Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Chemical Thermodynamics & Solution **Semester: II**

Program: BSc (H) Chemistry by Research **Time: 03 hrs.**

Course Code: CHEM1031 **Max. Marks: 100**

Instructions: Answer all the questions. Internal choices are provided in Question No. 9 and Question N. 11. Students can use scientific calculators.

SECTION A

S. No.		Marks	CO
Q 1	Calculate the free-energy change which occurs when one mole of an ideal gas expands reversibly and isothermally at 300 K from the initial volume of 5 litres to 50 litres.	**04**	**CO1**
Q 2	Describe Le-chatlier's principle with example.	**04**	**CO1**
Q 3	Derive the relation between ΔU and ΔH for an ideal gas.	**04**	**CO1**
Q 4	The vapour pressure of a 5% aqueous solution of non-volatile organic substance at 373 K is 745mm. Calculate the molecular mass of solute.	**04**	**CO1**
Q 5	Calculate the standard free energy change of the reaction $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + H_2O(l)$ And say whether this reaction is feasible at 25°C and 1 atm pressure. The standard free energies of formation of NH_3 (g), NO(g), H_2O(l) are -16.65, 86.61 and -237.20 KJ/mol, respectively.	**04**	**CO3**

SECTION B

Q 6	Derive the expression of Gibbs Duhem equation and also write its significance.	**10**	**CO2**
Q 7	Calculate the free-energy change accompanying the compression of 1 mole of CO_2 at 57°C from 5 atm to 50 atm. Assume that CO_2 behaves like an ideal gas.	**10**	**CO2**
Q 8	A solution of 12.5 g of urea in 170 g of water gave boiling-point elevation of 0.63K. Calculate the molar mass of urea. K_b= 0.52 K Kg/mol.	**10**	**CO1**
Q 9	One mole of ideal gas is heated at constant pressure from 0°C to 100°C. (a) Calculate the work involved. (b) If the gas were expanded isothermally and reversibly at 0°C from 1 atmosphere to some other pressure P, what must be the final pressure if the isothermal work is equal to the work in (a)? **Or**	**10**	**CO3**

	Derive the equation for change in free energy for a process under isothermal condition.		
SECTION-C			
Q 10	(a) Calculate the standard free energy change of the reaction $CO + \frac{1}{2}O_2(g) \rightarrow CO_2(g) \qquad \Delta H^\circ = 270KJ$ Standard entropies of CO_2, CO and O_2 are 205, 190 and 200 J/degree mole respectively. Predict whether the reaction is feasible or not. (b) Describe Henry's law along with its limitations and also discuss applications of Henry's law.	**10 + 10**	**CO2**
Q 11	(a) Derive the thermodynamic derivation of relation between Gibbs free energy of reaction and reaction quotient. (b) Calculate the freezing point of a solution containing 0.520g glucose ($C_6H_{12}O_6$) in 80.2 grams of water. For water, K_f =1.86 K Kg/mol. ***Or*** One mole of an ideal mono-atomic gas at 27°C expands reversibly and adiabatically from a volume of 10 dm^3 to volume 20 dm^3. Calculate (i) q (ii) ΔU (iii) w and (iv) ΔH. Assume that C_v = 3/2 R.	**10 + 10**	**CO3**