LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2025**

UCH 5503 – SPECTROSCOPY

Date: 02-05-2025 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

SECTION A

Answer ANY FOUR of the following **(4 x 10 = 40)**

1. (a) Explain the quantized electronic, vibrational and rotational energy levels of a diatomic molecule.
   (b) Find the frequency and energy of a radiation with wavelength of 3000 Å. (5+5)
2. (a) Explain various types of electronic transitions.
   (b) State and explain Franck-Condon principle. (5+5)
3. Derive Beer-Lambert's law and mention its limitations.
4. (a) Describe the various kinds of stretching and bending fundamental vibrations observed in the molecules when they absorb infrared radiation.
   (b) Sketch the block diagram of infrared spectrophotometer. (6+4)
5. (a) What are Rayleigh and Raman scatterings?
   (b) State and explain mutual exclusion principle with examples. (5+5)
6. (a) What is TMS? Mention its significance in NMR spectroscopy.
   (b) With the help of block diagram describe NMR spectrophotometer. (3+7)
7. (a) Define coupling constant and explain any two types of coupling.
   (b) Predict the number of lines in the ESR spectrum of benzene radical. (6+4)
8. Define the following:
   (a) Stokes' lines (b) Base peak (c) Molecular ion peak
   (d) Isotopic peak (e) Nitrogen rule

SECTION B

Answer ANY THREE of the following **(3 x 20 = 60)**

9. (a) Explain the factors affecting line width and intensity of spectral lines.
   (b) Discuss the different regions of electromagnetic spectrum and mention the transitions corresponding to each region. (10+10)
10. (a) Describe the instrumentation and applications of atomic absorption spectroscopy.
    (b) With a block diagram explain the instrumentation of UV-visible spectrophotometer. (10+10)
11. Distinguish the following:
    (a) Emission and Absorption spectra (b) Chromophores and Auxochromes
    (c) Bathochromic and Hypsochromic shifts (d) IR and Raman Spectroscopy
12. (a) Discuss the various factors affecting fundamental vibrational frequencies.
    (b) Explain the various sampling techniques applied for scanning solid, liquid and gaseous samples in infrared spectrometer. (10+10)
13. (a) Define chemical shift and discuss the factors affecting the chemical shift.
    (b) Discuss the principle of EPR spectroscopy. Predict the number of hyperfine spectral lines in CH_3 radical. (10+10)
14. (a) Outline the principle of mass spectrometry.
    (b) Explain McLafferty rearrangement with an example.
    (c) Discuss the fragmentation pattern in hydrocarbons with examples. (5+8+7)
