STELLA MARIS COLLEGE (AUTONOMOUS), CHENNAI - 600 086
(For candidates admitted from the academic year 2019 & thereafter)

SUBJECT CODE: 19CH/MC/SP 64

B.Sc. DEGREE EXAMINATION, APRIL 2023
BRANCH IV – CHEMISTRY
SIXTH SEMESTER

COURSE : MAJOR CORE
TITLE OF PAPER : SPECTROSCOPY
TIME : 3 HOURS **Maximum Marks : 100 Marks**

SECTION –A

Answer all the questions: **(30 x 1 =30 Marks)**

I. Choose the correct answers:

1. The moment of inertia I of any molecule about any axis through the centre of gravity
   a) mass of atom b) distance of atom from the axis
   c) mass and distance of atom i from the axis d) none of the above

2. Among the following which has the highest energy.
   a) microwave radiation b) radiofrequency radiation
   c) Infra red radiation d) Ultraviolet radiation

3. For CO_2 molecule, number of modes of vibration are
   a) 3 b) 5 c) 4 d) 6

4. In infra-red spectroscopy, the pair of isomers, which cannot be distinguished is / are
   a) geometrical isomers b) position isomers
   c) functional isomers d) optical isomers

5. An auxochrome is one which is
   a) colour enhancing b) a group or atom with lone pairs of electrons
   c) extending conjugation d) all of these

6. The absorption maximum in the ultra-violet spectrum of 2, 4- Hexadiene is
   a) 227 mμ. b) 214 mμ. c) 142 mμ. d) 265 mμ.

7. NMR spectra are observed in _____ region
   a) microwave radiation b) radiofrequency radiation
   c) Infra red radiation d) Ultraviolet radiation

8. NMR peak observed for methyl chloride is/are
   a) one b) two c) three d) six

9. In Mass spectra of chloro compounds, M^+ and $(M^+ + 2)$ peaks are formed in the intensity ratio
   a) 1:1 b) 1:2 c) 1:3 d) 2:3

10. The base peak in the mass spectrum of toluene appears at m/e is
    a) 90 b) 91 c) 93 d) 97

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II. Fill in the blanks:

11. The three principal moments of inertia are not equal in case of_____ rotor
12. The distance between the two adjacent crests or troughs in a particular wave is called _____.
13. The region below 1500 cm–1 is called _____.
14. The scattered lines having lower frequency compared to the incident beam are called _____.
15. The most suitable sources of UV light is _____.
16. The absorption when shifted towards shorter wavelength is called_____
17. The distance between the centres of the two adjacent peaks in a multiplet is called the _____
18. Reference material commonly uses as internal standards is _____.
19. The most intense peak in the mass spectrum is called _____.
20. Mass spectra are plotted against relative abundance of ions and _____.

III. State whether true or false:

21. The energy carried by an electromagnetic radiation is indirectly proportional to its frequency.
22. Hooke's law helps to calculate the value of stretching vibrational frequency.
23. Hydrogen bonding shifts the ultraviolet absorptions to longer wavelengths.
24. Greater the deshielding of protons, larger will be the value of chemical shift.
25. Molecular ion peak in mass spectrum is usually the basic peak for aldehyde.

IV. Answer in one or two lines:

26. Define Stark effect.
27. What is the range of infra-red radiations?
28. What are chromophores?
29. Define the term chemical shift.
30. What is the Nitrogen rule?

SECTION – B

V. Answer any FIVE of the following: (5 x 6 = 30 Marks)

31. Calculate the moment of inertia of a rigid diatomic rotor with bond distance equal to 130 pm and the reduced mass equal to 2×10^{-47} kg?
32. Outline the differences between IR and Raman spectroscopy.
33. What is Beer Lambert's law? Mention its limitations.
34. Write a short note on spin-spin relaxation and quadrupole relaxation processes in NMR.
35. Illustrate McLafferty rearrangement with a suitable example.
36. In acetylene, —C≡C—H stretching appears at about 3300 cm–1. How will you distinguish it from an O—H stretching in alcohol using IR spectroscopy?
37. Define spin-spin coupling. Explain the types of spin-spin couplings in NMR spectroscopy.

SECTION-C

VI. Answer any TWO of the following: (2 x 20 = 40 Marks)

38. a) Describe the various fundamental modes of vibrations using a suitable example. (6 marks

b) An organic compound of molecular formula $C_4H_8O_2$ shows a broad band in the range 3000-3300cm^{-1}, strong absorption at 1700cm^{-1}. The mass spectrum exhibits a peak at m/e45. Elucidate the structure of the compound (6 marks)

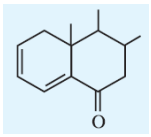
b) Explain the instrumentation of the double beam UV spectrophotometer with a neat block diagram. (8 marks)

39. a) Discuss in detail about the factors affecting chemical shift in NMR spectroscopy. (10 marks)

b) Explain the basic principle and instrumentation of Mass spectrometer. (10 marks)

40. a) What do you understand about the mutual exclusion principle? (5 marks)

b) Calculate Absorption Maximum for the following compound using Woodward-Fieser Rules. (10 marks)



c) Predict the number of signals and their multiplicities for the PMR spectrum of toluene. (5 marks)

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