



UNIVERSITI TEKNOLOGI MARA

CHM301: ORGANIC CHEMISTRY II

Course Name (English)	ORGANIC CHEMISTRY II APPROVED
Course Code	CHM301
MQF Credit	3
Course Description	This course is an introductory course on the structure and physical properties of alcohols, carbonyls, carboxylic acids and derivatives, and amines. This course also includes the nomenclature, preparations, reactions, chemical tests and uses of the organic compounds.
Transferable Skills	Ability to apply knowledge of science, knowledge of practical skills and solve problem with thinking and scientific skills.
Teaching Methodologies	Lectures, Lab Work, Tutorial, Collaborative Learning
CLO	CLO1 Apply the rules in organic chemistry towards nomenclature, structural and chemical reaction of selected organic compounds. CLO2 Perform (plan, conduct and analyse) scientific investigation in area of organic chemistry. CLO3 Outline the reaction mechanisms together with reagents and conditions for the selected chemical reactions.
Pre-Requisite Courses	No course recommendations
Topics	
1. Alcohols 1.1) 1.1 General formula: ROH, ArOH. Nomenclature – common and IUPAC names. Structure: classification of alcohols as 1o, 2o and 3o, functionality of hydroxyl group in the carbon chain e.g. inductive effect of the hydroxyl group. 1.2) 1.2 Physical properties of alcohols: boiling points and solubility 1.3) 1.3 Acidity and basicity of alcohols. 1.4) 1.4 Preparation of alcohols 1.5) 1.4.1 Grignard synthesis 1.6) 1.4.2 Hydrolysis of alkyl halides 1.7) 1.4.3 Industrial and laboratory preparations of ethyl alcohol 1.8) 1.5 Reactions of alcohols 1.9) 1.5.1 Formation of alkoxides 1.10) 1.5.2 Esterification 1.11) 1.5.3 Dehydration (discuss mechanism) 1.12) 1.5.4 Halogenation 1.13) 1.5.5 Oxidation 1.14) 1.6 Chemical test for 1o, 2o and 3o alcohols	
2. Carbonyl Compounds (Aldehydes and Ketones) 2.1) 2.1 Structure, reactivity and physical properties of carbonyl compounds 2.2) 2.2 Nucleophilic addition reaction and mechanism 2.3) 2.3 Nomenclature of aldehydes and ketones 2.4) 2.4 Preparation of aldehydes 2.5) 2.4.1 Oxidation of 1o alcohols 2.6) 2.4.2 Reduction of acid chlorides 2.7) 2.5 Preparation of ketones 2.8) 2.5.1 Oxidation of 2o alcohols 2.9) 2.5.2 Friedel-Crafts acylation 2.10) 2.6 Reaction of aldehydes and ketones 2.11) 2.6.1 Oxidation of aldehyde 2.12) 2.6.2 Reduction to alcohol, Clemmensen, Wolff-Kishner 2.13) 2.6.3 Addition (with HCN, H ₂ O, Grignard Reagent)	

- 2.14) 2.6.4 Condensation with ammonia derivatives (hydroxylamine, hydrazine phenylhydrazine and 2,4-dinitrophenylhydrazine)
2.15) 2.6.5 Iodoform reaction
2.16) 2.7 Chemical test for aldehydes and ketones

3. Carboxylic acids

- 3.1) 3.1 General formula: RCOOH or ArCOOH
3.2) 3.2 Nomenclature: IUPAC and trivial names for carboxylic acids
3.3) 3.3 Physical properties: boiling points and solubility
3.4) 3.4 Acidity
3.5) 3.5 Preparation:
3.6) 3.5.1 Oxidation from alkyl benzenes, alkenes, alcohols and aldehydes
3.7) 3.5.2 Carboxylation of Grignard reagents
3.8) 3.5.3 Hydrolysis of nitriles
3.9) 3.6 Reactions
3.10) 3.6.1 Salt formation
3.11) 3.6.2 Reduction
3.12) 3.6.3 Conversion to acid chlorides
3.13) 3.6.4 Conversion to esters
3.14) 3.6.5 Conversion to amides

4. Carboxylic acids derivatives

- 4.1) 4.1 General formula: RCO-Z, Nomenclature
4.2) 4.2 Nucleophilic acyl substitution reactions and mechanism
4.3) 4.3 Relative reactivity of Nucleophilic acyl substitution reactions

5. Acid chlorides

- 5.1) 5.1 General formula: RCOCl
5.2) 5.2 Nomenclature: IUPAC and trivial name
5.3) 5.3 Preparation from carboxylic acids
5.4) 5.4 Reactions
5.5) 5.4.1 Hydrolysis
5.6) 5.4.2 Ammonolysis
5.7) 5.4.3 Alcoholysis
5.8) 5.4.4 Friedel-Crafts acylation

6. Acid anhydrides

- 6.1) 6.1 General formula: (RCO)₂O
6.2) 6.2 Nomenclature
6.3) 6.3 Preparation from dry salt of carboxylic acid
6.4) 6.4 Reactions
6.5) 6.4.1 Hydrolysis
6.6) 6.4.2 Ammonolysis
6.7) 6.4.3 Alcoholysis
6.8) 6.4.4 Friedel-Crafts acylation

7. Esters

- 7.1) 7.1 General formula: RCOOR
7.2) 7.2 Nomenclature: IUPAC and trivial names
7.3) 7.3 Preparation from:
7.4) 7.3.1 Carboxylic acids
7.5) 7.3.2 Acid chlorides
7.6) 7.4 Reactions
7.7) 7.4.1 Hydrolysis
7.8) 7.4.2 Ammonolysis
7.9) 7.4.3 Grignard reagents
7.10) 7.4.4 Transesterification

8. Amides

- 8.1) 8.1 General formula: RCONH₂
8.2) 8.2 Nomenclature
8.3) 8.3 Preparation from:
8.4) 8.3.1 Carboxylic acids and ammonium carboxylates
8.5) 8.3.2 Acid chlorides
8.6) 8.4 Reactions
8.7) 8.4.1 Hydrolysis
8.8) 8.4.2 with nitrous acid
8.9) 8.4.3 Reduction
8.10) 8.4.4 Hoffmann degradation
8.11) 8.4.5 Dehydration
8.12) 8.5 Chemical tests for carboxylic acids and its derivatives to differentiate amides, acid chlorides, anhydrides and esters

9. Amines

- 9.1) 9.1 General formula: RNH_2 and ArNH_2
- 9.2) 9.2 Nomenclature
- 9.3) 9.3 Classification of amines: 1o, 2o and 3o
- 9.4) 9.4 Preparation
 - 9.5) 9.4.1 Reduction of nitro compounds
 - 9.6) 9.4.2 Reduction of halides with ammonia
 - 9.7) 9.4.3 Reduction of amines
 - 9.8) 9.4.4 Reduction of nitriles
 - 9.9) 9.4.5 Hoffmann degradation of amides
- 9.10) 9.5 Reactions
 - 9.11) 9.5.1 Formation of amides
 - 9.12) 9.5.2 Amine alkylation: Formation of quaternary salts
 - 9.13) 9.5.3 with nitrous acid
 - 9.14) 9.5.4 Isocyanides (nitrile compound)
 - 9.15) 9.5.5 Benzenediazonium salts
 - 9.16) 9.5.5.1 Preparation of benzenediazonium chloride
 - 9.17) 9.5.5.2 Reaction of benzenediazonium chloride

Assessment Breakdown	%
Continuous Assessment	60.00%
Final Assessment	40.00%

Details of Continuous Assessment	Assessment Type	Assessment Description	% of Total Mark	CLO
	Assignment	Assignment - Written assignment (2)	20%	CLO1
	Practical	Written report (3) Experiment 1: Reaction of alcohols and phenols, Experiment 2: Reaction of aldehyde and ketone, Experiment 5: Synthesis of isopentyl acetate (banana oil)	15%	CLO2
	Practical	Direct Observation (Skills)	15%	CLO2
	Test	Test - Written test (2)	10%	CLO3

Reading List	Reference Book Resources
	<ul style="list-style-type: none"> • Solomon T.W.G., Fryhle C.B. and Snyder S.A., 2016, <i>Organic Chemistry</i>, 12 Ed. [ISBN: 978119233640] • McMurry J.E. 2016, <i>Organic Chemistry</i>, 6 Ed., Brooks/Cole [ISBN: 978130508048] • Brown W.H., Iverson B.L., Anslyn E. and Foote C., 2014, <i>Organic Chemistry</i>, 7 Ed., Brooks/Cole [ISBN: 978-113395284] • Smith J., 2016, <i>Organic Chemistry</i>, 5 Ed., McGraw Hill [ISBN: 978-00780215] • Pavia D.L., Lampman G.M., Kriz G.S. and Engel R.G., 2016, <i>A Small Scale Approach to Organic Laboratory Technique</i>, 4 Ed., Brooks/Cole [ISBN: 978130525392]
Article/Paper List	This Course does not have any article/paper resources
Other References	This Course does not have any other resources