MCH-025

ASSIGNMENT BOOKLET

M.Sc. in Chemistry Programme
(MSCCHEM)

Electroanalytical and other Analytical Methods

(Valid from 1st July 2026 to 30th June 2027)

It is compulsory to submit the assignment before filling in the examination form

School of Sciences
Indira Gandhi National Open University
New Delhi-110068
(2026-2027)

Dear Learner,

Please read the section on assignments in the Programme Guide for M.Sc. in Chemistry that we sent you after your enrolment. A weightage of 30 per cent, as you are aware, has been earmarked for continuous evaluation, which would consist of one tutor-marked assignment for this course. The assignment is in this booklet, and covers both the blocks of the course. The total marks of all the parts are 100, of which 40% are needed to pass it.

Instructions for Formatting Your Assignments

Before attempting the assignment, please read the following instructions carefully:

1. On top of the first page of your answer sheet, please write the details exactly in the following format:

ENROLAMENT NO. :…..…….

NAME :……...

ADDRESS :……

COURSE CODE :……..

COURSE TITLE :……..

ASSIGNMENT NO :……..

STUDY CENTRE :…….. DATE :…….

(Name and Code)

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2. Use only foolscap size paper (but not of very thin variety) for writing your answers.
3. Leave about 4 cm margin on the left, top and bottom of your assignment response sheet.
4. Your answers should be precise.
5. Submit the complete assignment answer sheets within the due date.
6. The assignment answer sheets are to be submitted to your Study centre within the due date. Answer sheets received after the due date shall not be accepted.
   We strongly suggest that you retain a copy of your answer sheets.
7. This assignment is valid from 1st July, 2026 to 30th June, 2027. If you have failed in this assignment or fail to submit it by June 2027, then you need to get the assignment for the year 2027-2028, and submit it as per the instructions given in the Programme Guide.
8. You cannot fill the examination form for this course until you have submitted the assignment.

Wishing you good luck

Tutor Marked Assignment

Electroanalytical and other Analytical Methods (MCH-025)

Course Code: MCH-025
Assignment Code: MCH-025/TMA/26-27
Maximum Marks: 100

Note: Attempt all questions. The marks for each question are indicated against it.

---

1. Answer ***any five*** of the following in brief. **(2x5)**

(a) Define a reference electrode and state its role in potentiometric measurements.

(b) What is the basic principle of potentiometry?

(c) Explain the purpose of adding a supporting electrolyte in an electrolytic cell.

(d) Define decomposition potential and its significance in electrolysis.

(e) What is junction potential and how does it arise at the interface of two electrolytic solutions?

(f) Discuss the role of a salt bridge in an electrochemical cell.

(g) Distinguish between an indicator electrode and a reference electrode.

2.

(a) Provide a theoretical explanation of the relationship between Gibbs energy change (ΔG) and cell potential (E_{cell}). Establish the logic for why ΔG serves as a criterion for spontaneity and equilibrium in electrochemical systems. **(5)**

(b) Calculate the electrode potential of a $\mathrm{Zn^{2+}/Zn}$ electrode at $298\ \mathrm{K}$ where $\mathrm{Zn^{2+}} = 0.015\ M$. (Given: $E^0 = -0.763\ V$). **(5)**

3.

(a) Describe the primary modes of mass transport in an electrolytic cell. Explain how each contributes to the movement of ions toward the electrode surface. **(5)**

(b) A current of $2.5\ \mathrm{A}$ is passed through a solution of $\mathrm{CuSO_4}$ for 45 minutes. Calculate the mass of copper deposited at the cathode. (Atomic mass of Cu $= 63.5\ \mathrm{u}$). **(5)**

4.

(a) Discuss the derivation and significance of the Ilkovic equation in quantitative polarography. Explain how it relates the diffusion current (i_d) to the concentration of the analyte. **(5)**

(b) Compare the Dropping Mercury Electrode (DME) and the Rotating Platinum Electrode in terms of their application and surface renewability. **(5)**

5.

(a) Describe the instrumentation and basic principle of Thermogravimetric Analysis (TGA). Discuss how a thermogram is used to interpret the thermal stability of a compound. **(5)**

(b) A 150 mg sample of Calcium Oxalate Monohydrate ($CaC_2O_4.H_2O$) is heated. The first mass loss step corresponding to the loss of water of crystallization, results in a residue of 131.5 mg. Calculate the percentage mass loss and compare it to the theoretical value. **(5)**

6. Answer ***any five*** of the following in brief. **(2x5)**

(a) Define 'specific activity' as used in radiochemical methods.

(b) What is the principle of radiochemical neutralization?

(c) Distinguish between Thermogravimetric Analysis (TGA) and Differential Thermal Analysis (DTA).

(d) Briefly describe the principle of Differential Scanning Calorimetry (DSC).

(e) What is the purpose of using a purge gas (e.g., Nitrogen or Argon) in TGA?

(f) Define 'carrier-free' isotopes and explain their importance in radiochemical tracers.

(g) Explain the working principle of a Scintillation counter for detecting radioactivity.

7.

(a) Discuss the principle of Neutron Activation Analysis (NAA). Why is this technique considered superior for trace element determination in complex matrices? **(5)**

(b) The half-life ($t_{1/2}$) of ^{60}Co is 5.27 years. If a radioactive source has an initial activity (N_0) of 500 Ci, calculate its remaining activity after a period of 10 years using the decay equation $N = N_0 e^{-\lambda t}$. **(5)**

8.

(a) Illustrate the shape of the titration curve for a strong acid-strong base conductometric titration. Comment on the changes in conductivity observed before and after the equivalence point. **(5)**

(b) Explain the principle of Controlled-Potential Coulometry. Discuss how this technique adheres to Faraday's Laws of electrolysis for quantitative determination. **(5)**

9.

(a) Describe the design and working principle of an Ion-Selective Electrode (ISE) specifically used for pH measurement. **(5)**

(b) Define Biosensors and describe the role of the transducer in converting a biochemical signal into a measurable electrical response. **(5)**

10.

(a) Discuss the importance of automation in a modern analytical laboratory, focusing on the improvement of precision and throughput. **(5)**

(b) Explain the method of 'Standard Addition' used in electroanalytical chemistry. How does this method minimize matrix effects compared to a standard calibration curve? **(5)**