

UNIVERSITY EXAMINATIONS

FIRST SEMESTER 2025/2026 ACADEMIC YEAR

**FOURTH YEAR EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE (GENERAL) AND BACHELOR OF
EDUCATION (SCIENCE)**

CHEM 411: ELECTROCHEMISTRY

STREAMS: BEd(Sc) & BSc (Gen)

TIME: 2 HRS

DAY: WEDNESDAY [8.30 -10.30 A.M]

DATE: 28/01/2026

THIS QUESTION PAPER CONSISTS OF THREE (3) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

Answer ALL the Questions**SECTION: A****QUESTION ONE (30 MARKS)**

- i) State Faraday's First and Second Laws of Electrolysis. (4 Marks)
- ii) Define the following terms: (a) Specific Conductance, (b) Molar Conductance, (c) Cell Constant. (3 Marks)
- iii) Explain Kohlrausch's Law of Independent Migration of Ions and list two of its important applications. (4 Marks)
- iv) Illustrate with a labeled graph how the molar conductance of a strong electrolyte (like KCl) and a weak electrolyte (like CH₃COOH) varies with concentration. Explain the reasons for the difference. (5 Marks)
- v) Calculate the mass of silver deposited at the cathode when a current of 1.5 A is passed through a silver nitrate solution for 20 minutes. (Given: Atomic mass of Ag = 108 g/mol, F = 96,500 C mol⁻¹). (4 Marks)
- vi) Highlight the difference between electrode potential and standard electrode potential. (4 Marks)
- vii) List the key components of an electrochemical cell used for e.m.f. measurement. (3 Marks)
- viii) Define transport number (Hittorf's number) and state its relationship with ionic mobility. (3 Marks)

SECTION B:**QUESTION TWO (20 MARKS)**

- i) Define Equivalent Conductance. How are Molar Conductance (Λ_m) and Equivalent Conductance (Λ_{eq}) related for (a) HCl and (b) MgCl₂? (3 Marks)
- ii) State the Onsager equation for a strong electrolyte and explain the terms involved. (4 Marks)
- iii) The resistance of a 0.1 M KCl solution in a conductivity cell is 300 Ω . If the cell constant is 1.2 cm⁻¹, calculate the specific conductance and molar conductance of the solution. (3 Marks)
- iv) Explain how Hittorf's method can be used to determine the transport number of an ion. (4 Marks)
- v) Describe four factors that affect the conductance of an electrolyte solution. (2 Marks)

- vi) The limiting molar conductance of NaCl, HCl, and NaOOC-CH₃ (Sodium Acetate) are 126.5, 426.2, and 91.0 S cm² mol⁻¹ respectively. Calculate the limiting molar conductance of acetic acid. **(4 Marks)**

QUESTION THREE (20 MARKS)

- i) Define Potentiometric Titration. Explain the principle on which it operates, mentioning the role of the indicator and reference electrodes. **(4 Marks)**
- ii) List the different types of visual indicators that are replaced by the potentiometric method and state one key advantage of this technique. **(4 Marks)**
- iii) What is Amperometry? Illustrate the principle of an amperometric titration with a dropping mercury electrode. **(4 Marks)**
- iv) Define Chronopotentiometry. State the relationship between the transition time (τ) and the concentration of the electroactive species (Sand equation). **(3 Marks)**
- v) Explain the term "Decomposition Potential" **(2 Marks)**
- vi) Highlight the difference between Coulometry and Potentiometry in terms of what is measured and controlled. **(3 Marks)**