

Exam. Code : 107406

Subject Code : 2176

B.Sc. (Bio-Technology) Semester—VI

**PHYSICAL, ORGANIC AND INORGANIC  
ASPECTS OF SPECTROSCOPY—B**

**Paper—BT-7**

Time Allowed—3 Hours]

[Maximum Marks—40

**Note :—** Attempt *all* questions of Section A and it is compulsory, do any *five* questions from Section B and do any *two* questions from Section C.

**SECTION—A**

(Compulsory, do *all* questions)

1. Mass spectrum of methyl chloride showed two molecular ions in the intensity ratio 3 : 1. What is the molecular weight for each ion (atomic masses : C = 12, H = 1, Cl (Two isotopes) = 35 and 37) ? 1
2. What is a metastable ion and how it is formed in a mass spectrometer ? 1
3. Mass spectrum of ethylamine showed three major ions with  $m/z$  values of 45, 30 and 15. Suggest the ions formed (atomic masses : C = 12, H = 1, N = 14). 1

4. Mass spectrum of cyclohexanone ( $C_6H_{10}O$ ) showed three major ions at  $m/z$  values of 98, 70 and 42. Indicate species revealed by these  $m/z$  values. 1
5. Depict clearly the  $^1H$  NMR spectrum of methanol with tetramethylsilane as a reference. 1
6. Discuss how spin-lattice relaxation occurs in NMR spectroscopy. 1
7. Depict proton NMR signals are expected for toluene. Assign the signals to different groups. 1
8. Why chemical shift is expressed in ppm? Give suitable reason. 1

### SECTION—B

(Do any five questions)

9. Discuss the use of mass spectrometry for the determination of molecular weight (MW) of a compound. Explain the steps needed to deal with a less stable compound for MW. 4
10. Explain using Mc Lafferty rearrangement the formation of ions at  $m/z$  values of 106 and 126 by the compound : butyrophenone (MW 148) with formula  $\{CH_3-CH_2-CH_2-C(=O)-C_6H_5\}$ . 4
11. Suggest different ions formed by 2-methyl-2-butanol  $\{CH_3-C(OH)(CH_3)-CH_2-CH_3\}$  in its mass spectrum (MW = 88). 4
12. How mass spectrometry is useful in distinguishing an aldehyde from a ketone? Explain using suitable examples. 4

13. Explain  $^1\text{H}$ NMR spectrum of ethanol using nuclear spin arrangements and also discuss intensity of signals. 4
14. Draw and explain proton NMR spectrum of acetylacetone. Also indicate why various signals occur at different magnetic fields. 4
15. How shielding/de-shielding affect proton NMR signals of organic compounds? 4
16. Depict and explain proton NMR spectrum of 1,1,2-tribromoethane. Also indicate how you calculate  $\delta$  and J values. 4

### SECTION—C

(Do any *two* questions)

17. Describe in detail the study of cyclic and acyclic esters using mass spectrometry. Explain the formation of various ions. 6
18. Explain the basic principles and applications of mass spectrometry. 6
19. Explain the terms : saturation, spin-spin relaxation, chemical shift and spin-spin splitting as related to NMR spectroscopy. 6
20. Describe applications of NMR spectroscopy for the determination of molecular structures of organic compounds. 6