2021
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 <u>five</u> *questions, taking* <u>one</u> *from each unit.*

UNIT–I

1. (a) Write a note on the structure of water.   4
   (b) Determine the mean ionic activity coefficient by cryoscopic method.
                                                                  7
   (c) Calculate the activity coefficient of 0.05 M KCl solution at 25°C.   3
2. (a) What is electrochemical potential? Explain.   2
   (b) What is solvation energy? Explain the different types of solvation
       number giving suitable examples.   5
   (c) Derive the Debye-Huckel-Onsager equation for an electrolyte.   5
   (d) Define the following terms: 2
       (i) Activity
       (ii) Activity coefficient

UNIT–II

3. (a) Explain the Stern model of the electrical double layer.   5
   (b) Give the expression of mean ionic activity coefficients in terms of
       ionic strength.   5
   (c) Define concentration polarization.   2
   (d) Write a note on non-polarization interface.   2
4. (a) Derive an expression of chemical potential charge acting in an
       electrolyte solution using Debye-Huckel theory of ion-ion interaction.
                                                                  5
   (b) Discuss the linearized Poisson-Boltzmann equation.   3½
   (c) Derive the Butler-Volmer equation of basic electrodes.   5½

UNIT–III

5. (a) State and explain the Fick's first law of steady state diffusion.   3
   (b) Give the mathematical expression of Nernst-Einstein equation.   3
   (c) Write a short note on thermodynamic view of diffusion.   2
   (d) Write the diffusion equation and state the importance of the equation.   4
   (e) How is thermal conductivity related to mean free path? Explain.   2
6. (a) Derive and explain the Stokes-Einstein equation.   6
   (b) Show how fluxes are related to concentration gradient.   5
   (c) Explain the Fick's second law of diffusion.   3

UNIT–IV

7. (a) Discuss the phenomenological equations.   5
   (b) Derive an expression for entropy production and entropy flow in open systems.   7
   (c) Write a short note on Clausius inequality.   2
8. (a) What are electrokinetic phenomena? Discuss.   5
   (b) Establish the expression for the entropy production due to heat flow.   7
   (c) Write a note on stationary non-equilibrium states.   2

UNIT–V

9. (a) Explain the most probable distribution in statistical thermodynamics. 4
   (b) Give an expression for rotational partition function.   4
   (c) Discuss Debye theory of heat capacity of solids.   4
   (d) Explain the partition function in terms of entropy.   2
10. (a) Discuss Fermi-Dirac statistics.   6
    (b) Derive the statistical expression for equilibrium constant.   6
    (c) Explain the electronic partition function.   2

—————————————