B.Sc. in EEE, 1st Semester

December 5, 2023
9.00 am 12.00 pm (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination
Course No.: CHEM 4121
Course Title: Engineering Chemistry

Winter Semester, A. Y. 2022-2023
Time: 3 hours
Full Marks: 150

There are 6 **(six)** questions. Answer all 6 **(six)** questions. The symbols have their usual meanings. Programmable calculators are not allowed. Marks of each question and corresponding COs and POs are written in the brackets.

---

1. a) Discuss the factors affecting on the magnitude of ionization potential. **7 (CO1, PO2)**

   b) Explain Heisenberg's uncertainty principle. "It is only applicable for microscopic particles". Justify the statement with proper reasoning. Calculate the uncertainty in position of an electron if the uncertainty in velocity is 5.7×10^5 m sec^{-1}. **8 (CO2, PO3)**

   c) State the postulates of Bohr's theory of the hydrogen atom. Derive an expression for the energy of n^{th} orbit of a hydrogen atom. **10 (CO2, PO3)**

2. a) Explain different types of chemical reaction with examples. **7 (CO1, PO2)**

   b) The molecules of CH_4 (methane), NH_3 (Ammonia) and H_2O (water) all involve sp3 hybridization of the central atom but the bond angles in these molecules are 109° 28′, 107° 18′ and 104° 30′ respectively. Explain with proper reasoning. **8 (CO2, PO2)**

   c) State the postulates of VSEPR theory. Explain the shape of PCl_5, XeF_4, SF_6 and BF_3 molecules with the help of VSEPR theory. **10 (CO2, PO3)**

3. a) Discuss the different types of liquid crystals. **7 (CO1, PO1)**

   b) State and explain Lowry-Bronsted theory and Lewis theory of acids and bases. In what way Lewis acid differs from Bronsted acid? Find the pH of a buffer solution containing 0.20 mole per litre CH_3COONa and 0.15 mole per litre CH_3COOH. K_a for acetic acid is 1.8×10^{-5}. **8 (CO2, PO2)**

   c) State the Le Châtelier's principle. Discuss the effect of temperature, pressure, concentration on chemical equilibrium. At 500°C, the reaction between N_2 and H_2 to form ammonia has $K_c = 6.0 \times 10^{-2}$. Find the numerical value of K_p for the reaction. **10 (CO2, PO3)**

4. a) Discuss working principle of alkaline dry cell. **7 (CO1, PO1)**

b) State the Kohlrausch law of independent migration of ions and write down three applications of it. **8 (CO2, PO1)**

c) Deduce Nernst equation. **10 (CO3 PO2)**
A voltaic cell is represented by $Zn(s)|Zn^{2+}$ (0.200 M)$||Ag^{+}$ (0.00200 M)$|Ag(s)$. Standard electrode potential are given as $E^0_{Ag+(aq)|Ag(s)} = 0.80$ V and $E^0_{Zn^{2+}(aq)|Zn(s)} = -0.76$ V. Calculate the E_{cell} for the above voltaic cell.

5. a) Discuss the effect of temperature on the rate of reaction. **7 (CO1, PO1)**

b) Describe collision theory. Derive rate constant equation from collision theory. **8 (CO2, PO1)**

c) Prove that half-life of 2nd order reaction is inversely proportional to the initial concentration of reactant. **10 (CO3 PO2)**
In an alkaline hydrolysis of an ester 25 cm^3 of the reaction mixtures were titrated at different time intervals against a standard solution of acid. The results are listed in the following table:

Time	0	5	15	25	35
Vol. of acid remain unused in the titration	16	10.5	6.25	4.5	3.62

Demonstrate the order of the reaction is 2.

6. a) State First Law of thermodynamic. Prove that at constant pressure $\Delta H = q_p$ **7 (CO1, PO1)**

b) Classify solution. Explain each type of solution with vapour pressure-composition. **8 (CO2, PO1)**

c) Derive a relationship between molecular mass of solute and osmotic pressure. **10 (CO3 PO2)**
300 cm^3 of an aqueous solution contains 1 g of a polymer: The osmotic pressure of such solution at 300 K is found to be 10^{-3} bar. Find the molar mass of polymer.