LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **CHEMISTRY**

FIFTH SEMESTER – **NOVEMBER 2023**

UCH 5503 – SPECTROSCOPY

Date: 07-11-2023 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

Part-A

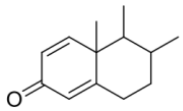
Answer ALL questions. **(10 × 2= 20)**

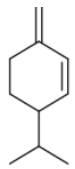
1. State Born-Oppenheimer approximation.
2. Find the energy of a radiation with the wavelength of 800 nm and mention the region in which it belongs to.
3. Define auxochrome and cite an example.
4. What are K and B bands in electronic spectroscopy?
5. Find the number of vibrational degrees of freedom for water and methane molecules.
6. Identify the stretching frequencies for O-H and N-H bonds.
7. What is coupling constant?
8. Distinguish propan-1-ol from propan-2-ol using PMR spectroscopy.
9. What is the principle of mass spectrometric technique?
10. Mention the formula to calculate the position of metastable peak.

Part-B

Answer any EIGHT questions. **(8 × 5= 40)**

11. Explain the interaction of electromagnetic radiations with matter.
12. With the block diagram explain the instrumentation of double beam UV-visible spectrophotometer.
13. Find the absorption maximum (λ_{max}) for the following compounds using Woodward- Fieser rule.

(i) 

(ii) 

14. Write the principle and mention the applications of atomic absorption spectroscopy.
15. Describe the various types of transitions observed in electronic spectroscopy.
16. Explain Stokes' and anti-Stokes' lines?

17. The infrared spectrum of a compound $C_5H_8O_2$ shows bands at 3100, 1760, 1675 and 1200 cm^{-1}. The ^1H NMR spectrum of the compound is shown the following signals: δ 18. ppm (s, 3H), 1.9 ppm (s, 3H) and 4.3 ppm (m, 2H). Predict the compound.
18. What is hyperfine splitting in EPR spectroscopy? Predict the number of EPR lines arising from hyperfine interaction in methyl radical.
19. With block diagram, explain the instrumentation of NMR spectrometer.
20. Draw the chemical structure of any two reference compounds used in NMR spectroscopy. List the advantages of TMS as reference in NMR spectroscopy.
21. Write the mechanism of McClafferty rearrangement and mention its significance in Mass spectroscopy.
22. Sketch and explain the mass spectrum of benzyl alcohol.

Part-C

Answer any FOUR questions. **(4 × 10= 40)**

23. (a) Discuss the factors affecting the line width and intensity of spectral lines.
    (b) Distinguish between absorption and emission spectra. (7+3)
24. (a) State and derive Beer-Lambert's law.
    (b) What are bathochromic and hypsochromic shifts? (6+4)
25. (a) Explain any two factors influencing the shift of fundamental vibrational frequencies.
    (b) Describe the sampling technique applied in recording the IR spectrum of solids.
26. (a) Explain the various stretching and bending vibrations. (5+5)
    (b) A compound gives a proton NMR peak at 450 Hz downfield from the TMS peak in a spectrophotometer operating at 250 MHz. Calculate the value of chemical shift.
27. (a) Give an account of shielding and deshielding of protons in acetylene and benzene.
    (b) Discuss the factors affecting coupling constant values. (5+5)
28. (a) Explain the importance of isotopic and base peaks in mass spectroscopy.
    (b) Discuss the retro-Diels-Alder type fragmentation in mass spectrometry with an example. (5+5)

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