**Duration-- 2 Hours** **Max Marks: 50**

**N.B. 1. All questions are compulsory.**
**2. Figures to the right indicate marks.**

Q.1 Attempt **any two** of the following. 10

A. What is the difference between the columns, C8 and C18 used in an HPLC system?

B. The retention time of two components on column were found to 3.28 min and 5.26 min respectively. Calculate (i) HETP for each peak (ii) Resolution. If the width of the two peaks is 0.46 and 0.57 min., respectively and the time for mobile phase was 0.17min with the length of the column as 24.1cm.

C. What are different ways of optimization of chromatographic conditions. Discuss in details.

D. Give ideal properties of the detectors to be used in GLC and GSC.

Q.2 Attempt any **two** of the following. 10

A. With the help of schematic diagram, describe lithium drifted silicon detector used in X-ray spectroscopy.

B. Write qualitative and quantitative applications of X-ray fluorescence spectroscopy.

C. Name ion sources used in molecular mass spectrometry. Discuss any one in details with its advantages.

D. Explain principle and theory of neutron activation analysis.

Q.3 Attempt **any two** of the following. 10

A. Discuss the principle of the scanning tunneling microscope (STM).

B. Draw a schematic diagram of scanning electron microscope (SEM) and discuss the process of obtaining SEM images.

C. With respect to transmission electron microscope (TEM), discuss:
i. Electron gun ii. Condenser lens and iii. Objective lens

D. Explain the appearance and temperature profile of the inductively coupled plasma source used in atomic emission spectrometer.

Q.4 Attempt **any two** of the following. 10

A. Write short note on enzyme-based biosensors with example.

B. Discuss effect of complex formation on the polarographic wave.

C. What is electrogravimetry? Discuss the factors that control the physical properties of electrolytic precipitates in electrogravimetry.

D. 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)



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Q.5 Attempt **any five** of the following. 10

A. Mention any two applications of thermionic detector.
B. Name the detectors used in HPLC and mention its use.
C. Describe powder method used in X-ray diffraction analysis.
D. Draw a schematic diagram of: 'Time of Flight Mass analyzer'.
E. Write the mathematical expression for magnification achievable in scanning electron microscope (SEM) images and explain the terms involved.
F. Mention the limitations of atomic absorption spectrometry (AAS).
G. State any two desired characteristics of ion selective electrodes.
H. State any two features of controlled potential coloumetry.

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**(2 Hours)** **Total Marks: 50**

**N.B: 1) All questions are Compulsory.**
**2) Figures to the right indicate full marks.**

Q 1. Attempt any **two** of the following**.**

A) Describe the mechanism of "inner sphere" electron transfer reaction in octahedral complexes. **5**

B) Concerning the Trans effect, explain the effect of the following factors.
i) Nature of the entering group. ii) Nature of leaving group. **5**

C) Explain the following factors affecting the rate of reaction.
1. Temperature. 2. Catalyst. **5**

D) Discuss the cis-trans isomerization reaction in a co-ordinate complex**.** **5**

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

A) What is an organometallic compound? Give the synthesis of cyclopentadiene complex of Iron. Draw its structure. 5

B) State 16 electron rule. With the help of electron count, show which of the following complexes obey the rule?
1) $[Rh\ Cl\ (PPh_3)_3]_2)$ 2) $[\ (\eta^5\text{-}C_5H_5)\ Mn\ \eta^6 - C_6H_6)]$ 3) $[Ir\ (CO)\ (Br)\ (PPh_3)_2]$
4) $[\ Pt\ Cl_4]^{2-}$

C) Describe the preparation of Zeise's salt. Explain its structure and bonding on the basis of valance bond theory. 5

D) Explain the preparation and chemical properties of alkene derivatives of Platinum and Palladium. 5

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

A) Explain the speciation by chromium. Hexavalent chromium is more toxic. Explain? 5

B) What is biochemical methylation. Illustrate how mercury gets propagated in the food chain. 5

C) State different sources of lead. Explain the toxic effects of lead. 5

D) Describe the case study of Ita-itai disease. 5



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**Q 4.** Attempt any **two** of the following**.**

A) Explain structural details of hemerythrin. 5

B) Schematically represent oxygen dissociation curve with respect to cooperative binding of oxygen with haemoglobin. 5

C) What is nitrogen fixation? Explain the mechanism of nitrogen fixation using suitable chemical reactions. 5

D) Which are the metal ion carriers in biological system? Discuss the role of Valinomycin as metal ion carrier. **5**

**Q 5.** Attempt any **five** of the following: **10**

A) Based on Taube's classification, Identify Labile and Inert complexes from the following complexes.

i) $[V(NH_3)_6]^{2+}$ ii) $[Cr(H_2O)_6]^{2+}$

B) Identify the products in the following reaction:

i) $[PtCl_4]^{2-} \xrightarrow{PPh_3} A \xrightarrow{H_2O} B$

C) Explain the preparation of Fischer Carbenes.

D) Draw the structure of Tricarbonyl (η4 butadiene) Iron (0). Explain its silent features.

E) Describe uses of $I^{123}$ as radio diagnostic aid.

F) Explain different sources of copper poisoning.

G) Explain catalytic activity of monooxygenase enzyme in brief.

H) Distinguish between haemoglobin and myoglobin.

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