



## UNIVERSITI TEKNOLOGI MARA

### CHM132: ORGANIC CHEMISTRY

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| <b>Course Name (English)</b>   | ORGANIC CHEMISTRY <b>APPROVED</b>  |
| <b>Course Code</b>   | CHM132   |
| <b>MQF Credit</b>  | 3  |
| <b>Course Description</b>  | The study begins with an outline of the structure, nomenclature and properties of the organic compounds. It also explains about preparation and reactions of hydroxyl, carbonyl, carboxylic acids and their derivatives and amines. Students can also participate in laboratory exercises to improve their understanding of organic reactions. |
| <b>Transferable Skills</b>   | 1) Problem-solving<br>2) Critical thinking<br>3) Teamwork<br>4) Writing  |
| <b>Teaching Methodologies</b>  | Lectures, Blended Learning, Practical Classes, Tutorial  |
| <b>CLO</b>   | CLO1 Apply knowledge in organic chemistry for the synthesis of organic compounds.<br>CLO2 Demonstrate respect, social communication and self-awareness while performing the group assignment.<br>CLO3 Conduct scientific experiments related to alcohols, aldehydes, ketones, carboxylic acids and their derivatives and amines.               |
| <b>Pre-Requisite Courses</b>   | No course recommendations  |
| <b>Topics</b>  |  |
| <b>1. Hydroxyl Compounds (Alcohols, Phenols and ether)</b><br>1.1) Structure, nomenclature, physical properties and classification of alcohols.<br>1.2) Acidity and basicity<br>1.3) Preparation of alcohols: hydration of alkenes, hydrolysis of haloalkanes<br>1.4) Reactions of alcohols: formation of alkoxides, formation of esters, oxidation of primary and secondary alcohols, dehydration of alcohols (mechanism), formation of ether, formation of alkyl halides<br>1.5) Laboratory tests for alcohols: Lucas test, oxidation, iodoform<br>1.6) Structure and IUPAC name of ethers<br>1.7) Preparation of ethers: Williamson ether synthesis<br>1.8) Structure and IUPAC name of phenols<br>1.9) Reactions of phenols: reaction with sodium, esterification, halogenation and nitration of the ring<br>1.10) Industrial uses of alcohols                           |  |
| <b>2. Carbonyl Compounds (Aldehydes and Ketones)</b><br>2.1) Structure and nomenclature<br>2.2) Nucleophilic addition reactions and mechanism<br>2.3) Physical properties: boiling and melting point<br>2.4) Functional group isomerism<br>2.5) Preparation of aldehydes and ketones: oxidation of alcohols, Friedel-Craft Acylation<br>2.6) Reactions of aldehydes and ketones: oxidation with mild and strong oxidizing agents (reactions with bromine water, acidified KMnO <sub>4</sub> and acidified K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> ), laboratory tests with Tollens' reagent and Fehling's or Benedict solutions, reduction to alcohols, condensation reaction with hydroxylamine, hydrazine, phenyl hydrazine and 2,4-dinitrophenylhydrazine, nucleophilic addition with hydrogen cyanide, iodoform test<br>2.7) Industrial uses of carbonyl compounds |  |

**3. Carboxyl Compounds (aliphatic and aromatic)**

- 3.1) Structure and nomenclature
- 3.2) Physical properties of carboxylic acids
- 3.3) Preparation of carboxylic acids and benzoic acid: oxidation of alkyl benzene, alcohols and aldehydes, hydrolysis of nitriles
- 3.4) Reactions of carboxylic acids and benzoic acid: formation of salt, formation of ester, formation of acid chloride, formation of acid anhydrides, formation of amides, reduction to alcohols
- 3.5) Industrial uses of carboxylic acids and its derivatives

**4. Carboxylic Acid Derivatives (acyl halides, acid anhydrides, esters and amides)**

- 4.1) Structure and nomenclature
- 4.2) Preparation of acyl chloride from carboxylic acid
- 4.3) Preparation and types of acid anhydrides
- 4.4) Preparation of ester from carboxylic acids and acyl chlorides
- 4.5) Classification (primary, secondary, tertiary and quaternary amides) and preparation of amides from carboxylic acid and acyl chloride
- 4.6) Reactions of acyl chlorides: formation of carboxylic acid, formation of ester, formation of acid anhydrides, formation of amides
- 4.7) Reactions of acid anhydrides: formation of carboxylic acid, formation of ester, formation of amides, Friedel-Craft acylation of benzene
- 4.8) Reactions of esters: ester hydrolysis in acid and base, formation of amides (ammonolysis), reaction with Grignard reagents
- 4.9) Reactions of amides: hydrolysis of amides, reduction of amides by  $\text{LiAlH}_4$ , Hoffman degradation, dehydration to nitriles, reaction with nitrous acid

**5. Amines**

- 5.1) Structures, classification and nomenclature
- 5.2) Physical properties of amines
- 5.3) Basicity
- 5.4) Preparation of amines: nucleophilic substitution using nitrogen nucleophile, reduction of other nitrogen-containing functional groups, reductive amination of aldehydes and ketones
- 5.5) Reactions of amines: Hoffman elimination, formation of amides
- 5.6) Industrial uses of amines.

| Assessment Breakdown             |   | %  |                 |      |
|----------------------------------|---|--|-----------------|------|
| Continuous Assessment            |   | 100.00%  |                 |      |
| Details of Continuous Assessment | Assessment Type   | Assessment Description   | % of Total Mark | CLO  |
|                                  | Assignment  | n/a  | 20%             | CLO2 |
|                                  | Final Test  | n/a  | 40%             | CLO1 |
|                                  | Practical   | n/a  | 20%             | CLO3 |
|                                  | Test  | n/a  | 20%             | CLO1 |
| Reading List                     | Recommended Text  | • John McMurry 2016, <i>Organic Chemistry</i> , 9th edition Ed., Cengage Learning Asia Pte Ltd Singapore |                 |      |
| Article/Paper List               | This Course does not have any article/paper resources   |  |                 |      |
| Other References                 | <ul style="list-style-type: none"> <li>• Books T.W. Graham Solomons and Craig B. Fryhle 2015, <i>Organic Chemistry, 11th ed</i>, Wiley</li> <li>• Books Paula Yurkanis Bruice 2016, <i>Organic Chemistry, 8th edition</i>, Pearson Education Limited</li> <li>• Books Michael Hornby and Josephine M. Peach 2016, <i>Foundations of Organic Chemistry</i>, Oxford University Press</li> <li>• Books Pavia, Lampman, Kris and Engel 2016, <i>Introduction to organic laboratory techniques: a small-scale approach</i> , Thompson Brooks/Cole</li> </ul> |  |                 |      |