

**M.Sc. 4th Semester Examination, 2025**

**CHEMISTRY**

*( Org, Inorg, Phy )*

**PAPER – CEM-401**

*Full Marks : 50*

*Time : 2 hours*

**Answer all questions**

*The figures in the right hand margin indicate marks*

*Candidates are required to give their answers in their own words as far as practicable*

1. Answer any *four* of the following :  $2 \times 4$

(a) How does spin-lattice relaxation affect the NMR peaks ?

*( Turn Over )*

- (b) How can you characterize A, B, P and Z form of DNA by circular dichroism spectroscopy ?
- (c) Write down the expression for specific and molar ellipticity.
- (d) Why recoilless emission and absorption of  $\gamma$ -ray is essential for Mössbauer spectroscopic study ?
- (e) What are essential "nuclear" and "electronic" conditions for occurrence of "electric quadrupole interaction" in Mössbauer spectroscopy ?
- (f) What is the full form of DEPT ? How is it useful ?

2. Answer any *four* of the following :  $4 \times 4$

- (a) Predict the Mössbauer spectrum of  $\text{Na}_2 [\text{Fe} (\text{CN})_5 (\text{NO})]$ .

- (b) How the NMR spectrum of an organic sample recorded in a 400 MHz NMR spectrometer will differ from the NMR spectrum recorded in a 100 MHz NMR spectrometer ?
- (c) An organic compound having molecular formula  $C_9H_8O_2$  shows following spectral data  $^1H$  nmr- $\delta$  (12.7, 1H, brs);  $\delta$ (7.8, 1H, d,  $J = 18$  Hz);  $\delta$  (7.56, 5H, m);  $\delta$ (6.45, 1H, d,  $J = 18$  Hz), IR-1680  $cm^{-1}$ , 2520-3070  $cm^{-1}$  (broad). Draw the structure of the compound.
- (d) (i) What is Mc Lafferty rearrangement in the mass spectral fragmentation of organic compounds? (ii) Give examples (iii) Using appropriate deuterium labeled compound prove that in Mc Lafferty rearrangement always  $\gamma$ -hydrogen transfers.

( 4 )

(e) An organic compound having molecular formula  $C_5H_8O$  shows following spectral data  $^1H$  NMR- $\delta$ : (6.2, 1H, d,  $J = 17\text{Hz}$ );  $\delta$ (5.4, 1 H, m,  $J = 17\text{ Hz}$ );  $\delta$  (2.3, 3H, s);  $\delta$ (1.9, 3H, d), IR- $1685\text{ cm}^{-1}$ ,  $3020\text{ cm}^{-1}$ , UV-VIS- $\lambda_{\text{max}}$  (ETOH) =  $277\text{ nm}$ ,  $\epsilon_{\text{max}} = 4600$ . Draw the structure of the compound.

(f) What is NMR shift reagent? Give an example and explain the mechanism of its activity.

3. Answer any *two* of the following :  $8 \times 2$

(i) Compound P ( $C_8H_{12}O_4$ ) shows the following  $^1H$  NMR spectral data :  
 $^1H$ -NMR (d) : 6.80 (s, 2H), 4.25 (q,  $J = 7\text{Hz}$ , 4H), 1.30 (t,  $J = 7\text{ Hz}$ , 6H).  
Suggest a possible structure with explanation.

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(ii) (a) An organic compound having molecular formula  $C_4H_6O_2$  shows a very strong IR band at  $1720\text{ cm}^{-1}$  and only one singlet signal in its  $^1\text{H NMR}$  spectrum. Draw the structure of the compound.

(b) An organic compound having molecular formula  $C_{10}H_{12}O_2$  shows following spectral data

$^1\text{H NMR}$ - $\delta$ : (8.0, 2H, m);  $\delta$ (7.2, 3H, m);  
 $\delta$ (5.2, 1H, m) ;  $\delta$ (1.3, 6H, d),  
IR- $1730\text{ cm}^{-1}$ ,  $3050\text{ cm}^{-1}$  and  
 $2950\text{ cm}^{-1}$ . Draw the structure of  
the compound.

4 + 4

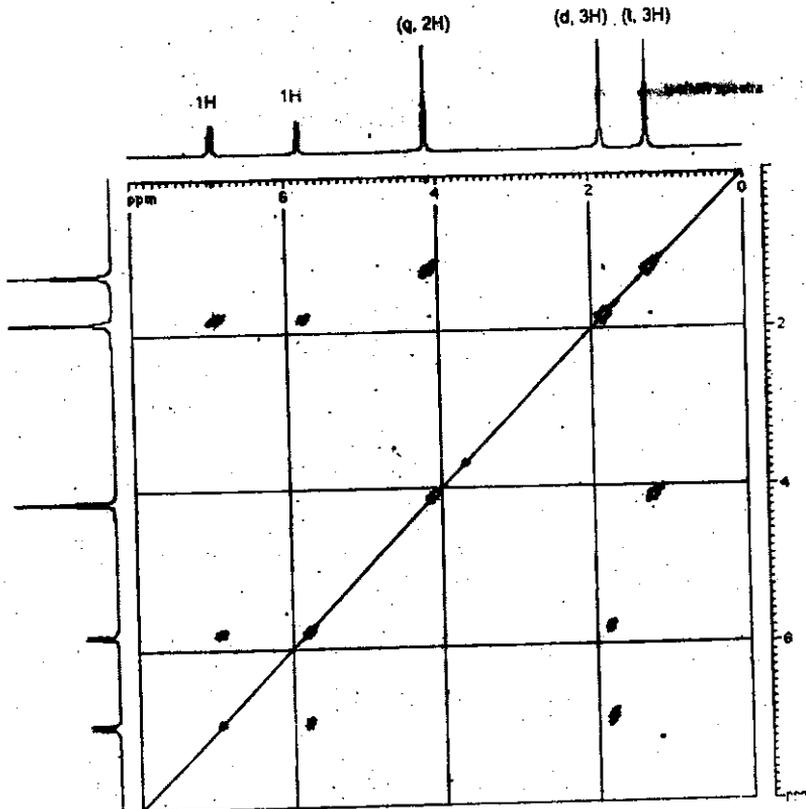
(iii)(a) What are the differences between ORD and CD ? Explain.

(b) Draw the absorption and CD spectra of adenine and guanine.

4 + 4

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(iv) A compound having molecular formula  $C_6H_{10}O_2$  shows the following 2D COSY NMR spectrum. Assign the structure. 8



[ Internal Assessment – 10 Marks ]