B.Sc. in EEE, 1st Semester October 03, 2023 **(Morning)**

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

Mid-Semester Examination
Course No.: Chem 4121
Course Title: Engineering Chemistry

Winter Semester, A. Y. 2022-2023
Time: 90 Minutes
Full Marks: 75

There are 3 **(three)** questions. Answer all 3 **(three)** 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.

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1. a) Discuss Rutherford α-particle experiment and its findings. Calculate the wavelength of 3rd line of Lymen series for hydrogen atom. **7 (CO1, PO1)**

   b) State the Mendeleef and modern periodic law. Find out the positions of the following elements in periodic table depending on their electronic configuration and mention what types of elements are they. **8 (CO2, PO1)**

   Cu, K, Kr, Sc, Cl, Th.

   c) Explain Pauli exclusion principle and why four quantum numbers are necessary to describe an electron in an atom. Analyze whether each of the following sets of quantum numbers is permissible for an electron in an atom. Justify your answer with proper reasons. **10 (CO3 PO2)**

   (i) $n = 1, l = 0, m_l = 0, m_s = +\frac{1}{2}$

   (ii) $n = 3, l = 1, m_l = 2, m_s = -\frac{1}{2}$

   (iii) $n = 2, l = -1, m_l = 0, m_s = +\frac{1}{2}$

   (iv) $n = 2, l = 1, m_l = 0, m_s = 1$

2. a) Define K_p and K_c. Derive an equation which relates K_p and K_c. **7 (CO1, PO1)**

   b) Explain molar conductance. Discuss how the molar conductance changes with the change of concentration of the solution. **8 (CO2, PO1)**

   c) Deduce the Henderson-Hasselbalch equation and discuss how buffer solutions can operate. Calculate the pH of 0.2 M CH_3COOH solution. The dissociation constant of acetic acid is $1.8 \times 10-5$. **10 (CO3 PO2)**

3. a) State reversible and irreversible process. Deduce an equation for isothermal reversible expansion of ideal gas. **7 (CO1, PO1)**

   b) Sketch the vapor pressure-temperature diagram for depression of freezing point. Illustrate that the depression of freezing point is proportional to the molal concentration of solution. **8 (CO2, PO1)**

   c) Discuss an experimental method for the determination of osmotic pressure of solution. **10 (CO3 PO2)**

   A water solution containing an unknown quantity of a nonelectrolyte solute is found to have a freezing point of -0.23°C. Calculate the molal concentration of the solution. Freezing point depression constant of water is 1.86 °C.kg/mole.