No. of Printed Pages : 6 **MCH–025**

M. SC. IN CHEMISTRY

(MSCCHEM)

Term-End Examination

June, 2026

MCH-025 : ELECTROANALYTICAL AND OTHER ANALYTICAL METHODS

Time : 2 Hours *Maximum Marks : 50*

Note : *Question no.* ***1*** *is compulsory. Attempt any* ***four*** *questions from question nos.* ***2*** *to* ***7****.*

1. Attempt any *five* questions from the following : 5×2=10

   (a) How is the cell potential related to electrode potential ?

(b) Which electrode is used in controlled potential coulometry for selective metal deposition ?

(c) What is the practical importance of limiting current in polarography ?

(d) In what form is the output of cyclic voltammetry usually displayed ?

(e) Why does X-ray Photoelectron Spectroscopy (XPS) not detect hydrogen and helium ?

(f) What is the resolution limit of Scanning Electron Microscopy (SEM) ?

(g) Write the name of any *two* surface analytical techniques.

2. (a) Differentiate between any *one* of the following pairs : 5

(i) Oxidation and Oxidizing agent

(ii) Reduction and Reducing agent

(b) If the electrogravimetric analysis involving control of cathode potential is used to separate Bi^{3+} and Sn^{2+} in a solution that is 0.10 M is each ion and buffered to pH 1.50 : 5

(i) Calculate the theoretical cathode potential at the start of the deposition of the more readily reduced ion.

(ii) Calculate the residual concentration of the more reality reduced species when the less reduced cation begins to deposit.

[Given : $E^{\bullet}_{Bi^{3+}/Bi} = + 0 \cdot 317$ V and

$E^{\bullet}_{Sn^{2+}/Sn} = - 0 \cdot 137$ V]

3. (a) Define neutralization coulometric titration. List any *two* advantages of coulometric titrations. 5

   (b) Write the key differences between voltammetry and polarography in terms of their working electrodes and measurement techniques. Give any *two* applications of them. 5

4. (a) What is dropping mercury electrode ? Give its advantages. 5

   (b) What are amperometric titrations ? What will be the shape of the curve in bioamperometry for the titration of iodine by thiosulphate ? Illustrate your answer. 5

5. (a) A mixture of CaO and $CaCO_3$ is analysed by TGA. The result indicates that mass of the sample decreases from

250.6 mg to 190.8 mg only between 600 °C and 900 °C. Calculate the percentage of calcium carbonate in the mixture. 5

[Given : Molar masses of C = 12 g/mol, Ca = 40 g/mol and O = 16 g/mol]

(b) What are the various terms involved in different stages of an enthalpogram. Write the expression to determine Δs for a reaction. 5

6. (a) How many α and β particles will be emitted in the following successive decays ? 5

(i) $^{231}Th \rightarrow \rightarrow \rightarrow {}^{211}Pu$

(ii) $^{233}U \rightarrow \rightarrow \rightarrow {}^{213}Bi$

(b) List the factors that contribute to higher sensitivity in Neutron Activation Analysis (NAA). Briefly explain any *one* of these factors. 5

7. (a) What is the main difference between Energy Dispersive Spectrometry (EDS) and Wavelength Dispersive Spectrometry (WDS) ? Write the advantages of WDS over EDS. 5

(b) Write the working principle of Scanning Tunneling Microscopy (STM). 5

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