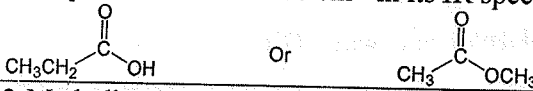
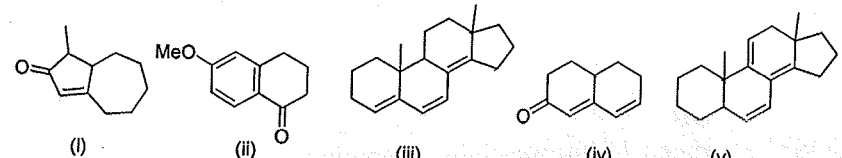
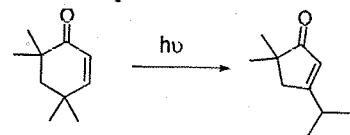


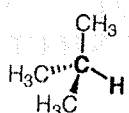
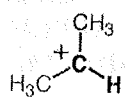
DEPARTMENT OF CHEMISTRY
SCHOOL OF CHEMICAL AND LIFE SCIENCES
M.SC. CHEMISTRY
SEMESTER-II EXAMINATION-2024
PAPER TITLE: PAPER TITLE: APPLICATIONS OF SPECTROSCOPY
PAPER CODE: MCHCC – 204

Time 2½ Hrs

Maximum Marks 60

Abbreviations Used: CLO- Course Outcome, PLO- Program Outcome, BTL- Bloom Taxonomy Level: BT level 1- Remember; BT level 2- Understand; BT level 3- Apply; BT level 4- Analyse; BT level 5- Evaluate, BT level 6- Create

Q1	Section A: Very short type questions: (1.5x10 = 15 Marks)	BTL	CLO	PLO
I.	Give the molecular formula of hydrocarbon cation with an m/z value of 51.	4,5	4,5	4
II.	Why is it necessary to use quartz cuvettes in the UV region, but less expensive glass or plastic cuvettes are acceptable in the visible region?	3	3	3
III.	How can you differentiate between Inter and intramolecular hydrogen bonding based on IR spectroscopy	3	3	3
IV.	How many normal modes of vibration do water, methane and benzene molecules have?	3	2	2
V.	How many equivalent "NMR" protons does TMS have?	3	2	2
VI.	What is the difference between a singlet and a triplet excited state?			
VII.	A sweet-smelling liquid with a boiling point of 374 K gives major absorption bands at; 2880- 2980 cm ⁻¹ , 1737 cm ⁻¹ (str), 1194 cm ⁻¹ (str) and 1166 cm ⁻¹ (str). Identify all frequencies given with their type of vibrations.			
VIII.	How many peaks are present in the ¹ H NMR spectrum of the following compounds? 3-hexanone and trimethylamine	4,5	4,5	4
IX.	Which of the following compounds show a strong absorption at ~1700 cm ⁻¹ and a broad absorption at 2500 – 3300 cm ⁻¹ in its IR spectrum? 	4,5	4,5	4
X.	2-Methylhexane shows an intense peak in the mass spectrum at m/z = 43. Propose a likely structure for this fragment.	4,5	4,5	4
Q2	SECTION B: Long Type questions (Attempt any two of four) : (10X2 = 20Marks), Each part has 5 marks.			
A	1) Draw structures for compounds that meet these descriptions: i. C ₂ H ₆ O; one singlet ii. C ₃ H ₇ Cl; one doublet and one septet iii. C ₄ H ₈ Cl ₂ O; two triplets iv. C ₄ H ₈ O ₂ ; one singlet, one triplet, and one quartet 2) What is the structure of a compound C ₉ H ₁₀ O that has an IR absorption at 1688 cm ⁻¹ and ¹ H NMR signals at 1.22 (triplet, 3H), 2.98 (quartet, 2H) and 7.28-7.95 (multiplet, 5H)?	4,5	4,5	4
B	1) Predict λ _{max} for the following:  2) It was proposed to use UV-VIS spectroscopy to follow the progress of the following photochemical reaction. Determine λ _{max} for both reactant and product. Is UV-VIS a good choice to follow this reaction? Explain. 	3-5	3-5	3-5
C	i) Discuss different fragmentation routes of ketones and aldehydes in mass spectrometry, giving suitable examples. ii) The natural abundances of chlorine's two major isotopes are ³⁵ Cl (75.5%) and ³⁷ Cl (24.5%). If the mass spectrum of chlorobenzene contains a peak at m/z 114 with an abundance of 15.0%, calculate the % abundance of the peak at m/z 112.	2/3 3/4/5	2/3 3/4/5	2/3 3/4/5

D	i) Explain the working of a Michelson interferometer ii) Explain the difference that could be observed in the absorption band of the highlighted C-H bond in 2-methylpropane and the given carbocation in their IR spectra.  	2/3	2/3	2/3
Q3	SECTION C: Short type questions: (Attempt all questions) : Marks) (5x 5= 25)			
a)	The absorbance values of a mixture of $K_2Cr_2O_7$ and $KMnO_4$ at 440 nm and 545 nm using a cell of 1 cm path length were found to be 0.405 and 0.712 respectively. The absorbance values of pure solutions of $K_2Cr_2O_7$ (0.001 M) and $KMnO_4$ (0.0002 M) in similar conditions were as follows: i. $A(Cr, 440\text{ nm}) = 0.374$, $A(Cr, 545\text{ nm}) = 0.009$ ii. $A(Mn, 440\text{ nm}) = 0.019$, $A(Mn, 545\text{ nm}) = 0.475$ Using the given data determine the concentration of $Cr_2O_7^{2-}$ ions and MnO_4^- ions in the mixture. OR List various electronic transitions possible in cyclobutanol and 2-butanol on the absorption of UV/Vis radiation. Chloromethane has an absorption maximum at 177 nm; bromomethane at 204 nm and iodomethane at 258 nm. What type of transition is responsible for each band? How can the trend of absorption be explained?	4/5	4/5	4/5
b)	How will you determine using IR whether an organic compound is still the amide or has hydrolyzed? OR Which kind of spectroscopy is often used to "fingerprint" molecules and why? Give examples to illustrate	4/5	5	4/5
c)	Differentiate between the isomers 2-methyl butanal & 3-methyl butanal based on their fragmentation pattern OR A liquid compound gave a mass spectrum in which the molecular ion appears as a pair of equal intensity peaks at $m/e = 122$ & $m/z = 124$. Small fragment ion peaks are seen at $m/z = 107$ & 109 (equal intensity), and at $m/z = 79, 80, 81, \& 82$ (all roughly the same size). Large fragment ions are seen at $m/z = 43$ (base peak), 41 & 39. Suggest a name for this compound.	4/5	4/5	4/5
d)	Predict the splitting pattern expected for each kind of proton in the 1H NMR spectrum of the following: i. $CH_3CH_2CH_2Br$ ii. $(CH_3)_3COCH_3$ iii. 3-hexanone iv. Cyclobutanol v. trimethylamine OR What is the significance of the COSY experiment? Illustrate giving example	3/4/5	3/4/5	3/4/5
e)	Predict the number of signals expected in the proton spin decoupled ^{13}C spectrum of i. 3-pentanone ii. 1,3-dichlorobenzene iii. Cyclopentane iv. cis-1,3-dimethylcyclopentane v. 3-hexanone OR List various hard and soft ionization techniques, discuss chemical ionization as a soft technique	2	2	2