

(2½ Hours)

- N.B. : (1) All questions are compulsory.  
 (2) Use of log table or non-programmable calculator is permitted.

1. (a) Attempt any two of the following:—

- (i) What is the significance of group frequency region and finger print region in qualitative analysis of organic compounds by IR spectroscopy?  
 (ii) Discuss the applications of Near-IR absorption spectrometry.  
 (iii) Explain the behaviour of a charged rotating particle in a magnetic field with a suitable diagram.  
 (iv) Give the applications of NMR in quantitative analysis of the compounds?

(b) Explain the basic principle of IR spectroscopy.

OR

(b) What is  $C^{13}$  NMR? What are its advantages over normal NMR?

2. (a) Attempt any two of the following:—

- (i) Explain the origin of metastable peaks in mass spectroscopy.  
 (ii) Discuss the applications of mass spectroscopy with respect to determination of molecular formulae from molecular weight.  
 (iii) Explain the method of sampling using optical fibres used in Raman spectroscopy with a suitable diagram.  
 (iv) Describe the working of FT Raman Spectrometer with a schematic diagram.

(b) For carbon tetra chloride the data for stokes and anti-stokes lines were obtained after irradiation of a sample with a He-Ne laser of 632.8 nm and 641.7 nm. Calculate Raman shift in  $cm^{-1}$ .

OR

(b) What is the function of ion sources and mass analysers in mass spectrometer?

3. (a) Attempt any two of the following:—

- (i) What is meant by substoichiometry in IDA? What are the requirements for tracers employed in this technique?  
 (ii) Discuss the advantages and disadvantages of thermal neutron activation analysis?  
 (iii) How are simultaneous thermal analysers superior to the individual instruments?

(iv) Describe the working of instrument used in the differential thermal analysis with a suitable diagram.

(b) Describe the different types of thermometric titrations with suitable examples.

OR

(b) What are radiometric titrations? Explain the titration and nature of the curve obtained in the determination of chloride ions using this technique.

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4. (a) Attempt any two of the following:—

- (i) Explain the interfacing devices used in GC-MS. How is it ensured that the carrier gas is removed from the sample components? 8
  - (ii) How can HPLC be coupled with MS? What are the interfaces available for this purpose?
  - (iii) How is the tandem mass spectroscopic technique used to identify compounds having same mass but different structures?
  - (iv) What are the advantages of using mass spectrometer as the detector? Explain the interface used in ICP-MS.
- (b) Describe the light pipe used in GC-IR instrument.

OR

(b) Give the principle and working of ICP-OES. 4

5. Attempt any four of the following:—

- (i) Describe the stretching and bending vibrations of molecules with a proper diagram. 12
- (ii) Explain the following terms:
  - (a) Chemical shift
  - (b) Spin-spin coupling
- (iii) Discuss the principle and working of a mass spectrometer.
- (iv) Give an account of surface-enhanced Raman spectroscopy.
- (v) Define autoradiography and explain how it is carried out for a metallurgical specimen.
- (vi) What is differential scanning calorimetry? Explain the instrument used in this technique.
- (vii) What is hyphenation? why is it required? what are its advantages?
- (viii) What is tandem mass spectrometry? What is the interface used in it? What are its advantages over mass spectroscopy?

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