

ADVANCE SPECTROSCOPIC TECHNIQUES
(CORE)

Time: 2:30 Hours

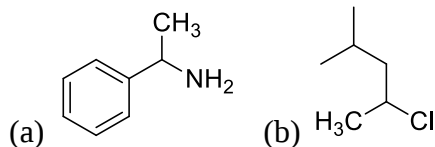
Marks: 70

Instructions:

1. All questions are compulsory.
 2. Figures to the right indicate marks.
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Q.1 Answer any **seven** of the following ten questions. (14)

1. Which types of nuclei NMR active? And why?
2. Explain nitrogen rule with example in mass spectroscopy.
3. Define equivalent proton with example.
4. Identify the types of protons in the following compounds:



5. Give the principle of IR spectroscopy.
6. Define the following terms:
(a) Base peak (b) Molecular ion peak
7. Give the applications of EPR spectroscopy.
8. State Lamberts-Beer's Law.
9. What is the application of Near Infrared Region?
10. Differentiate Ethanol and Dimethyl ether by CMR spectroscopy.

Q.2 Answer any **two** of the following three questions. (14)

1. Discuss Homolytic and Heterolytic cleavage in Mass spectroscopy.
2. Explain Spin-Spin splitting in NMR Spectroscopy with suitable examples.
3. Give the application of UV Spectroscopy.

Q.3 Answer the following questions. (14)

1. Discuss instrumentation of IR spectroscopy with schematic diagram.
2. Calculate ^{13}C NMR chemical shifts of aromatic C-atoms of 4-chloroaniline and p-xylene.
Take base value 128.5 and following incremental shift of aromatic C-atom are given below.

Substituent	C1 (<i>ipso</i>)	C2 (<i>ortho</i>)	C3 (<i>meta</i>)	C4 (<i>para</i>)
CH ₃	+9.3	+0.7	-0.1	-2.9
Cl	+6.4	+0.2	+0.1	-2.0
NH ₂	+19.2	-12.4	+1.3	-9.5

OR

Q.3 Answer the following questions. (14)

1. Explain Retro-Diels-Alder and McLafferty rearrangement in Mass spectrometry.
2. Give the number of signals and their multiplicity in the proton-noise decoupled and off-resonance decoupled ¹³C NMR spectra of the following compounds:
 - a) Isopropyl benzene
 - b) 1-Pentene
 - c) 1-Propanol
 - d) p-Xylene
 - e) Chlorobenzene
 - f) p-methoxyaniline
 - g) Salisaldehyde

Q.4 Answer any **two** of the following three questions. (14)

1. Deduce the structure of compound from the given analytical data.
 MW: 158 g/mol, Elements: C-60.8%, H-8.8%.
 IR: 2910, 1830, 1750, 1410, 1385, 1365, 1225, 710 cm⁻¹
 PMR: a/septate/2H/2.73 δppm, b/doublet/12H/1.20 δppm.
 CMR (Proton noise decoupled): 3 Signals (δppm: 18.8, 35.6 and 173.2)
2. What is Raman Spectroscopy? Give difference between Raman and Infrared spectra.
3. Explain α-, β- and γ-Effects in CMR spectroscopy.

Q.5 Answer any **two** of the following four questions. (14)

1. Explain the different types of absorption shift observed in UV spectroscopy.
2. Discuss Chemical ionization and Electron ionization technique in mass spectrometry.
3. Discuss ESR spectrum of K₃Fe(CN)₆.
4. Deduce the structure of compound from the given spectral data.
 MF: C₁₀H₁₀O
 IR: 3030, 2950, 1710, 1480, 1380, 750 and 700 cm⁻¹
 PMR: (a/singlet/3H/7.8 τppm), (b/doublet/1H/3.8 τppm/J = 16.5 Hz),
 (c/doublet/1H/3.2 τppm/J = 16.5 Hz), (d/multiplet/5H/2.2-2.8 τppm),
 CMR (Proton noise decoupled): 8 signals
