April 2025
B.A./B.Sc.
Fourth Semester
CORE – 10
CHEMISTRY
Course Code: CHC 4.31
(Physical Chemistry - IV)

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

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

UNIT–I

1. (a) Define transport number of an ion. Describe Hittorf's method for the determination of transport number. 1+6=7
   (b) The resistance of 0.01 M solution of an electrolyte was found to be 210 ohm at 25°C. Calculate the molar conductance of the solution at 25°C. Cell constant = 0.88 cm^{-1}. 3
   (c) Write the Debye-Huckel-Onsager equation. Explain the verification of the equation. 4

2. (a) Give the postulates of Arrhenius theory of ionization. Discuss the limitations of Arrhenius' theory. 4+3=7
   (b) How does the equivalent conductivity of electrolytes vary upon dilution? 3
   (c) The molar conductance of sodium acetate, hydrochloric acid and sodium chloride at infinite dilution are 91.0×10^{-4}, 426.16×10^{-4} and 126.45×10^{-4} S m^2 mol^{-1}, respectively at 25°C. Calculate the molar conductance at infinite dilution for acetic acid. 4

UNIT–II

3. (a) Derive Nernst equation for the calculation for the potential of hydrogen-electrode. 4
   (b) A current of 2.68 ampere is passed for one hour through an aqueous solution of $CuSO_4$ using copper electrodes. Calculate

the change in mass of cathode and that of anode. (Atomic mass of Cu = 63.5 g) 3

(c) Write a note each on the following: 3½×2=7
(i) Polarography
(ii) Decomposition potential

4. (a) What is meant by EMF of a cell? How is it measured? 1+5=6
(b) What is the potential of a half-cell consisting of Zn electrode in 0.01 M $ZnSO_4$ solution at 25°C? ($E° = 0.763$ V) 3
(c) Discuss with examples reversible and irreversible cells. 5

UNIT–III

5. (a) Discuss the quantization of energy using Bohr's model. 5
(b) Explain the Heisenberg uncertainty principle. 4
(c) Write a note on quantum mechanical operators. 5

6. (a) Derive the radial part of Schrodinger equation. 6
(b) Write a note on probability distribution functions. 7
(c) What are eigenvalues and eigenfunctions? 1

UNIT–IV

7. (a) Pure rotational spectra are also known as microwave spectra. Why? Explain one application of microwave spectroscopy. 2+3=5
(b) Derive the expression of the energies of rotational levels for diatomic molecules taking it as a rigid rotator. 6
(c) Write a note on Morse potential. 3

8. (a) Write a note each on the following: 1½×3=4½
(i) Anharmonicity
(ii) Dissociation energies
(iii) Fundamental frequencies
(b) Explain the concept of group frequencies. 3½
(c) State and explain the selection rules for rotational and vibrational spectra. 4
(d) Explain the different types of spectra in molecular spectroscopy. 2

UNIT–V

9. (a) Write a note each on the following: 2×3=6
   (i) Diamagnetism
   (ii) Paramagnetism
   (iii) Ferromagnetism
   (b) Discuss how to determine the dielectric constant of different materials. 6
   (c) The bond angle in H_2O is 104.5° and the dipole moment is 1.85 D. Calculate the bond moment for the O–H bond. (cos 52.25° = 0.6129) 2

10. (a) Define dipole moment. Explain the measurement of dipole moment by refractive method. 1+3=4
   (b) What is magnetic susceptibility? Describe the method of measurement of magnetic susceptibility. 1+5=6
   (c) Explain using dipole moments in 4
   (i) predicting the shapes of molecules
   (ii) distinguishing between cis and trans isomers