



M.Sc. IV Semester Degree Examination, Sept./Oct. - 2024

CHEMISTRY

DSE - 4 : A : Advanced Chromatographic and Microscopic Techniques

(NEP)

Time : 3 Hours

Maximum Marks : 70

Note : (i) Answer **any five** questions including **Q.No.1**.
(ii) **Q.No.1** is **compulsory**. All questions carries **equal** marks.

1. (a) Explain the factors that influence the selection of the stationary phase in chromatography. **5**
(b) What are the three main components of the Van Deemter equation ? How does the Van Deemter equation help in optimizing column performance ? Explain. **5**
(c) Discuss the advantages of using HPLC over conventional chromatography. **4**
2. (a) What is the significance of the base peak in a mass spectrum ? Describe a metastable ion and its role in mass spectrometry with an example. **5**
(b) How can UV, IR, ¹H-NMR, and ¹³C-NMR be combined with mass spectrometry for structural elucidation ? Explain in detail. **5**
(c) What is the principle of high-resolution mass spectrometry and how does it differ from low-resolution MS ? Discuss. **4**
3. (a) With the help of Jablonski diagram illustrate the process of fluorescence and phosphorescence. **5**
(b) Differentiate chemiluminescence from fluorescence and phosphorescence ? Describe a method for measuring chemiluminescence. **5**
(c) What is optical rotatory dispersion (ORD) ? How does ORD differ from circular dichroism (CD) ? Explain. **4**
4. (a) How does hyperfine splitting manifest in different molecular structures ? List the factors that influence hyperfine splitting. **5**
(b) What is Kramers' degeneracy and how does it relate to ESR spectroscopy ? **5**
(c) Enumerate the applications of Mössbauer spectroscopy in the study of $\text{Fe}_3(\text{CO})_{12}$ and Prussian blue. **4**



5. (a) Classify electrophoresis techniques. Describe the instrumentation used in capillary electrophoresis. **5**
- (b) Explain the significance of the critical temperature and critical pressure in SFC. Mention the applications of SFC. **5**
- (c) Define electroosmosis. Describe the basic instrumentation used for electroosmosis. **4**
6. (a) Explain the fragmentation pattern of : (i) 2-Bromopropane and (ii) Dodecane **5**
- (b) Explain the characteristics of fragmentation of alcohols and phenols in mass spectroscopy. **5**
- (c) How does the chemical structure of molecules affect the fluorescence properties ? Discuss. **4**
7. (a) An organic compound showed the following spectral data : **5**
FTIR_(cm⁻¹) 3450, 1580, 1384, 1120
¹H NMR : 2.2(s, Rel.Int.2), 4.1(s, Rel.Int.1)
(δ , ppm) 7.15(s, Rel.Int.5)
Mass : 110, 109, 91, 77
Predict the structure of the compound.
- (b) What is the spin Hamiltonian and how is it used in ESR spectroscopy ? **5**
- (c) Give the principle of Field flow fractionation. List two advantages of field flow fractionation over chromatographic methods. **4**
8. (a) What is the McLafferty rearrangement ? Explain with an example. **5**
- (b) With neat schematics, illustrate the principle and working phosphorescope. **5**
- (c) List two factors that affect the “g” value. Explain the significance of zero-field splitting. **4**

