
Final Assessment	50.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Practical	Observation	10%	CLO2
	Quiz	Quiz	4%	CLO1
	Quiz	Quiz	6%	CLO4
	Test	Test	8%	CLO1
	Test	Test	12%	CLO4
	Written Report	Laboratory report	10%	CLO3

Reading List	Reference Book Resources
	<ul style="list-style-type: none"> • Brown, Foote, Iverson and Anslyn 2009, <i>Organic Chemistry</i>, 5 Ed., Brooks/Cole • McMurry 2004, <i>Organic Chemistry</i>, 6 Ed., Brooks/Cole • Solomon and Fryhle 2008, <i>Organic Chemistry</i>, 9 Ed., John Wiley & Sons • Pavia, Lampman, Kriz and Engel 2005, <i>Introduction to Organic Laboratory Techniques</i>, 2 Ed., Brooks/Cole • Wade, 2005, <i>Organic Chemistry</i>, 6 Ed., Prentice-Hall
Article/Paper List	This Course does not have any article/paper resources
Other References	This Course does not have any other resources