

Name: Enrolment No:			
UPES End Semester Examination, December 2025 Course: Chemical Thermodynamics Semester: V Program: BSc (Geology & Mathematics) Time : 03 hrs. Course Code: CHCE 3061 Max. Marks: 100 Instructions: 1. Attempt all questions. 2. Internal choices are given for Q9 & Q11.			
SECTION A (5Qx4M=20Marks)			
S. No.		Marks	CO
Q 1	Study the effect of (a) temperature (b) increasing the amount of reactant and product on the following chemical reaction $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \leftrightarrow 2 \text{NH}_3(\text{g})$	4	CO2
Q 2	State the second law of thermodynamics and discuss its applications in chemical processes.	4	CO1
Q 3	Explore the relationship between Kp, Kc and Kx.	4	CO2
Q 4	Define Le Chatelier's principle and give its significance.	4	CO3
Q 5	Mention the characteristics of salt bridge used in electrochemical cells.	4	CO1
SECTION B (4Qx10M= 40 Marks)			
Q 6	Discuss the significance of free energy in thermodynamics and explain how does it relate to the spontaneity of a reaction.	10	CO2
Q 7	The standard free energy change for the given reaction $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2 \text{NO}(\text{g})$ is +173.28 kJ. Calculate Kp and Kc for the reaction at 25°C.	10	CO3
Q 8	Sketch and describe the potentiometric titration curves of the following and indicate the end point. (a) HCl Vs. NaOH (b) CH ₃ COOH Vs NH ₄ OH	10	CO3
Q 9	Explain the significance and working of moving boundary method for the determination of transport number of a weak electrolyte with a neat sketch. OR In the electrolysis of copper sulfate between copper electrodes the total mass of copper deposited at the cathode was 0.153 g and the mass of copper per unit volume of the anode liquid before and after electrolysis were 0.79 and 0.91 g respectively. Calculate transport number of copper	10	CO1

	and sulfate ions.		
SECTION-C (2Qx20M=40 Marks)			
Q 10	A. A cell is formed by dipping Zn rod in 0.05 M Zn^{2+} solution and Ni rod in 0.5 M Ni^{2+} solution. The standard reduction potentials of Zn and Ni are -0.76 V and -0.25 V respectively. Write the cell representation and cell reaction. Also calculate the EMF of the cell. B. The resistance of 0.15N solution of an electrolyte was found to be 242 ohms at 25°C. Calculate equivalent conductance of the electrolyte if the distance between the electrodes is 1.5 cm and an area of 3.6 cm².	10+10	CO3
Q 11	A. Derive an expression for the work done by an ideal gas in isothermal reversible expansion. B. One mole of an ideal gas at 25°C is allowed to expand reversibly at constant temperature from 10 litres to 20 litres. Calculate the work done by the gas in Joules and Calories. OR A. Calculate the enthalpy of formation of OH^- ions at 25° C from the following thermochemical data. $\text{H}_2\text{O (l)} \rightarrow \text{H}^+ \text{ (aq)} + \text{OH}^- \text{ (aq)}; \Delta H^\circ = 57.3 \text{ kJ}$ $\text{H}_2 + \frac{1}{2} \text{O}_2 \text{ (g)} \rightarrow \text{H}_2\text{O (l)}; \Delta H^\circ = - 285.9 \text{ kJ}$ B. Define enthalpy of a system and derive an expression showing the relation between enthalpy and free energy function of a thermodynamic process.	10 + 10	CO1