U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

October 2024 Supplementary Examinations

Programme: B.E. **Semester: IV**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 23CH4PCTD2 **Max Marks: 100**
Course: Process Engineering Thermodynamics-II

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

				CO	PO	Marks
			UNIT - I			
1	a)	Show that, $dU = [CP - PV\alpha]\,dT + V[P\beta - T\alpha]\,dP$ Where, α = Co efficient of expansion; and β= Coefficient of compression.		CO1	PO1	12
	b)	Mercury has a density of 13690 kg/m^3 in the liquid state and 14193 kg/m^3 in the solid state, both measured at the melting point of 234.33 K at 1 bar. Estimate the melting point of mercury at a pressure of 10 bar. The heat of fusion of mercury around 9.7876 kJ/kg.		CO2	PO2	08
		OR				
2	a)	At 573 K and pressures of 0–6.0 MPa, the Joule-Thomson coefficient of N_2 (g) can be represented as $\mu = 0.14 - 2.533 \times 10^{-2} P$ Where, μ is in $\left(\frac{K}{MPa}\right)$. Assuming this equation to be temperature-independent near 573 K, find the temperature drop which may be expected in the Joule-Thomson expansion of the gas from 6.0 MPa to 2.0 MPa pressure.		CO 3	PO2	10
	b)	Derive Gibbs Helmholtz equation with suitable assumptions.		CO3	PO2	10
		UNIT - II				
3	a)	Determine fugacity coefficient from compressibility factor.		CO3	PO2	08
	b)	Deduce Gibbs -Duhem equation from the fundamental partial molar properties. Mention various forms of Gibbs -Duhem equation.		CO3	PO2	12
		OR				
4	a)	Explain the tangent intercept method for the estimation of partial molar property.		CO3	PO2	10

		b)	Calculate the partial molar volume of water in a 50 mole % ethanol-water solution in which the partial molar volume of ethanol is 52.37×10^{-6} m^3/mol. Data: The density of solution is 800.21 kg/m^3.	***CO3***	***PO2***	**10**
			UNIT - III			
	5	a)	Derive the criteria for phase equilibrium for the following conditions i. Constant U and V ii. Constant T and V iii. Constant P and T	***CO4***	***PO3***	**12**
		b)	A binary liquid mixture consists of 60 mol percent ethylene and 40ml percent propylene. At 423 K, the vapour pressure of ethylene and propylene are 15.2 atm and 9.8 atm respectively. Calculate the total pressure and equilibrium composition of the vapour phase. Assume that the mixture behaves like an ideal gas.	***CO4***	***PO3***	**08**
			UNIT - IV			
	6	a)	Sketch and explain minimum boiling and maximum boiling azeotrope.	***CO5***	***PO3***	**12**
		b)	An equimolar solution of benzene and toluene is totally evaporated at constant temperature of 363 K. At this temperature, the vapor pressure of benzene and toluene are 135.4 and 54 kPa, respectively. Calculate the pressures at the beginning and at the end of the vaporization.	***CO5***	***PO3***	**08**
			UNIT - V			
	7	a)	Discuss reaction coordinate and establish the equation for mole fraction of component *'i'*, in the reaction mixture is given by $$y_i = \frac{n_i}{n} = \frac{n_{i_0} + \gamma_1 \varepsilon}{n_0 + \gamma\varepsilon}$$	***CO6***	***PO3***	**12**
		b)	The following reaction takes place in a system consisting of 3 mol CH_4, 1 mol H_2O, 1 mol CO and 4 mol H_2 initially: $$CH_4 + H_2O \rightarrow CO + 3H_2$$ Express the composition of the mixture in terms of mole fraction as a function of extent of reaction.	***CO6***	***PO3***	**08**

****