# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – **APRIL 2023**

**16UCH6MS01 – SPECTROSCOPY**

Date: 12-05-2023 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

## PART-A

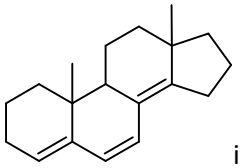
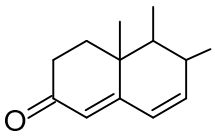
**Answer ALL questions** **(10 x 2 = 20 Marks)**

1. What are the fundamental physical parameters of a wave?
2. State Born-Oppenheimer approximation.
3. Mention the significance of Beer-Lambert's law.
4. Differentiate between chromophore and auxochrome.
5. Define Hooke's law based on the simple harmonic oscillator.
6. State mutual exclusion Principle.
7. Which of the following are NMR active? $^{12}C_6$, $^{13}C_6$, $^{1}H_1$, $^{16}O_8$
8. Chemical shift is a relative value. Justify
9. Distinguish between the parent ion peak and base peak.
10. What is the nitrogen rule?

## PART-B

**Answer any EIGHT questions** **(8 x 5 = 40 Marks)**

11. Write a note on the interaction of radiation with matter.
12. Analyze the selection rules followed for electronic transitions.
13. Examine the factors affecting line width and intensity of spectral lines.
14. Find out the $\lambda_{max}$ for the following compounds.

i.  ii. 

15. Examine the principles of atomic absorption spectroscopy and flame photometry.
16. Draw the block diagram for IR spectrometer and mention the parts.
17. Compare IR and Raman spectroscopic techniques.
18. Mention the advantages of TMS as the reference standard in $^{1}H$, $^{13}C$ NMR spectroscopy.
19. The chemical shift values of CH4, H2C=CH2 and HC≡CH are 0.9, 5.3 and 2.3 δ respectively. Account for the anomalies in δ values with reference to the C hybridization.
20. Analyze the impact of inductive effect and mesomeric effect on the chemical shift values in NMR.
21. Evaluate the types of fragmentation patterns generated in mass spectrometry.
22. Deduce the molecular formula with the given spectral data.
    Molecular ion peak at m/z 107 with a relative intensity of 100. The relative intensity of M+1 peak is 8.00 and the relative intensity of M+2 peak is 0.3%.

## PART-C

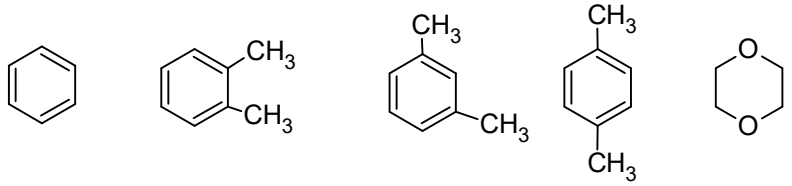
**Answer any FOUR questions.** **(4 x 10 = 40 Marks)**

23. a) If it takes $3.36 \times 10^{-19}$ J of energy to eject an electron from the surface of a certain metal, calculate the longest possible wavelength, in nanometers, of light that can ionize the metal. (6)
    b) Analyse the significance of the Franck-Condon principle. (4)

24. a) Investigate the factors affecting the shift in $\lambda_{max}$. (5)
b) Draw the block diagram of UV-Visible spectrophotometer. (5)

25. a) Demonstrate the application of IR and Raman spectroscopic techniques in elucidating the structure of organic compounds. (5)
b) Explain the types of stretching and bending vibrations. (5)

26. a) Predict how many signals in $^{13}C$ NMR are observed for the following compounds. (5)




A B C D E

b) Delineate the different types of coupling constant. (5)

27. a) Explain the following (6)
(i) McLafferty rearrangement
(ii) Retro Diels-Alder reaction
b) How will you identify alcohols, aldehydes in a mass spectrum? (4)

28. Deduce the structure of the compound which exhibits the following data.
A $C_9H_{12}O$ compound has strong infrared absorption at 3300 to 3400 $cm^{-1}$. It's $^1H$ NMR spectrum has three sets of lines: singlets at δ1.1 (6H), 1.9 (1H) and 7.3 (5H) ppm. The $^{13}C$ NMR spectrum of this compound has six discrete signals: 149.18, 128.13, 126.56, 124.41, 72.41 and 31.66. Mass spectrum: m/e: 136.19.

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