# University of Information Technology & Sciences (UITS)

## School of Science and Engineering

## Department of Computer Science and Engineering

## Program: B.Sc. in CSE

**Term Final Examination, Autumn-2022**

**Course Title: Engineering Chemistry**

**Course Code: CHE 175**

**Marks: 50** **Time: *3(three)* hours**

*[Answer any **five (05)** out of following **seven (07)** questions. Assume necessary data/values if missing]*

1. a) Derive the integrated rate equation for a first order reaction $2A \rightarrow P$ and prove that the half-life for a second order reaction is not independent of initial concentration. **[04]**

   b) A first order reaction is 40% complete at the end of 50mins. What will be value of the rate constant (k)? In how many minutes will the reaction be 80% complete? **[03]**

   c) Discuss two methods for the determination of order of a reaction. **[03]**

2. a) Derive a relationship between elevation of boiling point of the solvent and the molecular mass of the dissolved non-volatile solute in the solvent. **[04]**

   b) Explain why the boiling point of a liquid rises when a nonvolatile solute is dissolved in it and the dissolution of gases in liquid is exothermic. **[02]**

   c) The vapour pressure of ether at 25°C is 445mm of Hg. When 6.5gm solute is dissolved in 50gm ether, the vapour pressure of the solution is 410mm of Hg. What is the MW of the solute when the MW of ether is 74gm/mol? **[04]**

3. a) Define and classify solution. Name the units of concentration and describe Molarity and Normality with example. **[03]**

   b) What is critical solution temperature (CST)? Draw and explain the CST diagram for the Phenol-water system. What is the application of this diagram? **[04]**

   c) 20gm NaCl is dissolved in 100ml water. Find out the molarity(M) and molality(m) of the solution. The density of the solution = 1.06gm/cc (MW of NaCl=58.5) **[03]**

4. a) Define Heat of Solution and Heat of Combustion with suitable examples. Discuss through Diagram how Heat of Combustion is determined is the laboratory. **[04]**

   b) Derive mathematical relationship between Heat of Reaction ($\Delta H_r$) and Temperature at constant volume and pressure. **[03]**

   c) The heat of reaction of $N_2(g) + 3H_2(g) \leftrightarrow 2NH_3(g)$ at 298K was found to be -21.976 kcal. What will be the heat of reaction at 50°C? The heat capacities $C_p$ at 25°C for $N_2$, $H_2$ and $NH_3$ are 6.80, 6.77 and 8.86 $cal.mol^{-1}.deg^{-1}$ respectively. **[03]**

5. a) State the postulates of Bohr's atom model. Derive an equation for calculating the radius of orbits in a hydrogen atom. [04]

b) Define Isotopes and Isobars. Choose isotopes and isobars from the following list: $^{12}_{6}C$ ; $^{12}_{5}B$ ; $^{14}_{7}N$; $^{16}_{8}O$ ; $^{14}_{8}O$ ; $^{13}_{6}C$ ; $^{13}_{7}N$ [03]

c) Explain the dual nature of electron and derive De Broglie's equation. [03]

6. a) Define orbital and orbit. Give a comparison between the two. [03]

b) What are Quantum Numbers? Name them and briefly discuss their significance and Inter relationship. [04]

c) What are Pauli Exclusion and AUFBAU principles? Discuss briefly What are Pauli Exclusion and AUFBAU principles? Discuss briefly. [03]

7. a) Why does ethyl alcohol an isomer of dimethyl ether ($C_2H_6O$) boil at higher Temperature? [03]

b) Describe the mode of formation of Ionic and Covalent bonds. Compare the properties of Ionic and Covalent compounds. [04]

c) The value of the half-life for a first order reaction is 1000 seconds. At what time $1/10^{th}$ of the reactant will remain unreacted? [03]