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**Department of Chemistry**

**College of Science**

**University of Salahaddin**

**Subject: Petroleum and Petrochemical Processing**

**Course Book – Class 3**

**Lecturer's name: Dr. Sangar Salih Ahmed (Theory & Practical)**

 **: M.Sc. Karim Ali Younis (Practical)**

**Academic Year: 2022/2023**

**Course Book**

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| **1. Course name** | **Petroleum and Petrochemical Processing** |
| **2. Lecturer in charge** | **Sangar Salih Ahmed** |
| **3. Department/ College** | **Chemistry Department / Science College** |
| **4. Contact** | **e-mail: sangar.ahmad1@su.edu.krd****Tel: (07504616485)** |
| **5. Time (2) per week**  | **Theory: 2****Practical: 3**  |
| **6. Office hours** | **Su 10:30-14:30 Theoretical Petroleum Chemistry****Mo 9:00-1:00 Office hours****Tu 9:00-1:00 student project research****We 8:30 – 5:00 Practical Petroleum Lab****Th 8:30 – 5:00 Practical Petroleum Lab** |
| **7. Course code** |  |
| **8. Teacher's academic profile**  | **High School:2002****BSc at 2007****Master degree at 2011****PhD degree at 2017** |
| **9. Keywords** | **Petroleum Chemistry, Crude oil, Hydrocarbons** |
| **10. Course overview:**▪The general aim of this course is to equip students with knowledge and skills to develop and understand principle of petroleum chemistry and the methods which use in practical petroleum chemistry.- It is important to learn what is the practical petroleum chemistry and its relation to their live.-they will understanding the principle of paraffin, naphthene , aromatics, flash point, aniline point and many other techniques in practical petroleum chemistry like potentiometric titration, separation methods of aromatics and non-aromatics, and they will take Sufficient knowledge and understanding working in petroleum lab. |
| **11. Course objective:**After this course and Upon completing this course, students should understand the basic concepts and practices of contemporary experimental petroleum chemistry. A successful student will learn how to keep a laboratory notebook and prepare laboratory reports in the style of a petroleum journal, and have practical experience in the fundamental petrochemical techniques that would be expected of a student applying to quantities and qualitative experiments in paraffin, naphthene, aromatics and asphalt. And some techniques form the foundation for many of the experiments of a contemporary petrochemical research laboratory. |
| **12. Student's obligation**- Lack of attendance and tardiness to class are unacceptable practices for laboratory courses. Obviously unforeseen events can lead to absenteeism and/or tardiness, but those instances are expected to be rare.Weekly report:- The purpose of the laboratory report is to communicate experimental work in writing. The educational goal is to help students learn and practice expressing their ideas and describing their work in a professional manner. - Homework assignments will be given to students.-PROJECT PRESENTATION some time will done- LABORATORY NOTEBOOK MAINTENANCE  All experimental data, except instrument output, should be recorded in indelible ink in a bound laboratory notebook with pre-printed sequential page numbers. Students should sign the notebook on the last page of that day’s experiment. Do not leave blank pages in a laboratory notebook. θ A lab notebook should include protocols, identification of samples, observations, and data. θ Record data and observations as you obtain or make them. Do not write on scraps of paper with the intention of transferring information to the lab notebook later. Do not worry if your notebook is a little messy. The recording and organization of a permanent record of laboratory observations is as important a technique to master as any of the experimental methods you learn. The research notebook is a day-by-day record of the progress of experimental work. It should reflect the integrity and honesty of the experimenter as well as the clarity of his or her thought. -Examination:- there will be two exam in a course and at end it will be final exam |
| **13. Forms of teaching****We use data show and white board** |
| **14. Assessment scheme**‌ The overall grading is 15% and distribute as in this scheme for this course is as follows:1% Laboratory Reports3% Laboratory Performance and Notebook Maintenance 1% Homework and quiz5% tow Mid exam and 15% Final Examinations‌ |
| **15. Student learning outcome:**Upon completing this course, students should understand the basic concepts and practices of contemporary experimental petroleum chemistry. A successful student will learn how to keep a laboratory notebook and prepare laboratory reports in the style of a petroleum journal, and have practical experience in the fundamental petroleum techniques. |
| **16. Course Reading List and References‌:**▪Key references: Practical petroleum chemistry, crude oil refining, hydrocarbons. ▪ Useful references: crude oil chemistry, the chemistry and technology of petroleum, fundamentals of petroleum refining▪ Magazines and review (internet):high wire press web siteThe journal of petroleum chemistryhydrocarbon journals |
| **17. The Topics:** | **Lecturer's name** |
| **Week 1:*** 1. **Introduction to Crude Oil.**
	2. **Petroleum Industry.**
	3. **Origin of Petroleum.**

**1.3.1. Abiogenic Origin.****1.3.2. Biogenic Origin.****1.4. Composition and Classification of Crude Oil.** **1.4.1. Pure Components.** **1.4.2. Non-hydrocarbon Compounds.****Week 2:*** 1. **Classification of Crude oil.**

**1.5.1. Classification as a Hydrocarbon Resource.****1.5.2. Classification by Chemical composition.****1.5.3. Classification According to Correlation Index.****1.5.4. Classification by Density.****1.5.5. Classification by Sulfur Content.****Week 3:*** 1. **Testing and Evaluation of Crude Oil.**

**1.6.1. Density.****1.6.2. Distillation Curve.****1.6.3. Volatility.****1.6.4. Pour Point.****1.6.5. Flash Point.****1.6.6. Aniline Point.****1.6.7. Water Content.****1.6.8. n-d-M Method.****Week 4:** **1.6.9. Total Acid Number (TAN).** **1.6.10. Total Base Number (TBN).** **1.6.11. Correlation Index.** **1.6.12. Carbon Residue.** **1.6.13. Salt Content.** **1.6.14. Ash Content.****Week 5:** **1.6.15. Total Sulfur Content.** **1.6.16. Hydrogen Sulfide Test.** **1.6.17. Viscosity.** **1.6.18. Viscosity-Gravity Constant.** **1.6.19. Viscosity Index.** **1.6.20. Octane Number.** **1.6.21. Cetane number.****Week 6:** * 1. **Pre-treatment and Distillation of Crude Oil.**

**1.7.1. Degassing of Crude Oil.****1.7.2. Desalting of Crude Oil.****1.8. Distillation of Crude oil.** **1.8.1. Atmospheric Distillation.** **1.8.2. Vacuum Distillation.****Week 7:*** 1. **Products of Crude Oil.**

 **1.8.1. Petroleum Gas.** **1.8.2. Naphtha.** **1.8.3. Gasoline.****Week 8:****1.9. Gasoline additives.** **1.9.1. Ant knocking Additives.** **1.9.2. Antioxidant Additives.** **1.9.3. Detergents.** **1.9.4. Metal Deactivators.** **1.9.5. De-icing Additives.** **1.9.6. Gasoline Dyes.****Week 10:****1.10. Kerosene.****1.11. Gas Oil (Diesel).****1.12. Biodiesel.****1.13. Diesel Additives.** **1.13.1. Cetane Improver.** **1.13.2. De-foamer.** **1.13.3. De-icing Additives.** **1.13.4. Fuel Stability Additives.** **1.13.5. Dispersants.** **1.13.6. Metal Deactivators.** **1.13.7. Corrosion Inhibitors.** **1.13.8. Demulsifiers.****Week 11:****1.14. Lubricants.****1.15. Treatment of Lubricants.****1.16. Monograde oils.****1.16. Multigrade oils.****1.17. Lubricant Additives.** **1.17.1. Antioxidants.** **1.17.2. Viscosity Index Improver.** **1.17.3. Pour Point Depressants.****Week 12:****1.18. Fuel Oil.****1.19. Lubricating Grease.****1.20. Transformer oils.****1.21. Paraffin (Petroleum) Wax.****1.22. Asphalt.****Week 13-17:****1.23. Chemical Processes in Petroleum Refining.** **1.23.1. Alkylation Process.** **1.23.2. Isomerization Process.** **1.23.3. Catalytic Reforming Process.** **1.23.4. Catalytic Cracking Process.** **1.23.5. Hydrocracking Process.** **1.23.6. Hydrodealkylaion Process.** **1.23.7. Hydrotreatment Process.** **1.23.8. Polymerization Process. Week 12-17****Week 18-24*** **Petrochemicals Processing**
* **Definitions of Petrochemicals**
* **Feedstocks, Intermediates, Finished Products**
* **Naphtha Cracking**
* **Conversion Processes for Selected Petrochemicals**
* **Polyethylene**
* **Polypropylene**
* **Polyethylene Terephthalate**
* **Polystyrene**
* **Polybutadiene**
* **Styrene–Butadiene Rubber**
* **Nylons**
 | Sangar Salih Ahmedex:(2 hrs)2022-2023 |
| **18. Practical Topics**  |
| In this section,the lecturer shall write titles of all practical topics he/she is going to give during the term. This also includes a brief description of the objectives of each topic, date and time of the lecture.***First semester; petroleum chemistry lab:******Course Schedule:***The schedule for the course is outlined below:***1st Week***:No labs this week, only demonstration of the theoretical parts for each petroleum experiments.***2ndWeek***:No labs this week, only demonstration of the theoretical parts for each petroleum experiments.***3rd*Week**/Evaluation of crude oil and determination of distillation calibration of petroleum products.***4th Week:*** This experiment includes three parts, having:**Part a))** Determination of flash point and fire point by Cleveland open cup tester.**Part b))** Determination of aniline point of petroleum products.**Part c))** Calculation of API of petroleum products.***5th Week:*** Separation of n-paraffin from kerosene by using urea-adduct method.***6th Week:*** This experiment includes three parts, having:***PartI))*** Determination of M.wt for petroleum oils by using viscosity method. ***Part II))*** Calculation of viscosity gravity constant (VGC) for petroleum oils.***Part III))*** Calculating of viscosity index (VI) from kinematics viscosity at 40 and 100°C.***7thWeek***:No labs this week, just having seminar.***8th*Week**;Calculation of carbon distribution and structural group analysis of petroleum oils by the n-d-M method.***Part i))*** Determination of refractive index (n) for petroleum oils by using refractometer.***Part ii))*** Determination of density(d) for petroleum oils by using pycnometer. ***Part iii))*** Determination of Molecular weight (M) for oil by using freezing point method.***9th Week:*** Separation of water from petroleum product by using Dean-Stark method.***10thWeek:*** Separation of representative aromatics and non-aromatics fractions of high- boiling oils by elution chromatography.***11th*Week:**Determination of hydrogen sulfide (H2S) in crude oil.**12thWeek:** Determination of cloud point and pour point of petroleum products.***13th Week:*** Determination of ash content from petroleum products.***14th Week:***Determination of asphalt in crude oil and Fuel oil***15th Week:***De-waxing processes of diesel oil**16th-19th Week**Unknown test for petroleum product (diesel oil, lubricating oil, and kerosene)**20th-23th Week**Scientific trips (Refinery Company, Coca cola Company, Wastewater treatment, steel company)***24th*Week:**Comprehensive Lab Exam | Lecturer's name:Dr.SangarSalih AhmedM.Sc. Karim Ali Younisex: (3hrs.) |
| **19. Examinations:*****1. Compositional:*** In this type of exam the questions usually starts with Explain how, What are the reasons for…?, Why…?, How….?Q1) Design a flow chart diagram for vacuum distillation of crude oil. |
| **20. Extra notes:**Here the lecturer shall write any note or comment that is not covered in this template and he/she wishes to enrich the course book with his/her valuable remarks. |
| **21. Peer reviewپێداچوونه‌وه‌ی هاوه‌ڵ** This course book has to be reviewed and signed by a peer. The peer approves the contents of your course book by writing few sentences in this section.*(A peer is person who has enough knowledge about the subject you are teaching, he/she has to be a professor, assistant professor, a lecturer or an expert in the field of your subject).*ئه‌م کۆرسبووکه‌ ده‌بێت له‌لایه‌ن هاوه‌ڵێکی ئه‌کادیمیه‌وه‌ سه‌یر بکرێت و ناوه‌ڕۆکی بابه‌ته‌کانی کۆرسه‌که‌ په‌سه‌ند بکات و جه‌ند ووشه‌یه‌ک بنووسێت له‌سه‌ر شیاوی ناوه‌ڕۆکی کۆرسه‌که و واژووی له‌سه‌ر بکات.هاوه‌ڵ ئه‌و که‌سه‌یه‌ که‌ زانیاری هه‌بێت له‌سه‌ر کۆرسه‌که‌ و ده‌بیت پله‌ی زانستی له‌ مامۆستا که‌متر نه‌بێت.‌‌  |