

2022
M.Sc.
First Semester
 CORE – 04
CHEMISTRY
Course Code: MCHC 1.41
 (Physical Chemistry – II)

Total Mark: 70
Time: 3 hours

Pass Mark: 28

Answer five questions, taking one from each unit.

UNIT-I

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| 1. (a) Define the following: | 2×3=6 |
| (i) Activity | (ii) Activity coefficient |
| (iii) Ionic strength | |
| (b) Obtain an expression for the Debye-Hückel limiting law. | 7 |
| (c) What is electrochemical potential? | 1 |
| 2. (a) Define solution number. Explain the different types of solution number with examples. | 5 |
| (b) Derive the expression of Debye-Hückel-Onsager equation for an electrolyte. | 5 |
| (c) Write a note on the structure of water. | 4 |

UNIT-II

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| 3. (a) State the demerits of both Helmholtz-Perrin and Gouy-Chapman model. Explain the Stern model of the electrical double layer. | 2+4=6 |
| (b) Derive an expression of chemical potential charge acting in an electrolytic solution using Debye-Hückel theory of an ion-ion interaction. | 6 |
| (c) Define concentration polarization. | 2 |
| 4. (a) Derive Born equation for an ion-solvent interaction in a solution. | 5 |
| (b) Derive Tafel equation from Volmer-Butler equation. | 5 |

- (c) Compare the graphical representation of potential energy versus distance from the electrode for all the three models of electrical double layer. 4

UNIT-III

5. (a) State Fick's second law of steady state diffusion. 2
(b) Explain the momentum flux in terms of coefficient viscosity. 4
(c) Define diffusion coefficient. Establish the Einstein relation between the diffusion coefficient and the ionic mobility. 2+6=8
6. (a) Discuss the viscosity and mean free path of a perfect gas. 4
(b) What do you mean by flux of electric field? Explain with the help of units and dimensional formula. 4
(c) Write an essay on the thermodynamic view of thermal conductivity in terms of "energy of thermal reaction" with supporting diagram. 6

UNIT-IV

7. (a) Write the postulates of non-equilibrium thermodynamics. 4
(b) Establish the expression for the entropy production due to heat flow. 7
(c) Explain fluxes and forces in terms of phenomenological equation. 3
8. (a) What are electrokinetic phenomena? Discuss. 7
(b) Derive an expression for entropy production and entropy flow in open systems. 7

UNIT-V

9. (a) Explain the concepts of distribution in statistical thermodynamics. 2
(b) Derive an expression for Maxwell distribution law. 6
(c) What is ensemble average? Explain. 4
(d) Give the postulates of statistical mechanics. 2
10. (a) Explain the Einstein theory for heat capacity of solids. 3
(b) Discuss Bose-Einstein statistics. 6
(c) Explain the partition function in terms of internal energy. 2
(d) Give an expression for translational partition function. 3