This question paper contains **3** printed pages]

NEPWT—184—2024

FACULTY OF SCIENCE

M.Sc. (First Year) (First Semester) EXAMINATION

NOVEMBER/DECEMBER, 2024

CHEMISTRY

SCHEC–403

(Physical Chemistry)

(Tuesday, 17-12-2024)   **Time : 10.00 a.m. to 1.00 p.m.**

Time—3 Hours   *Maximum Marks*—80

N.B. :— (*i*)   Question No. **1** is compulsory.

(*ii*)   Solve any *three* questions from Q. No. **2** to Q. No. **6**.

(*iii*)   Use of log table and simple calculator is allowed.

Given :

(*i*) $h = 6.626 \times 10^{-34}$ Js

(*ii*)   Mass of electron, $m_e = 9.109 \times 10^{-31}$ kg

(*iii*)   Velocity of light $= c = 3 \times 10^8$ ms^{-1}

(*iv*)   Gas constant, $R = 8.314$ JK^{-1}mol^{-1}.

P.T.O.

1. Solve the following : 20

(a) What is Russel-Sander's coupling ? Determine the ground state term symbol for p^4 and d^5 configurations.

(b) Calculate the ionic strength of 0.20 molal Na_2SO_4 solution and 0.125 molal $AlCl_3$ solution.

(c) Explain Debye-Huckel theory of strong electrolytes.

(d) Explain N and P-type semiconductors. What is the effect of temperature on them ?

2. Attempt the following : 20

(a) Derive an equation for energy of particle in 1-D box. Calculate the energies in eV of an electron moving in an infinite 1-D box of width 1 A° and show them in a suitable energy level diagram.

(b) Derive Lipmann equation for surface excess phenomenon.

3. Attempt the following : 20

(a) (i) State Onsagar equation applicable to strong electrolytes. Explain its verification and the need of Onsager equation to explain behaviour of strong electrolytes.

(ii) Calculate mean activity coefficient, $r_\pm$ of

(a) 0.01 molal NaCl

(b) 0.001 molal Na_2SO_4 solution at 25ºC.

(b) State the phase rule for three component system. Explain ternary system with phase diagram containing one pair of partially miscible liquids.

4. Attempt the following : 20

(a) (i) Define Ladder operator and prove that :

$$\left[\hat{J^2}, \hat{J_+} \right] = 0$$

(ii) State postulates of quantum mechanics.

(b) What is fugacity ? Explain graphical method of determination of fugacity.

5. Solve the following : 20

(a) Explain Zeta-potential. Describe :

(i) Gouy-Chapmann theory of electrical double layer.

(ii) Describe Debye-Huckel limiting law with its significance.

(b) What are solid state defects ? Explain in detail.

6. Write short notes on the following : 20

(1) Partial molar properties and its significance

(2) Zeeman effect

(3) Debye-Falkenhagen effect

(4) Two solid and a liquid component eutectic systems.