

QP Code : 76189

(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) Elaborate the term "cotton effect".
 - (b) What is thermal diffusion length in photoacoustic spectroscopy?
 - (c) Explain the working of ISFET with a suitable diagram.
 - (d) How can be the simultaneous DTA–TG data obtained using combined instrument?
 - (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) What is the function of ICP torch in ICP – MS?
- 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) Explain the principle of Auger electron spectroscopy with a block diagram. Why does Auger emission occur concurrently with ESCA electron? How will you differentiate the two processes? 5
- OR
- (b) With the help of neat diagram explain the instrumentation used for measurements of chemiluminescence. 5
 - (c) If the tunneling current was 12 picoampere when an STM probe is 4.80 nm from the surface and 20 picoampere when the probe is 0.60 nm from the surface, Calculate the current on moving the tip in 0.05 nm step from 0.30 to 0.60 nm. 5
- Q. 3. (a) Explain the basic principle and nature of spectrum obtained in 2 – D NMR. 5
OR
- (a) How can a thermal analyzer be coupled with a mass spectrometer? Why is an Interface needed in this technique? 5
 - (b) What are screen printed electrodes? How are the analytes determined using these electrode? 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

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- (c) For CCl_4 the data for Stokes and Anti-Stokes line were obtained after irradiation Of a sample with a helium – neon laser of 632.8 nm wavelength at 641.7 and 624.2 nm. Calculate the Raman shift in cm^{-1} and identify whether they are Stokes or Anti-Stokes lines. 5

- Q. 4. (a) Attempt any **Two** of the following 10
- (i) Give the basic principle of cathodic stripping voltammetry? How do you select the supporting electrolyte and deposition potential?
 - (ii) Explain chronopotentiometry with respect to Sand's equation and nature of chronopotentiogram.
 - (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 6.5mM solution of lead at a Scan rate of 500 mV/s. The diffusion coefficient of lead is $1 \times 10^{-6} \text{ cm}^2\text{s}^{-1}$. If the current obtained is 5.5 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.