TIME: 2 ½ 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**

a) Discuss the reasons of broadening of chromatographic peaks?

b) Write a note on "Optimization of chromatographic conditions".

c) Give the classification of chromatographic techniques based on physical state of mobile and stationary phases involved.

d) What is HETP? How is it related to column efficiency?

B) Attempt **any one** of the following: **4**

a) Describe: "fluorescence detector" used in HPLC. Give its applications.

b) Explain the use of mass spectrometer as detector in chromatography.

Q.2 A) Attempt **any two** of the following: **8**

a) With the help of schematic diagram, discuss the X-ray tube used in X-ray instruments.

b) With a suitable diagram describe the construction and working of "Time Of Flight"(TOF) mass analyzer. Compare between magnetic sector mass analyzer and TOF.

c) Enlist any four applications of isotopic dilution analysis.

d) With respect to isotope dilution method, discuss the single dilution method.

B. Attempt **any one** of the following: **4**

a) Discuss Fast Atom Bombardment Sources (FAB) used in mass spectrometer. Write any two drawbacks of FAB.

b) Draw a schematic diagram of various components of a mass spectrometer and write the function of each component.

Q.3 A) Attempt **any two** of the following: **8**

a) Draw a schematic diagram of scanning electron microscope (SEM). How is it used to obtain SEM images?

b) What is Transmission electron microscope (TEM)? Discuss the different lens used in TEM.

c) Discuss the applications of electron spectroscopy for chemical analysis (ESCA).

d) With a schematic diagram, explain the different components of an ICP torch.

B) Attempt **any one** of the following: **4**

a) Discuss the principle Scanning Tunneling Microscope (STM).

b) Compare the techniques: ESCA and Auger electron spectroscopy.

Q.4 A) Attempt **any two** of the following: **8**

a) Write short note on solid state electrodes. State any one application of solid state electrodes.

b) Discuss effect of complex formation on the polarographic wave.

c) Discuss the instrumentation for coulometry at controlled potential.

d) What is electrogravimetry? Give applications of elecrogravimetry.

B) Attempt **any one** of the following: **4**

a) Determine the diffusion current for a Nickel solution, if diffusion coefficient for Ni having concentration of 3mM is $0.69 \times 10^{-5} cm^2 s^{-1}$. Flow rate of Hg is 4 mgs^{-1} and drop time is 4 s.

b) A constant current of 0.800A is used to deposit copper at the cathode and oxygen at the anode of an electrolytic cell. Calculate the number of grams of Cu deposited in 15.2 min, assuming no other redox reaction (1Faraday = 96500 C, molar mass of Cu = 63.54).

Q.5 Attempt **any four** of the following: **12**

a) Integrator output for the separation of hydrocarbons by capillary column GC-FID.

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

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

b) Discuss in brief "Chiral Chromatography".

c) What are X-rays? Discuss the Bragg's law for diffraction of X-rays.

d) Give quantitative applications of mass spectrometry.

e) Differentiate between ICP-AES and AAS.

f) With the help of schematic diagram, describe an electron gun used in instruments for auger electron spectroscopy.

g) Discuss desired characteristics of ion selective electrodes.

h) Discuss wire net cylindrical cathode used in electrogravimetry and state any one advantage.