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:

a) Draw a labeled schematic diagram of Michelson's interferometer. Explain its working in FTIR. 4

b) What are the different types of IR Sources? Describe any one in detail. 4

c) The observed λ_{max} values for phenol and phenolate ion are 211 nm and 235 nm respectively while in case aniline and anilinium ion λ_{max} values are 230 nm and 203nm respectively. Explain. 4

d) With respect to spectroscopic analysis, explain the use of wavelength selectors. Describe prism monochromators in detail. 4

B Attempt any one of the following:

a) What are thermal transducers? Describe any one thermal transducer in detail. 4

b) A simultaneous determination for cobalt and nickel ions is based upon absorption by their respective 8- hydroxyquinolinol complexes. Calculate the molar concentration of nickel and cobalt ions in a solution of nickel and cobalt ions on the basis following data. 4
(Thickness of absorbing medium is 1 cm)

Solution	Molar absorptivity, ε mole^{-1}dm^{3}cm^{-1} at		Absorbance	
	365nm	700nm	365nm	700nm
Cobalt	65	5493	----	----
Nickel	3235	15	----	----
Mixture of cobalt and nickel	----	----	0.553	0.346

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

a) With the help of labeled diagram, describe lithium drifted silicon detector used in X-ray spectroscopy. 4

b) With reference to mass spectrometry, discuss the purpose and types of inlet systems. 4

c) Describe wavelength dispersive instrument used in X-ray fluorescence spectroscopy. 4

d) With the help of suitable diagram, describe the construction and working of quadrupole mass analyzer. 4

B. Attempt any one of the following:

a) Name ion sources used in molecular mass spectroscopy. Discuss any one in detail. 4

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b) Describe following technique with respect to compensation, of matrix effect in X-ray spectroscopy   **4**

       i) External standard calibration

       ii) Use of internal standard.

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

a) Describe the enzyme electrodes that can be used to measure blood urea nitrogen.   **4**

b) What are gas sensing probes? With the help of schematic diagram, describe a gas sensing probe used for determination of dissolved CO_2 in sample solution.   **4**

c) What are the applications of coulometric titrations?   **4**

d) Explain controlled cathode potential electrogravimetry.   **4**

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

a) A cell consisting of a saturated calomel electrode and nickel electrode developed a potential of -0.483V when immersed in $40.0 cm^3$ of sample solution. When $5.0 cm^3$ of standard $1.75 \times 10^{-2}M$ nickel ion solution was added to the sample solution the potential of the cell shifted to -0.432V. Calculate the concentration of nickel ions in sample solution in terms of pNi.   **4**

b) A 0.1895g sample of a purified organic acid was neutralized by the hydroxide ions produced, in 8 min 12 seconds by a constant current of 380 mA. Calculate gram equivalent weight of the acid. (1 Faraday = 96,500 C)   **4**

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

a) What is pulse polarography? What are its different types? Discuss its advantages over normal polarography.   **4**

b) Discuss the basic principle of cyclic voltametry with respect to
(i) the triangular waveform of the applied potential.
(ii) the peaks produced in the cycle   **4**

c) Give the advantages and limitations of the dropping mercury electrode as compared with platinum or carbon microelectrode.   **4**

d) What is bi-amperometric titration? Explain the nature of amperometric titration curve.   **4**

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

a) State the Randles-Sevick equations for the peak current used in cyclic voltametry and give the significance of each term involved in it. How is the peak potential (Ep) for a reversible process related to half wave potential $E_{1/2}$?   **4**

b) Calculate the concentration of Cd^{+2} ions in a solution which gave a diffusion current of 67µA.
Given: Diffusion coefficient for Cd^{+2} = $5.7 \times 10^{-5} cm^2 s^{-1}$, Rate of flow of mercury drops = 3.4mg s^{-1}, drop time = 3.5 s   **4**

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

a) Describe the methods of sample preparation in recording IR spectra.

b) Give a brief account of fiber optics in optical instruments.

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c) Describe rotating crystal method used in X-ray diffraction analysis.
d) Explain basic principle of mass spectrometry.
e) Explain the factors affecting the nature of deposit in electrogravimetry.
f) How ion Selective field effect transistors are useful in determination of pH?
g) Give an account of anodic stripping voltametry.
h) Discuss the principle of Karl Fisher titration

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