2023
M.Sc.
First Semester
CORE – 04
CHEMISTRY
Course Code: MCHC 1.41
(Physical Chemistry - II)

Total Mark: 70 *Pass Mark: 28*
Time: 3 hours

Answer five *questions, taking* one *from each unit.*

UNIT–I

1. (a) Write short note on the following: 2×2=4
   (i) Activity coefficient
   (ii) Ion-ion interaction
   (b) Explain the effect of ion on the structure of water. 5
   (c) Determine the mean ionic activity coefficient by solvent vapour pressure method. 5

2. (a) What do you mean by mean ionic activity coefficient? Explain. 4
   (b) What is solvation number? Explain the solvation number taking examples. 5
   (c) How will you determine the mean ionic activity coefficient by cell concentration method? 5

UNIT–II

3. (a) What is ion-solvent interaction? Explain the free energy change due to ion-solvent interaction. 2+3=5
   (b) Derive the expression for the Butler-Volmer equation for the kinetics of the electrode reaction. 5
   (c) Explain the electrochemical mechanism of the nervous system. 4

4. (a) Write a note on the following: 3×2=6
   (i) Overvoltage
   (ii) Polorography

(b) Explain the Helmholtz-Perrin model of electrical double layer. 5
(c) Discuss the diffusion overpotential using Nernst model. 3

UNIT–III

5. (a) What do you understand by diffusion coefficient? Explain. 5
(b) Define mean free path. Derive the relationship between diffusion coefficient and mean free path. 1+4=5
(c) Derive the expression of Nernst-Einstein equation for diffusion coefficient and equivalent conductivity. 4

6. (a) Write a note on mobility of ions. 3
(b) State and explain the Ficks first law of steady state diffusion. 5
(c) Derive the Einstein relation between absolute mobility of ions and diffusion coefficient. 6

UNIT–IV

7. (a) Explain in detail the generalized forces and fluxes of entropy production. 4
(b) Write a note on Onsager reciprocity relation. 4
(c) Deduce the expression for the entropy production due to electrochemical reaction. 6

8. (a) Explain the Clausius inequality for the irreversible process. 4
(b) Discuss the states of minimum entropy production in a non-equilibrium state. 5
(c) What do you understand by entropy flow in an open system? Explain. 5

UNIT–V

9. (a) Write short note on the following: 2×2=4
(i) Grand canonical ensemble
(ii) Microcanonical ensemble
(b) Derive the expression for the molecular rotational partition function of an ideal gas. 4
(c) Derive the statistical expression for equilibrium constant. 6

10. (a) Explain the Fermi-Dirac statistics. 6

(b) Discuss the Debye theory of heat capacities of solid. 5

(c) Derive the expression for the internal energy in terms of partition function. 3

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