

**M. Sc DEGREE END SEMESTER EXAMINATION - JULY 2021****SEMESTER 2 : CHEMISTRY / PHARMACEUTICAL CHEMISTRY****COURSE : 16P2CHET07 / 16P2CPHT07 : PHYSICAL CHEMISTRY - II***(For Regular - 2020 Admission and Supplementary - 2019/2018/2017/2016 Admissions)*

Time : Three Hours

Max. Marks: 75

**PART A****Answer any 10 (2 marks each)**

1. Give the rule of mutual exclusion principle seen in IR and Raman spectroscopy.
2. What are Stokes and anti-Stokes lines.
3. Why vibrations involving relatively neutral bonds such as C-C, C-H and C=C are strong Raman scatterers while they are weak in IR absorption?
4. What are the Laser light properties? How are they produced?
5. What are Auger electrons? Explain
6. What is meant by laser action? Mention three types of energies that can be used to bring out population inversion.
7. How are Mossbauer nuclides formed?
8. Draw the EPR spectrum of methyl free radical.
9. What is 'g' factor? How are 'g' values determined?
10. What is isomer shift? Explain isomer shift for iron and tin compounds?
11. Discuss Zeeman splitting with an example.
12.  $^{13}\text{C}$  in NMR is active while  $^{12}\text{C}$  is not. Explain?
13. What is FT - NMR spectroscopy? How does it differ from CW - NMR spectroscopy?

**(2 x 10 = 20)****PART B****Answer any 3 (5 marks each)**

14. How can rotational spectra data be used to calculate the moment of inertia in the case of a diatomic molecule.
15. Outline the concept of normal modes of vibration of a molecule. Sketch schematically the normal modes of  $AB_2$  linear molecule and comment on its IR and Raman activity.
16. Explain electronic spectra of conjugated system using free electron molecular orbital (FEMO) theory.
17. Explain Kramer's theorem with an example?
18. Explain the NMR spectrum of trans cinnamic acid detailing the coupling interaction.

**(5 x 3 = 15)****PART C****Answer any 2 (5 marks each)**

19. In the rotational spectrum of HF, the lines are  $41.9\text{ cm}^{-1}$  apart. Calculate the moment of inertia and bond length in HF ( $H = 1.008$ ,  $F = 19.0$ )
20. The fundamental vibrational frequency of HCl is  $2890\text{ cm}^{-1}$ . Calculate the force constant of this molecule. The atomic masses are  $H^1 = 1.673 \times 10^{-27}\text{ kg}$ ;  $Cl^{35} = 58.06 \times 10^{-27}\text{ kg}$ .
21. (a) How many hertz does 1 ppm correspond to, for a  $^1\text{H}$  NMR instrument operating at a radiofrequency of 60 MHz?  
(b) Calculate the magnetic field (in Tesla) required for flipping a  $^1\text{H}$  nucleus in an NMR spectrometer operating at 400 MHz. [Given:  $\gamma = 2.67 \times 10^8\text{ T}^{-1}\text{ s}^{-1}$ ,  $\pi = 3.14$ ]

22. (a) Calculate the NMR frequency(in MHz) of the proton ( $^1\text{H}$ ) in a magnetic field of intensity 1.4092Telsa.  
(b) A compound shows a Proton-NMR peak at 240Hz down field from the TMS peak in a spectrometer operating at 60MHz What are the value of chemical shifts  $\delta$  and  $C$  in ppm relative TMS.

**(5 x 2 = 10)**

**PART D**

**Answer any 2 (15 marks each)**

23. (a) Discuss the factors which determines width and intensity of spectral lines.  
(b) What is the principle of SERS?
24. Write briefly on X-ray photoelectron spectroscopy
25. Explain the application of Mossbauer spectroscopic techniques in the study of Fe (II) and Fe (III) cyanides
26. (a) The molecular formula of following organic compounds have only one NMR signal. Draw the structure formula of them  
(i)  $\text{C}_5\text{H}_{12}$  (ii)  $\text{C}_3\text{H}_6$  (iii)  $\text{C}_3\text{H}_4$  (iv)  $\text{C}_4\text{H}_6$  (v)  $\text{C}_8\text{H}_{18}$  (vi)  $\text{C}_2\text{H}_6\text{O}$  (vii)  $\text{C}_2\text{H}_4\text{Br}_2$   
(b) What are the two important characteristics of NMR spectroscopy. Using these two, differentiate low resolution and high resolution NMR spectrum.  
(c) What are the reason for using TMS as references in NMR

**(15 x 2 = 30)**