Reg. No…….. Name……

M. Sc. DEGREE END SEMESTER EXAMINATION - APRIL 2025

SEMESTER 2 : CHEMISTRY/PHARMACEUTICAL CHEMISTRY

COURSE: **24P2CHET07/24P2CPHT07 : PHYSICAL CHEMISTRY - II**

(*For Regular 2024 Admission)*

Time: Three Hours Max. Weightage : 30

PART-A **Weight : 1**

Answer any 8 Questions

1. Define the term lamb dip spectrum. (CO1)
2. What are the factors that affects the width of spectral lines? (CO1)
3. Deduce an expression for maximum population (J_{max}) in microwave spectroscopy. (CO2)
4. Why Stokes lines are more intense than anti-Stokes lines? (CO2)
5. Explain the term frequency doubling. (CO2)
6. Define the term double resonance in NMR spectroscopy. (CO2)
7. Differentiate between the principles COSY and HETCOR. (CO2)
8. ^{13}C-NMR measurements are conducted at lower frequencies relative to ^{1}H-NMR. Justify. (CO2)
9. Distinguish between the working of ^{1}H, ^{19}F and ^{31}P NMR spectroscopic techniques. (CO2)
10. With a suitable example, explain how Mossbauer spectroscopy can be used to identify the oxidation state of a metal ion. (CO3)

(1 x 8 = 8)

PART- B **Weights : 2**

Answer any 6 Questions

11. Define the term principal moment of inertia. Based on principal moments of inertia, discuss the classification of molecules. (CO2)
12. Demonstrate the effect of isotopic substitution on the rotational energy levels and the spectrum of a diatomic molecule using relevant equations and diagram. (CO2)
13. The equilibrium vibration frequency of the iodine molecule is 215 cm^{-1} and the anharmonicity constant is 0.003. Calculate the intensity of the hot band relative to the fundamental band at 300 K. (CO2)
14. Discuss the classification of lasers. (CO2)
15. Discuss the theory of spin coupling in NMR spectroscopy. (CO2)
16. What do you mean by Karplus relationship? Discuss its significance in NMR spectroscopy. (CO2)

17. Explain the working principle and applications of NOE. (CO2)
18. Predict the number of lines in the e.s.r. spectrum of the following radicals:
    (a) $[CF_2H]\bullet$ (b) $[^{13}CF_2H]\bullet$, (c) $[CF_2D]\bullet$, (d) $[CClH_2]\bullet$ (CO3)

(2 x 6 = 12)

PART- C **Weights : 5**

Answer any 2 Questions

19. (a) Discuss the concept of vibrating rotor and arrive at P, Q and R branch lines.
    (b) Using relevant equations, sketch the energy levels and Raman spectrum of a linear molecule. Mark the Rayleigh, Stokes and Anti-Stokes lines and the separation between each of them. (CO2)
20. State and explain the Franck Condon principle. Sketch the operations of the Franck-Condon principle for (a) internuclear distance is equal in upper and lower states, (b) upper state internuclear distance is a little less than in the lower state, (c) upper state internuclear distance is a little greater than in the lower state, and (d) upper state internuclear distance is considerably greater than the lower state. (CO2)
21. Outline the difference between first and second order NMR spectra. Discuss various methods used to simplify the second order spectra. (CO2)
22. Briefly explain
    (a) Kramer's degeneracy and McConnell equation.
    (b)Factors affecting (i) g-values in EPR and (ii) chemical shift in Mossbauer spectroscopy. (CO3)

(5 x 2 = 10)

	Course Outcome
CO1	Explain the foundations of spectroscopy
CO2	Explain the principles and applications of Microwave, IR, Raman, Electronic and NMR spectroscopy.
CO3	Explain EPR, NQR and Mossbauer spectroscopy.