

(3 Hours)**Total Marks: 75**

N. B. (1) All questions are compulsory.

(2) Use of log tables or non-programmable calculator is permitted.

- Q.1. Attempt any **Five** of the following **15**
- (a) How does it possible to obtained elemental composition using Electron Microscope (SEM)?
 - (b) What is “cotton effect”?
 - (c) Explain the working of ISFET with a suitable diagram.
 - (d) Discuss the need of simultaneous thermal methods.
 - (e) Explain the difference between normal and differential pulse polarography with the help suitable sketches.
 - (f) How is the transition time related to concentration? What is the significance of quarter wave potential?
 - (g) What are the radioactive titrations? Explain the determination of Mg using this method.
 - (h) Why is an interface needed for coupling HPLC to mass spectrometer?
- Q. 2. (a) Compare and contrast reflectance spectroscopy with absorption spectroscopy. **5**
What is the significance of remission function in reflectance spectroscopy?
- OR**
- (a) What are the problems observed in surface analysis? How can you obtain the depth profile of the sample? **5**
 - (b) Discuss the basic principle of CD and ORD. How is it useful in chemistry? **5**
- OR**
- (b) With the help of neat diagram explain the instrumentation used for measurements of chemiluminescence. **5**
 - (c) An XPS electron was found to have kinetic energy of 1052.6eV, when a source of wavelength 0.89 nm was used. What would be the kinetic energy of the same electron if the wavelength used is 0.95 nm. **5**
($h = 4.1 \times 10^{-15} \text{ eV.s}$, $C = 3 \times 10^{10} \text{ cm/s}$)
- Q. 3. (a) Discuss the applications of EGA. **5**
- OR**
- (a) How can a thermal analyzer be coupled with a mass spectrometer? Why is an Interface needed in this technique? **5**
 - (b) Explain the basic principle and technique of MRI. **5**
- OR**
- (b) Describe the construction of electrochemical biosensor for the determination of glucose in blood. What is the role of enzyme? How is the detection carried out? **5**

- (c) At what wavelength in nm would be the Stokes and Anti-Stokes Raman lines for CCl_4 ($\Delta\nu = 218, 314, 459, 762$ and 790 cm^{-1}) appear for argon ion laser (488nm)? **5**

Q. 4. (a) Attempt any **Two** of the following **10**

- (i) What do you understand by electrochemical stripping method? Describe the procedure for the determination of cadmium in water sample by this method.
- (ii) Explain chronoamperometry with suitable example.
- (iii) Discuss the applications of electrochemistry for organic synthesis. Elaborate the benefits of electrochemical methods over conventional methods.
- (iv) What is TAST polarography? Why is it called current sampled polarography? Give its advantages over dc polarography.

- (b) A cyclic voltammogram at HMDE was obtained for a 6.2 mM solution of lead at a Scan rate of 2.5 V/s. The diffusion coefficient of lead is $9.8 \times 10^{-6} \text{ cm}^2\text{s}^{-1}$. If the current obtained is 16.2 microampere, Calculate the area of the electrode using Randles – Sevcik equation. **5**

Q.5. Attempt any **Three** of the following **15**

- (a) Define autoradiography. How is it carried out for a metallurgical sample?
- (b) Discuss the basic principle and working of radio – chromatography. What is the detection device used in this method?
- (c) What are the advantages of using mass spectrometer as the detector? Explain the nature of interface in ICP-MS.
- (d) Explain in details the different types of sources available in NAA.
- (e) Discuss the application of isotope dilution analysis with special reference to:
 - (i) Determination of volume of blood in a living being.
 - (ii) Estimation of antibiotics in a large fermentation broth.