



Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech(AEIE)/SEM-2/EIEM-201/2013

2013

INSTRUMENTAL METHODS AND ANALYSIS

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any five questions.

1. a) Define spectroscopy.

 b) Briefly describe the objectives of sample handling system.

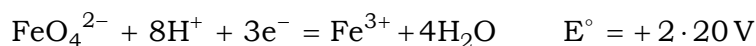
 c) Describe a suitable method for measurement of CO₂ in air. 2 + 5 + 7

2. a) Why is it required to combine a standard electrode with half-cell for measurement in an electrochemical cell ?

 b) Derive Nernst equation for an electrochemical cell.



- c) Calculate E_{cell} for a galvanic cell based on the following half-reactions at 25°C :



Where

$$[\text{FeO}_4^{2-}] = 2.0 \times 10^{-3} \text{ M} \quad \text{pH} = 5.2$$

$$[\text{Fe}^{3+}] = 1.0 \times 10^{-3} \text{ M} \quad [\text{O}_2] = 1.0 \times 10^{-5}$$

4 + 4 + 6

3. a) Derive Beer-Lambert law and establish relation between Absorbance and Transmittance.
- b) If the molar absorptivity for iron (II)-1, 10-phenanthroline complex is 12000 litre/mol/cm and the minimum detectable absorbance is 0.001 for a 1.00 cm path length, then find the minimum detectable molar concentration.
- c) Describe a dual beam dual detector type UV analyzer.
- 5 + 3 + 6
4. a) Describe the principle of operation of an Infra-red absorption type analyzer.
- b) Write the differences between IR and UV analyzers.
- c) Write the uses of UV analyzer.
- 8 + 4 + 2



5. a) Write the main functions of mass spectroscopy.
b) Describe the principle of operation of a magnetic deflection type mass spectrometer.
c) Establish the relation between time and mass to charge ratio for a Time of Flight type Mass Spectrometer.

2 + 8 + 4

6. a) How are X-rays obtained in different ways ?
b) Draw a schematic of an X-ray tube and describe it.
c) Explain how $K\alpha$ and $K\beta$ lines arise in X-ray spectroscopy.
d) Write the conditions of X-ray diffraction and establish Bragg's law.
e) Calculate the short wavelength limit for an X-ray tube operated at 50 kV.

2 + 4 + 3 + 3 + 2

7. a) Describe the construction of a hollow cathode lamp. What are the advantages/disadvantages of a multi-element lamp ?
b) Describe a double-beam atomic absorption spectrophotometer.

Between the choice of a single beam and a double beam atomic absorption spectrophotometers, give reasons for opting for the latter.

7 + 7



8. a) Explain with a diagram how a mixture of two compounds is separated by column elution chromatography.
- b) Define partition coefficient and retention time.
- c) Draw a schematic of an apparatus of HPLC and explain its operation.

5 + 3 + 6

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