BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION MO/25)

CLASS: BTECH **SEMESTER: III**
BRANCH: CHEMICAL ENGG./FT **SESSION: MO/25**

SUBJECT: CL24201 THERMODYNAMICS

TIME: 03 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will not be supplied to the candidates**

Q.1(a)	N_2 gas is expanded reversibly and adiabatically from a volume of one liter at 0°C and 1 atm. to a volume of 2 litre. C_v and C_p values are 20.8 and 29.1 J $mole^{-1}K^{-1}$. Assuming ideal behaviour calculate the final temperature and pressure. What are q,w, $_{\Delta U,}$ and $_{\Delta H?}$	[5]	CO-1	BL2
Q.1(b)	Derive the Clausius Inequality equation. Show that the entropy of the universe always increases.	[5]	CO-1	BL3
Q.2(a)	Deduce the Clausius-Clapeyron equation using the criterion of equilibrium.	[5]	CO-2	BL2
Q.2(b)	μ for a Van-der-Waals gas is given by μ=[{(2a/RT)-b}]/Cp Calculate the value of ΔH in calories for the isothermal(300°K) compression of 1mole of nitrogen from 1 to 500 atm. (a=1.34 litre^{2}atm.mole^{-2}; b=0.039 litre/mole)	[5]	CO-2	BL2
Q.3(a)	A vapour contains 60.0% n-pentane, 25.0% n-hexane and 15.0% n-heptane. The Antoine constants for the constituents are given below: Assuming that Raoult's law is applicable, determine the following: Dew-point temperature at 400kPa.	[5]	CO-3	BL2
Q.3(b)	Explain the P-V-T Behaviour of Real Fluids in detail with a neat sketch.	[5]	CO-3	BL2
Q.4(a)	Define activity. Deduce the relationships of activity as a function of temperature and pressure	[5]	CO-4	BL1
Q.4(b)	The two-suffix-Margules equation is the simplest expression for excess Gibbs free energy that is obeyed by chemically similar materials. $G_E = Ax_1x_2$ where *A* is an empirical constant independent of composition. Derive the expressions for the activity coefficients that result from this expression.	[5]	CO-4	BL4
Q.5(a)	Derive the expression related to the equilibrium constant (K) and standard free energy changes.	[5]	CO-5	BL3
Q.5(b)	One mole steam undergoes the water-gas shift reaction at a temperature of 1100 K and a pressure of 1 bar. CO (g) + H_2O (g) = CO_2 (g) + H_2 (g) The equilibrium constant for the reaction is *K* = 1. Assuming ideal gas behaviour, calculate the fractional dissociation of steam in the following cases and discuss the effect of the presence of excess reactant on the extent of reaction. (a) CO supplied is 100% in excess of the stoichiometric requirement. (b) CO supplied is only 50% of the theoretical requirement.	[5]	CO-5	BL4

Name	A	B	C
n-pentane	13.8183	2477.07	39.94
n-hexane	13.8216	2697.55	48.78
n-heptane	13.8587	2911.32	56.51

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