Reg. No ..... Name **23P2033-S**

M.Sc. DEGREE END SEMESTER EXAMINATION - MARCH 2023

SEMESTER 2 : CHEMISTRY / PHARMACEUTICAL CHEMISTRY

COURSE : **16P2CHET07 / 16P2CPHT07 ; PHYSICAL CHEMISTRY - II**

(For Supplementary 2020/2019/2018/2017/ 2016 Admissions)

Time : Three Hours Max. Marks: 75

PART A

Answer any 10 (2 marks each)

1. Explain HETCOR spectra?
2. What is the error as indicated by the signal –to-noise ratio. Explain.
3. Define coupling constant J?
4. Mention the advantages of FTIR over dispersive IR
5. Discuss Zeeman splitting with an example.
6. What is Auger Electron Spectroscopy?
7. Raman spectroscopy and IR can be used to detect the presence of a centre of symmetry in a molecule. Justify.
8. State the guiding principle for investigating the vibrational structure of eletronic spectra
9. Predict the number of signals and their multiplicities for the NMR spectrum of P-nitrotolune?
10. Explain resonance and Larmor frequency in NMR spectroscopy?
11. What is meant by shielding and deshielding of a nucleus?
12. State the characteristics of Lasers.
13. Name four solvents used for NMR acquisition?

(2 x 10 = 20)

PART B

Answer any 3 (5 marks each)

14. Illustrate exchange phenomenon in ^{1}HNMR spectrum with a suitable example?
15. Explain two dimensional NMR
16. Which among the following molecules will give rise to rotational spectrum: Br_2, HBr, CS_2 and CCl_4. Explain
17. What are the advantages of Gas Laser over the Solid state Laser?
18. Discuss Resonance Raman scattering and resonance fluorescence

(5 x 3 = 15)

PART C

Answer any 2 (5 marks each)

19. (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: $\Upsilon = 2.67 \times 10^{8}\ T^{-1}\ s^{-1}$, $\pi = 3.14$]
20. Calculate the nuclear spin angular momentum and the magnetic moment for a proton given that I =1/2, g_N for the proton is 5.585 and $\mu_N = 5.05 \times 10^{-27}\ JT^{-1}$

21. The bond length in HBr molecule is 141 pm. Calculate the wave number in cm^{-1} for the transition J = 0 to J = 1 for this molecule (H = 1.008 $\times$ 10^{-3}kgmol^{-1}, Br = 79.909 x 10^{-3}kgmol^{-1}).

22. 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}.

(5 x 2 = 10)

PART D

Answer any 2 (15 marks each)

23. a) Explain chemical shift in ^1HNMR spectroscopy?
b) What are the factors influencing chemical shift?

24. (a) Show that for a rigid diatomic rotor, the moment of inertia is given by I = μr^2
(b) Using the energy level expression and selection rules, draw an energy level diagram and the spectral transitions for the pure rotational spectrum of a rigid diatomic rotor. Also show the appearance of the spectrum.

25. Explain the application of Mossbauer spectroscopic techniques in the study of Fe (II) and Fe (III) cyanides

26. (a) State and illustrate with suitable potential energy curves, the frank-condon principle in the vibronic spectrum of a diatomic molecule. Briefly discuss
(b) Predict the kind of electronic transitions in (i) Cl_2 and (ii) C = O group. Also give their intensity.
(c) What is meant by population inversion? Mention any one method of achieving it.

(15 x 2 = 30)