

TIME: 2½ HOURS

MAX. MARKS:60

N.B. 1) All questions are compulsory

2) Figures to the right indicate full marks

3) Use of logarithmic table/non programmable calculator is allowed.

- Q.1 A) Attempt **any two** of the following: **8**
- Discuss in brief "Thermionic detector" and give its application.
 - Write a note on "Optimization of chromatographic conditions".
 - Define chromatography. Give the classification of chromatographic techniques based on the mechanism of the separation.
 - Discuss the requirements of ideal detector to be used in chromatographic analysis.
- B) Attempt **any one** of the following: **4**
- Describe: "fluorescence detector" used in HPLC. Give its applications
 - Write note on "Normal and reversed phase chromatography in HPLC."
- Q.2 A) Attempt **any two** of the following: **8**
- Give a schematic sketch of instrumentation of mass spectrometer; write in detail about various components of instrumentation.
 - With a suitable diagram, describe the construction and working of 'Quadrupole Mass Analyzer'.
 - Name the different isotopic dilution methods and discuss any one in detail.
 - With the help of neat labelled diagram, describe the gas filled transducer used in X-ray diffraction analysis.
- B. Attempt **any one** of the following: **4**
- With the help of schematic diagram, discuss the Electron Ionization source used in mass spectrometry.
 - Write qualitative and quantitative applications of X-ray Fluorescence Spectroscopy.
- Q.3 A) Attempt **any two** of the following: **8**
- With reference to scanning electron microscopy (SEM), discuss electron gun and optics.
 - Draw a schematic diagram of Transmission electron microscope (TEM) and write the functions of each component.
 - What is electron spectroscopy for chemical analysis (ESCA)? Discuss the source of primary beam and sample holders used in the ESCA instrument.
 - Discuss the basic principle of atomic spectroscopy based on plasma sources.

- B) Answer **any one** of the following: 4
- Draw the schematic diagram of Scanning Tunneling Microscope (STM) and discuss the modes of STM operation.
 - Compare the techniques: scanning electron microscopy (SEM) and Transmission electron microscopy (TEM)

- Q.4 A) Attempt **any two** of the following: 8
- Distinguish between controlled current and controlled potential Coulometry.
 - Discuss gas sensing electrode with example.
 - Discuss the factors effecting the nature of deposit in electrogravimetry
 - Write short note on enzyme based biosensors.

- B) Attempt **any one** of the following: 4
- In a polarographic estimation of Cd(II) ions, the following results were obtained : $i_a = 5.65 \times 10^{-6} \mu A$, $D = 6.85 \times 10^{-6} \text{ cm}^2 \text{ s}^{-1}$, $m = 3.45 \text{ mg s}^{-1}$ and $t = 2.90 \text{ s}$. Calculate the concentration of Cd in the solution.
 - Calculate the time needed, in minutes, for a constant current of 0.96 A to deposit 0.5 g of Co(II) as elemental cobalt on the surface of a cathode. (1 Faraday = 96500 C, Molar mass of cobalt = 58.93)

- Q.5 Attempt **any four** of the following: 12
- Integrator output for the Separation of Hydrocarbons by Capillary Column GC-FID are as given in table:

| Analyte | Retention time (min) | Area | Peak width at the base (minutes) |
|---------------|----------------------|--------|----------------------------------|
| Ethyl Benzene | 13.359 | 510009 | 0.090 |
| o-xylene | 13.724 | 618229 | 0.087 |

Calculate: Calculate k' , α for any two adjacent compounds.

- Give applications of HPLC.
- Explain the basic principle of mass spectrometry.
- Enumerate applications and limitations of isotopic dilution analysis.
- Discuss the advantages and limitations of AAS.
- What is Auger electron? How is it produced?
- Discuss instrumentation of electrogravimetry.
- Write short note on ion selective field effect transistors.