Reg. No ..... Name **24P2033**

M. Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2024

SEMESTER 2 - CHEMISTRY / PHARMACEUTICAL CHEMISTRY

COURSE : **21P2CHET07 / 21P2CPHT07 - PHYSICAL CHEMISTRY - II**

(For Regular 2023 Admission and Improvement/Supplementary 2022/2021 Admissions)

Duration : Three Hours Max. Weights: 30

PART A

Answer any 8 questions **Weight: 1**

1. Explain shielding and deshielding in the resonance spectrum of benzene? (R, CO 2)
2. Explain the uncertainty principle related to coupling constant in ^{1}H NMR spectroscopy? (An, CO 2)
3. Explain the operation of Nd: YAG laser. (An, CO 2)
4. Why Deuterium is inactive in NMR? (R, CO 2)
5. Describe the factors that lead to the width of spectral lines. (U, CO 3)
6. What is NQR spectroscopy? (A, CO 3)
7. Explain the coloured spectra in conjugated compounds taking as example. (U, CO 2)
8. What is FT pulsed spectrometry? Explain the advantages? (R, CO 2)
9. The internuclear distance of carbon monoxide molecule is $1.13A^{0}$. Calculate the energy in Joules of CO in the first excited rotational level. The atomic masses are $^{12}C = 1.99 \times 10^{-26}$ kg; $^{16}O = 2.66 \times 10^{-26}$ kg. (A, CO 2)
10. What is meant by polarized and depolarized Raman Lines? (U, CO 2)

(1 x 8 = 8)

PART B

Answer any 6 questions **Weights: 2**

11. For the linear molecule nitrous oxide, N_2O, predict which rotational energy level will be most populated for a temperature of 300 K. The rotational constant of nitrous oxide is 0.419 cm^{-1}. (A, CO 2)
12. What are the advantages of FT technique over CW technique? How is uncertainty equation connected with relaxation time? (R, CO 2)
13. Distinguish between harmonic and anharmonic oscillators. (U, CO 2)
14. Draw the ESR spectra for a) $\cdot NH_3$ b) $\cdot CH\text{-}CH_2$ c) $\cdot CH_2D$ d) $\cdot CH_3$ (A)
15. (a) How many hertz does 1 ppm correspond to, for a ^{1}H NMR instrument operating at a radiofrequency of 60 MHz?
    (b) Calculate the magnetic field (in Tesla) required for flipping a ^{1}H nucleus in an NMR spectrometer operating at 400 MHz. [Given: $\Upsilon = 2.67 \times 10^{8}\ T^{-1}\ s^{-1}$, $\pi = 3.14$] (E, CO 2)
16. Calculate the CO and CS bond lengths in OCS from the rotational constants $B(^{16}O^{12}C^{32}S) = 6081.5$ MHz, $B(^{16}O^{12}C^{34}S) = 5932.8$ MHz. (A, CO 2)
17. Consider a gas of atoms at T=300K, P=100 torr and mass of each atom is 4.2×10^{-27} kg. Some atoms in the excited state emit radiation of frequency υ. Estimate the amount of Doppler broadening. (A, CO 3)
18. What are the relaxation methods in nuclear magnetic resonance? (R, CO 2)

(2 x 6 = 12)

PART C

Answer any 2 questions **Weights: 5**

19. (a) Explain Larmor frequency in NMR spectroscopy?.
(b) Spin coupling in NMR? (An, CO 2)
(c) Explain rotating frame of reference?

20. What do you mean by optical pumping? (U, CO 2)

21. Explain Mossbauer spectra of Z-in/Z-out complexes taking suitable example? (An)

22. (1) Explain mutual exclusion principle.
(2) A molecule AB_2 has the following IR and Raman spectra. Comment on its structure.

Frequency (cm^{-1})	IR	Raman
1,285	very strong, PQR contour	Very strong, polarized
589	Strong, PQR contour	-
2224	Very strong, PR contour	strong, depolarized

(An, CO 2)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO 2	Define aspects of specific spectroscopic techniques, applications of molecular symmetry in spectroscopy	A	1, 2, 3, 4, 7, 8, 9, 10, 11, 12, 13, 15, 16, 18, 19, 20, 22	35
CO 3	Understand the fundamental concepts of light-matter interaction, lasers and laser systems, detectors and other relevant aspects of instrumentation necessary for spectroscopy and imaging.	U	5, 6, 17	4

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;