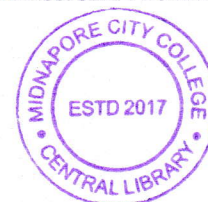


Total pages: 02

PG (CBCS)
M.SC. Semester- IV Examination, 2026
CHEMISTRY
PAPER: CEM 401
(ADVANCED SPECTROSCOPY-II)



Full Marks: 40

Time: 2 Hours

The figures in the right-hand margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.

GROUP-A**1. Answer any FOUR of the following questions:****4×2=8**

- a) What do you understand by even electron rule in mass spectroscopy?
- b) What is molecular ion peak in mass spectroscopy?
- c) What is typical in the mass spectrum of a compound containing (i) one bromine atom and (ii) one chlorine atom?
- d) How do you distinguish between cis and trans alkene using coupling constant?
- e) What types of solvents are used in ¹H NMR spectroscopy.
- f) In the 500 MHz, ¹H NMR spectrum of organic compound exhibited a doublet. The two lines of the doublet are at δ 3.35 and 3.38 ppm. Calculate the value of the coupling constant (J).

GROUP-B**2. Answer any FOUR of the following questions:****4×4=16**

- a) In the mass spectrum of toluene, strong peaks are formed at m/e 91 and m/e 65. Also a broad peak appears at 46.4. Justify the origin of these signals.
- b) What is McLafferty rearrangement? Write down the important features of parent ion peak. 2+2
- c) Briefly describe the working principle of CD spectroscopy.
- d) Why does ethylene exhibit a downfield chemical shift compared to acetylene in ¹H NMR spectroscopy?
- e) Describe about the factors which influences chemical shifts and coupling constants.
- f) Describe the Relaxation phenomenon in NMR spectroscopy.

GROUP-C**3. Answer any TWO of the following questions:****2×8=16**

- a) Describe the basic principles of mass spectroscopy. Give the typical fragmentation pattern of butanal. 6+2
- b) Write the principle of Mössbauer spectroscopy. What is the isomer shift in Mössbauer? 6+2

P.T.O

(1)

- c) (i) A Compound $C_9H_{10}O_2$ has strong infrared absorption at 1695 cm^{-1} . The ^1H NMR spectrum has five sets of lines: a singlet at δ 9.8 (1H) ppm, a doublet at δ 7.8 (2H), a doublet at δ 7.0 (2H), a quartet at δ 4.1 (2H), and a triplet at δ 1.3 (3H). Suggest a structure of this compound.
- (ii) A and B are two isomers having molecular formula $C_9H_{10}O_2$, deduce the structure of the isomers (A & B) with the help of given FTIR and ^1H NMR data:
 For isomer A: FTIR: 1680 cm^{-1} ; $^1\text{HNMR}$ (δ): 7.6 (2H, d), 6.9 (2H, d), 3.9 (3H, s), 2.0 (3H, s).
 For isomer B: FTIR: 1740 cm^{-1} ; $^1\text{HNMR}$ (δ): 7.2 (5H, s), 5.0 (2H, s), 1.98 (3H, s), 4+4
- d) An unknown organic compound (molecular formula: C_4H_8O) shows the following spectral data:
 IR Spectrum: i) Strong absorption at 1715 cm^{-1} , ii) No broad peak around $3200\text{--}3600\text{ cm}^{-1}$
 ^1H NMR Spectrum: i) δ 2.1 ppm (singlet, 3H), ii) δ 2.4 ppm (quartet, 2H), iii) δ 1.0 ppm (triplet, 3H)
 UV Spectrum: $\lambda_{\text{max}} \approx 280\text{ nm}$ (weak absorption)
 Identify the structure of the compound and justify your answer using the given spectral data.

<<>>

