

**BACHELOR OF ENGINEERING IN CHEMICAL ENGINEERING
EXAMINATION, 2025**

(2nd YEAR, 1st SEMESTER)

Subject: Physical Chemistry

Full Marks – 100 Time: 3 hours

Use Separate Answer scripts for each Part

Part –I

- 1. Answer any ten questions: $3 \times 10 = 30$**
- I. What is conductometric titration? What is the advantage of conductometric titration against indicator titration for acid-base titration?
 - II. Define molar conductance. What is its unit?
 - III. NaCl is soluble in H₂O but insoluble in CCl₄ – why?
 - IV. What is meant by mean ionic activity co-efficient?
 - V. What is concentration polarization?
 - VI. What are the factors that affect electrolytic conduction?
 - VII. State the difference decomposition potential and between over potential.
 - VIII. Define contact angle.
 - IX. What are surfactants? Give one example of nonionic surfactant.
 - X. Instead of employing the term ‘colloidal substances’ it is the practice to refer ‘colloidal system’- Explain why?
 - XI. What happens during endosmosis?
 - XII. What are microemulsions?

Part –II

Answer any seven questions:

$10 \times 7 = 70$

1. Explain the variation of equivalent conductance of strong and weak electrolytes with concentration. **$5 + 5 = 10$**
2. Define the term ‘solubility product’. Derive an expression for the activity solubility product of a sparingly soluble salt, A_pB_q at a particular temperature. **$3 + 7 = 10$**
3. Define electromotive force. From the thermodynamic consideration, deduce the relationship between equilibrium constant and electromotive force of an electrochemical cell. **$3 + 7 = 10$**

[Turn over

4. (a) The statement 'With decrease of concentration, the degree of dissociation of weak electrolyte increases' – Justify or criticize. **6**
 (b) The pH of a 10^{-3} (M) aqueous solution of weak acid was found to be 4.0 at 25 °C. Find the degree of dissociation. **4**

5. What is meant by cell potential? How is cell potential affected by concentration of the reactants? State the differences between primary and secondary cells with examples. **2+3+5=10**

6. (a) What is fuel cell? Discuss the advantage and disadvantages of fuel cell. **2+4=6**
 (b) Equal volumes of 0.08 (N) CaCl_2 and 0.02 (N) Na_2SO_4 are mixed at room temperature. Will there be any precipitation? Solubility product of CaSO_4 is 2.4×10^{-5} at the same temperature. **4**

7. Explain the conductometric titration curve of (i) HCl vs. NaOH and (ii) AgNO_3 vs. KCl . **5+5=10**

8. Differentiate between micelle and reverse micelle. Why water does not spread over the surface of oil? Which type of fluids will have zero surface tension and why? **3+3+4=10**

9. Why do surfactant molecules decrease the surface tension of water? Define critical micellar concentration (CMC). A drop of water, 0.4 cm in radius, is split up into 125 tiny drops. Find the increase in surface energy. [$\gamma_{\text{water}} = 72$ dynes/cm]. **2+3+5=10**

10. What are nanoparticles? How microemulsion can act as a template for the fabrication of size-controlled nanoparticles? **3+7=10**