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**Department:**  Chemistry Dept.

**College:** Education College

**University:**  Salahaddin University

**Subject:**  Organic Identification (I)

**Course Book:**  *Stage* 4

**Lecturer's name:** Prof. Dr. Farouq Emam

**Academic Year: 2023/2024**

**Course Book**

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| **1. Course name** | Organic Identification (I) | |
| **2. Lecturer in charge** | Dr. Farouq Emam Hawaiz | |
| **3. Department/ College** | Chemistry/ Education | |
| **4. Contact** | e-mail: [farouqemam@yahoo.com](mailto:farouqemam@yahoo.com), farouq.hawaiz@su.edu.krd | |
| **5. Time (in hours) per week** | Theory: 2x2  Practical: 10 | |
| **6. Office hours** | **Sunday 10.5 am – 12.5 pm or by appointment** | |
| **7. Course code** |  | |
| **8. Teacher's academic profile** | Dr. Farouq Emam Hawaiz works as Professor at the Department of Chemistry, College of Education, Salahaddin University - Erbil (SUE). He received MSc & PhD in Organic chemistry from (SUE) in 1998 and 2007. He is a member of Postgraduate Committee at Department of Chemistry (SUE), teaching the subjects of Stereochemistry and Spectroscopy for MSc. & PhD students. As for undergraduate program, teaching subjects of Organic chemistry and organic identification for 4th stage students. His main research interests are synthesis and characterization of newly organic compounds and their biological activities. He has published more than 50 papers in local and international journals and conferences. | |
| **9. Keywords** | **IR, NMR and Mass** | |
| **10. Course overview:**  When a chemist prepares an organic compound or discovers a new compound with physiological activity, its structure must be determined, because without knowing  It`s structure, chemists cannot design ways to synthesize the compound. Before the structure of a compound can be determined, the compound must be isolated. For example, if the product of a reaction carried out in the laboratory is to be identified, it must first be isolated from the solvent and from any unreacted starting materials, as well as from any side products that might have formed. A compound found in nature must be isolated from the organism that manufactures it. The only tools chemists had to isolate products were distillation (for liquids) and sublimation or fractional recrystallization (for solids). Now a variety of chromatographic techniques allow compounds to be isolated relatively easily. At one time, identifying an organic compound relied upon determining its molecular formula by elemental analysis, determining the compound’s physical properties (its melting point, boiling point, etc.), and simple chemical tests that indicated the presence (or absence) of certain functional groups. These procedures were not sufficient to characterize molecules with complex structures, and because a relatively large sample was needed to carry out all the tests, they were impractical for the analysis of compounds that were difficult to obtain. Today, a number of different instrumental techniques are used to identify organic compounds. These techniques can be performed quickly on small amounts of a compound and can provide much more information about the compound’s structure than simple chemical tests can provide. These techniques are:  1. CHN analysis and determination of MF  2. Infrared spectroscopy  3. Ultraviolet/visible (UV /Vis)  4. Nuclear magnetic resonance (NMR) | | |
| **11. Course objective:**  The aim of this course is to observe the fundamental concepts of structures determination of organic compounds.  A key feature is the use of different techniques to illustrate and explain the structures of organic compounds.  Students are given enough detail information to understand basic concepts and more practices problems lead students to easily solving problems and allow students to apply what they have just learned. | | |
| **12. Student's obligation**  The student attendance in class two hours a week, preparation of the home works examinations and participate in the discussion in the classroom. | | |
| **13. Forms of teaching**  Different forms of teaching will be used to reach the objectives of the course: Direct questions, Quizzes, Discussion and conclusions. Power point presentations | | |
| **14. Assessment scheme**  At least one exam for each course (100pts) and 5-10 quizzes during the course (50-100pts). Participation in class and answering the questions (25pts) and then an extra degree to attend the lecture (\*).  ‌ | | |
| **15. Student learning outcome:**  Upon completion of these topics, the student will learn how to:  1: Recognize the characteristic features of organic compounds and their derivatives.  2. Determination of MF, Mwt and HDI  3**.** Recognize information about organic compounds with conjugated double bonds.  4. Determine the molecular mass and the molecular formula of a compound, as well as certain structural features of the compound.  5.Determine the kinds of functional groups a compound has. | | |
| **16. Course Reading List and References‌:**  1: Introduction to spectroscopy; 4th & 5th edition, Donald L. Pavia  2: Elementary Organic Spectroscopy; Y.R. Sharma  3: Organic Structures From Spectra; 4th edition , L. D. Field  4: Organic Chemistry 4th edition, Paula Bruice | | |
| **17. The Topics:** | | **Lecturer's name** |
| Week 1  Introduction to Organic Identification  Week 2:  CHN analysis and determination of MF  Week 3  HDI hydrogen deficiency of organic compounds  Week 4:  Spectroscopy and the Electromagnetic Spectrum  Week 5:  IR & Principles of infrared spectroscopy  Week 6:  HOW TO APPROACH THE ANALYSIS OF A SPECTRUM  Week 7  Factors influencing vibration frequencies  Week 8&9:  PREPARATION OF SAMPLES FOR INFRARED SPECTROSCOPY  Week 10-12  Structures elucidation examples by IR spectroscopy.  ---------------------------------------------------------------------------------------  **18. Practical Topics:**  I work as a supervisor at a practical topics and the details exist in the practical course teacher. | | Dr. Farouq Emam  (2 hrs) |
| **19. Examinations:**  Q1/ Propose five possible structures for C5H9N that exhibits a sharp signal between 2100-2300 cm-1 in its IR spectrum and does not contain any signals between 3000 - 4000 cm-1.    Q2/ Hydrocarbon containing 10% hydrogen show the following bands in its IR spectrum:  (i) 3295 cm-1 (ii) 2130 cm-1. Deduce the structure of this hydrocarbon.  Q3/ Arrange and explain the following compounds in order of increasing carbonyl absorption (cm-1) bands.    ethyl benzoate phenyl ethanoate  Q4/ how could IR spectroscopy distinguish between?  The two isomers of (C6H12) trans-3-hexene and 2,3-dimethyl-2-butene    Q5/ Deduce the structure of organic compound (C7H7NO) that exhibit the following absorption positions.  (i) 3370 cm–1 (ii) 3170 and 3070 cm–1 (iii) 1670 cm–1(s) (iv) 1630 cm–1 (v) 690 and 750 cm–1. ↓ 30pts  Q6/ Propose four possible structures for a compound C4H8O that exhibits a broad signal between 3200 and 3600 cm-1 in its IR spectrum and does not contain any signals between 1600 and 1850 cm-1.  Q7/ Compare the **O-H str.** Position and shapeof **non-**, **intra** and **inter-** hydrogen bonded hydroxyl compounds. **10pts**  Non-hydrogen bonded….  Intra-molecular-hydrogen bonded…..  Intermolecular-hydrogen bonded…..  Q8/ Arrange and explain the following compounds in order of increasing **carbonyl** absorption (cm-1) bands.    p-nitro benzaldehyde, m-nitro benzaldehyde and p-hydroxy benzaldehyde  Q9/ How could IR spectroscopy distinguish among hex-1-yne, hex-2-yne, and hex-3-yne?  Q10/The carbonyl stretching frequency in 2, 4, 6-cycloheptatrienone is exceptionally low. Explain.  Q11/ An aromatic organic compound (C9H8O) decolorize bromine and KMnO4 and exhibit the following  absorption positions. (*i*) 3090 cm–1 (*ii*) 3040 and 3000 cm–1 (*iii*) 2820 and 2750 cm–1 (*iv*) 1685 cm–1(s) (*v*)  1630 cm–1 (*vi*) 1580, 1450 cm–1 (*vii*) 690 and 750 cm–1. | | |
| **20. Extra notes:**  Here are some hints I give to my students at the beginning of the course:  1. Read the material in the subject and previous one before the lecture. Knowing what to expect and what is in the book, you can take fewer notes and spend more time listening and understanding the lecture.  2. After the lecture, review your notes, and try to solve problems. Also, read the material for the next lecture.  3. If you are confused about something, visit your instructor during office hours  immediately, before you fall behind. Bring your attempted solutions to problems  with you to show the instructor where you are having trouble.  4. To study for an exam, begin by reviewing each chapter and your notes, then concentrate on the end-of-chapter problems. Also use old exams for practice, if  available. Many students find that working in a study group and posing problems  for each other is particularly helpful. | | |
| **21. Peer review** | | |