

Total No. of Questions : 4]

SEAT No. :

P8928

[Total No. of Pages : 2

Oct-22/TE/Insem-510

T.E. (Chemical)

CHEMICAL ENGINEERING THERMODYNAMICS

(2019 Pattern) (Semester - I) (309344)

Time : 1 Hour]

[Max. Marks : 30

Instructions to the candidates:

- 1) Answer Q.1 or Q.2, Q.3 or Q.4.
- 2) Figures to the right side indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of calculator is allowed.
- 5) Assume Suitable data if necessary.

Q1) a) For N_2 gas compressibility factor is the function of pressure and is given by $Z=1-0.36 \times 10^{-2}P$. Calculate fugacity of N_2 gas at 10 atm and 50 atm. **[6]**

b) Calculate the fugacity of CO at 50 bar and 400 bar, if the following data are application at 273 K. **[9]**

P, bar	25	50	100	200	400	800	1000
Z	0.9890	0.9792	0.9741	1.0196	1.2482	1.8057	2.0819

OR

Q2) a) Explain the Gibbs-Duhem equation and its various forms. **[6]**

b) The molar enthalpy of a binary solution at constant T and P is given by the relation. **[9]**

$$h = 500x_1 + 1000x_2 + (50x_1 + 40x_2) x_1 x_2 \text{ where } h \text{ is in J/mol.}$$

Determine h_1 and h_2 as function of x_1 and the numerical values of the pure component enthalpies h_1 and h_2 . Also determine the partial molar enthalpies at infinite dilution.

P.T.O.

Q3) a) For each of the following non-reactive equilibrium system determine the degree of freedom. [6]

- i) Two miscible materials in vapor- liquid equilibrium with vapor composition specified temperature.
 - ii) A mixture of methane & air in contact with a solid adsorbent at atmospheric pressure.
 - iii) Liquid water in equilibrium with water vapor & nitrogen.
 - iv) A vapour phase containing ammonia and air and a liquid phase containing ammonia and water.
- b) A 30% by mole methanol-water solution is to be prepared. How many cubic meters of pure methanol (molar volume, $40.727 \times 10^{-6} \text{ m}^3/\text{mol}$) and pure water (molar volume, $18.068 \times 10^{-6} \text{ m}^3/\text{mol}$) are to be mixed to prepare 2 m^3 of desired solution? The partial molar volumes of methanol and water in a 30% solution are $38.632 \times 10^{-6} \text{ m}^3/\text{mol}$ and $17.765 \times 10^{-6} \text{ m}^3/\text{mol}$, respectively. [9]

OR

Q4) a) Explain phase rule for non-reacting systems with suitable examples. [6]

- b) The excess Gibbs free energy is given by $G^E/RT = -3X_1X_2(0.40X_1 + 0.5)$. Find expressions for $\ln \gamma_1$ and $\ln \gamma_2$ [9]

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