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B.Sc. Engg. CSE 2nd Semester — 17 February 2023 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **SUMMER SEMESTER, 2021-2022**

DURATION: 1 HOUR 30 MINUTES — **FULL MARKS: 75**

Chem 4241: Chemistry

Programmable calculators are not allowed. Do not write anything on the question paper.

Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions whereas corresponding CO and PO are written within parentheses.

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1. a) Derive the integrated rate equation for a first-order reaction $A \rightarrow P$, and prove that the half-life for a first-order reaction is independent of initial concentration. — 10 (CO2) (PO2)

   b) A first-order reaction is 40% complete at the end of 50 minutes. Determine the value of the rate constant (k). Calculate the remaining amount of time (in minutes) required to complete 80% of the reaction. — 8 (CO3) (PO1)

   c) Discuss Differential and Isolation methods for the determination of order of a reaction. — 7 (CO1) (PO1)

2. a) State and explain Le Chatelier's principle with suitable examples. — 6 (CO1) (PO1)

   b) Derive the expression of K_p and K_c for the reaction $N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$ in terms of "a", "b", and "x" where "a" and "b" are the initial number of moles of the reactants and "x" is the number of moles going into reaction at equilibrium. Let "P" and "V" be the total pressure and volume of the system, respectively. Mention the significance of the obtained expressions. — 11 (CO2) (PO1)

   c) For the reaction $PCl_5(g) \leftrightarrow PCl_3(g) + Cl_2(g)$ is dissociated at equilibrium temperature $373K$. If the total pressure of the system at equilibrium is $1.5atm.$, calculate the value of K_p and K_c. — 10 (CO3) (PO1)

3. a) Define chemical potential and Gibb's free energy. — 6 (CO1) (PO1)

   b) Derive a mathematical equation relating the free energy change (ΔG) and equilibrium constant (K). Mention the significance of the obtained equation. — 12 (CO1) (PO1)

   c) Calculate K_p for the reaction $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$ at $25°C$, when the value of standard free energy ($\Delta G°$) is 173 KJ. Comment on the result. — 7 (CO3) (PO1)