Module (Course Syllabus) Catalogue

2022-2023

College	**Erbil Technology College**	
Department	**Petroleum Technology**	
Module Name	**Organic Chemistry- Morning**	
Module Code	**ORC303**	
Degree	**Technical Diploma** [X] **Bachelor** [ ] **High Diploma** [ ] **Master** [ ] **PhD** [ ]	
Semester	**3rd**	
Qualification	**Doctor of Philosophy (PHD)**	
Scientific Title	**Lecturer**	
ECTS (Credits)	**7**	
Module type	**Prerequisite** [ ] **Core** [X] **Assist.** [ ]	
Weekly hours		
Weekly hours (Theory)	**(2)hr Class**	**(5)Total hrs Workload**
Weekly hours (Practical)	**(3)hr Class**	**(7)Total hrs Workload**
Number of Weeks	**16**	
Lecturer (Theory)	**Assist Prof. Dr Jalil Hussein Kareem**	
E-Mail & Mobile NO.	**Jalil.kareem@epu.edu.iq 07504608533**	
Lecturer (Practical)	**Assist Prof. M Qasim Yahya Mohammed**	
E-Mail & Mobile NO.	**qasm.mohmmed@epu.edu.iq 07714986911**	
Websites	**https://moodle.epu.edu.iq/**	

Course Book

Course Description	**Course overview:** The purpose of this course is to provide students with an understanding of Organic Chemistry. The course addresses the chemical composition and properties of petroleum (oil and gas), and provide knowledge of chemical compounds. The course will also review the chemical basis for the most important chemical reactions. The course provides the student with a basic knowledge and understanding types of bonds, types of hydrocarbon compounds, physicochemical properties, technical aspects, business model, and impact on society and the environment. The primary emphasis is on the identification of chemicals. At the end of the course, the student should be able to speak in a general way on all aspects of the chemical compounds.
Course objectives	○ Describe the study of organic compounds and reactions. ○ Concentrates on the study of the reactions of organic chemistry. ○ The study proceeds through the organic functional groups from alcohols to amino acids. ○ Special attention is given to the classic synthesis reactions and named reactions. ○ Mechanisms are stressed throughout and the problem solving is extended to include the mechanisms. ○ Draw valence bond and Lewis dot structure for organic species, including formal charges. ○ Draw skeletal structures for organic compounds. ○ Apply acid-base concepts to organic systems; predict ordering of acid or base strength. ○ Name alkanes, alkenes, polyenes, alkynes, alkyl halides, aromatic compounds, carbonyl compounds, amines and their various derivatives using systematic (IUPAC) nomenclature.
Student's obligation	➢ Attendance – is expected at all lectures and labs. Attendance in lecture and lab is required for course completion. Class attendance is monitored and recorded. YOU are responsible for missed information. Attendance does affect your grade because you probably missed something you needed to learn how to do. ➢ Students in all sections of this course will be required to do the following:

	1. Students will participate in lecture activities including discussions, quizzes and in class assignments 2. Quizzes are designed to assist you in understanding the course materials and to provide you with examples of the type of questions that will be on the exams. 3. Students will turn in assigned homework problems and questions 4. Students may participate in optional cooperative learning groups 5. Students will participate in laboratory experiments and turn in laboratory reports 6. NO CELL PHONES- Cell phones are not allowed to be used as calculators in class or lab
Required Learning Materials	1. First five minutes is to remind students with a previous subject in last lecture. 2. Noted and handout of lecture are given to students containing details of the topics using power point presentation. 3. During the lecture, lecturer explains subject by a written on white board to become more understandable and simple. 4. At the end of the lecture, lecturer allows students ask their questions. 5. Regarding practical lectures, they give in the Lab where the students are divided into more than one groups. 6. The students work as multigroup at the lab to run equipment's and to submit a report for what they have done at the lab for the next practical lecture.

Evaluation

Task		Weight (Marks)	Due Week	Relevant Learning Outcome
Paper Review				
Assignments	Homework	**10**		**Tech student to have activity and make their works properly and professionally.**
	Class Activity	**10**		
	Report	**10**		
	Seminar	**10**		
	Essay			
	Project			
Quiz		**4**		**To know exam style**
Lab.				
Midterm Exam		**16**		**To know his level after finishing term**
Final Exam		**40**		

	Total	**100**		**To know if student successes or no**
Specific learning outcome:	1. Students will learn and apply basic techniques used in the organic laboratory for preparation, purification and identification of organic compounds. 2. Students will employ the major techniques used in organic chemistry laboratory for analyses such as melting point determination, extraction, distillation, identification and chemical characterization tests. 3. Students will synthesize at least one organic compound will be synthesized and identify the corresponding alteration in the functional groups. 4. Students will correctly calculate reaction yield for relevant lab experiments. 5. Students will analyze the given procedure of an experiment and suggest or recommend improvements. 6. Students will apply safety rules in the practice of laboratory investigations. Students will develop better understanding of the organic chemistry behind everyday observations such as the action of refining, or application in the refinery as petrochemicals.			
Course References:	1- Organic Chemistry as a Second Language. Book by David Klein 2- Organic Chemistry. Book by Jonathan Clayden 3- Part B: Reactions and Synthesis. Book by Francis A. Carey and Richard J. Sundberg Advanced Organic Chemistry: Reactions, Mechanisms, and Structure. Book by Jerry March			

Course topics (Theory)	**Week**	**Learning Outcome**
Introduction in organic chemistry, atomic structure and carbon bond types.	1	Getting info about principle of organic chemistry.
Polarization of bonds and effect of it on the physical and chemical property of organic compounds	2	Chemical structure and composition of petroleum products
Hydrocarbons-saturated hydrocarbons(alkanes), formula, property. Preparations, reactions, using in petrochemical industries Unsaturated hydrocarbons(alkenes), formula, nomenclature.	3	Getting info about all types of chemicals and petroleum products.
Alkynes, formula, properties, preparations Reactions, chemical uses, magnetic resonance	4	

Aromatic hydrocarbons (benzene), formula, property Reactions of benzene, addition and elimination of aromatic compounds.	5	All things about aromatics of crude oil.
Classification of alcohols preparations general properties, reactions, their uses.	6	Understanding physicochemical properties and structure differences between alcohols.
Phenols, phenol derivatives, reactions, preparations, their uses.	7	
Aldehydes formula, preparations, reactions,	8	Getting most important properties on aldehydes.
Ketones, formula, preparations, reactions	9	Getting most important properties on Ketones amino acids and carboxylic acids .
Carboxylic acid, formula, preparations, reactions uses	10	
Carboxylic acid derivatives, hydrates, amino acids, classification.	11	
Sulfur content organic compounds, property, reactions, uses. Hetero ring compounds, property	12	Learn differences and types of non-hydrocarbons with its definition
Practical Topics	**Week**	**Learning Outcome**
Separation and purification of organic compounds by filtration.	1	Determining the impurity of organic chemicals by filtration
Separation and purification of organic compounds by extraction.	2	Determining the impurity of chemicals by extraction.
Separation and purification of organic compounds by recrystallization.	3	Determining the impurity of chemicals by crystalisation.
Separation and purification of organic compounds by distillation and sublimation, unknown test.	4	All about distillation and its types.
Differentiate between aromatic and aliphatic	5	To evaluate the differences of circle and linear compounds.
Detection of aldehydes	6	To determine and detect each of these organic compounds through their properties and chemical identifications.
Detection of Ketones	7	
Detection of carboxylic acids	8	
Detection of alcohols	9	

Questions Example Design

Q1 Each member of the alkane series differs from the preceding member by one additional carbon atom and

(1) 1 hydrogen atom; (2) 2 hydrogen atoms; (3) 3 hydrogen atoms; (4) 4 hydrogen atoms.

Q2 what's difference between oxidation of ˚1, ˚2 and ˚3 alcohol?

Primary alcohols

Primary alcohols can be oxidised to either aldehydes or carboxylic acids depending on the reaction conditions. In the case of the formation of carboxylic acids, the alcohol is first oxidised to an aldehyde which is then oxidised further to the acid.

Partial oxidation to aldehydes

You get an aldehyde if you use an excess of the alcohol, and distil off the aldehyde as soon as it forms.

The excess of the alcohol means that there isn't enough oxidising agent present to carry out the second stage. Removing the aldehyde as soon as it is formed means that it doesn't hang around waiting to be oxidised anyway!

If you used ethanol as a typical primary alcohol, you would produce the aldehyde ethanal, CH_3CHO.

The full equation for this reaction is fairly complicated, and you need to understand about electron-half-equations in order to work it out.

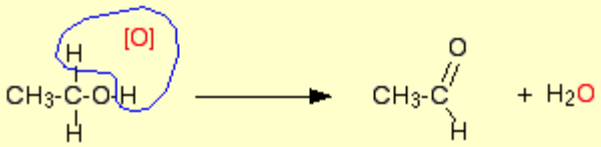
$$3CH_3CH_2OH + Cr_2O_7^{2-} + 8H^+ \longrightarrow 3CH_3CHO + 2Cr^{3+} + 7H_2O$$

In organic chemistry, simplified versions are often used which concentrate on what is happening to the organic substances. To do that, oxygen from an oxidising agent is represented as [O]. That would produce the much simpler equation:

$$CH_3CH_2OH + [O] \longrightarrow CH_3CHO + H_2O$$

This means "oxygen from an oxidising agent".

It also helps in remembering what happens. You can draw simple structures to show the relationship between the primary alcohol and the aldehyde formed.



Important! This is not intended to suggest any sort of mechanism for the reaction - it is just a way of helping you to remember what happens.

If you are in the UK A level system (or its equivalent), it is highly likely that your examiners will accept equations involving [O]. To be sure, consult your syllabus, past papers and mark schemes. If you are studying a UK-based syllabus and haven't got any of these things, follow this link to find out how to get them.

Full oxidation to carboxylic acids

You need to use an excess of the oxidising agent and make sure that the aldehyde formed as the half-way product stays in the mixture.

The alcohol is heated under reflux with an excess of the oxidising agent. When the reaction is complete, the carboxylic acid is distilled off.

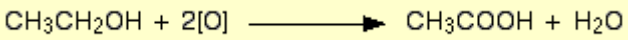
The full equation for the oxidation of ethanol to ethanoic acid is:

$$3CH_3CH_2OH + 2Cr_2O_7^{2-} + 16H^+ \longrightarrow 3CH_3COOH + 4Cr^{3+} + 11H_2O$$

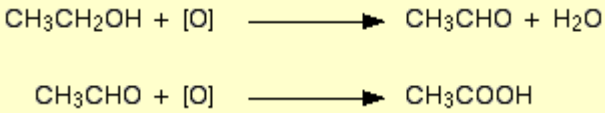
Note: This equation is worked out in detail on the page about electron-half-equations mentioned above, if you are interested.

If you choose to follow this link, use the BACK button on your browser to return to this page.

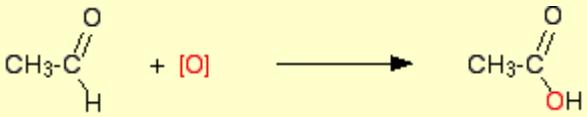
The more usual simplified version looks like this:



Alternatively, you could write separate equations for the two stages of the reaction - the formation of ethanal and then its subsequent oxidation.



This is what is happening in the second stage:

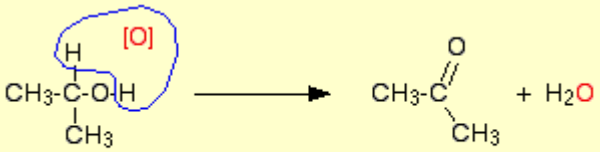


Secondary alcohols

Secondary alcohols are oxidised to ketones - and that's it. For example, if you heat the secondary alcohol propan-2-ol with sodium or potassium dichromate(VI) solution acidified with dilute sulphuric acid, you get propanone formed.

Playing around with the reaction conditions makes no difference whatsoever to the product.

Using the simple version of the equation and showing the relationship between the structures:



propan-2-ol propanone

If you look back at the second stage of the primary alcohol reaction, you will see that an oxygen "slotted in" between the carbon and the hydrogen in the aldehyde group to produce

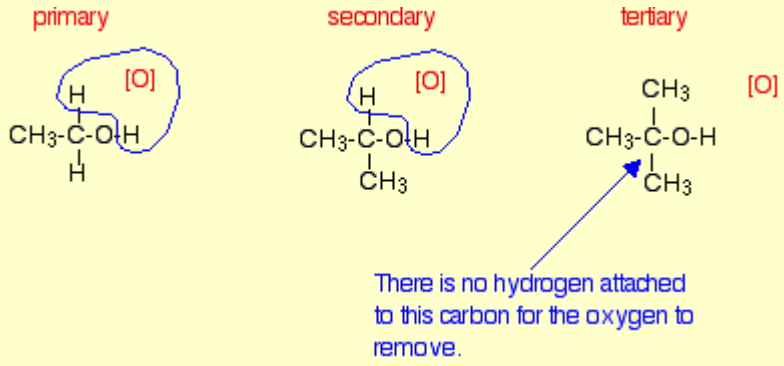
the carboxylic acid. In this case, there is no such hydrogen - and the reaction has nowhere further to go.

Tertiary alcohols

Tertiary alcohols aren't oxidised by acidified sodium or potassium dichromate(VI) solution. There is no reaction whatsoever.

If you look at what is happening with primary and secondary alcohols, you will see that the oxidising agent is removing the hydrogen from the -OH group, and a hydrogen from the carbon atom attached to the -OH. Tertiary alcohols don't have a hydrogen atom attached to that carbon.

You need to be able to remove those two particular hydrogen atoms in order to set up the carbon-oxygen double bond.



Q3 Define the following terms:

a-Alcohols: a colourless volatile flammable liquid which is produced by the natural fermentation of sugars and is the intoxicating constituent of wine, beer, spirits, and other drinks, and is also used as an industrial solvent and as fuel.

B- aldehydes: an organic compound containing the group —CHO, formed by the oxidation of alcohols. Typical aldehydes include methanal (formaldehyde) and ethanal (acetaldehyde).

Q5 Why aldehyde oxidised while ketones are not?

Ans: Because aldehydes have Oh group, while ketones do not.

Q6 Draw chemical structure of ethane, propanol:

CH_3-CH_3, CH_3-CH_2-CH_2-OH

Practical questions:

Q1 Enumerate classes of distillation?

Ans: **Some important types of distillation include:**

Simple **distillation**.

Fractional **distillation**.

Steam **distillation**.

Vacuum **distillation**.

Air-sensitive vacuum **distillation**.

Short path **distillation**.

Zone **distillation**.

Q3 Identified if this test solution is aldehyde or ketone?

Ans: ollens' **test**, also known as silver-mirror **test**, is a qualitative laboratory **test used to distinguish between** an **aldehyde** and a **ketone**. It exploits the fact that **aldehydes** are readily oxidized (see oxidation), whereas **ketones** are not.

Extra notes:

Around 10% of lectures might be changed during course.

External Evaluator