Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E Sem-II Examination July 2010

Subject code: 721604

Subject Name: Property Prediction for Mixtures

Date: 07 /07 /2010 **Time: 11.00am – 1.30pm**

Total Marks: 60

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 "Mathematical Model – based on "Hypothetical Ideal Gas State" could be utilized conveniently to calculate S(Entropy) at any temperature(T) and any pressure-(P). Explain the concept with relevant data, graphs etc. Hence or otherwise derive an expression for $\Delta S'_{T,P}$ using Vander Waal's equation of state. **12**

Q.2 Give critical account of the following: **12**

(a) Carlson and Coulburn Method of evaluation activity coefficient at infinite dilution.

(b) Calculate the degree of vaporization of a ternary system containing molar 10% propane, 65%, n-butane and 25% n-pentane at t=5°c and P=600 mmHg. The value of equilibrium constants for phase equilibria are K_1=6.34, K_2=1.37 and K_3=0.32 respectively. Show that the degree of vaporization (e) is 0.665.

OR

(b) Derive Equilibrium Relationships between F, V and L for complex mixtures.

Q.3 Derive following thermodynamic relationships for properties **12**

(a) $$C_p - C_V = T \cdot \left(\frac{\partial P}{\partial T}\right)_V \cdot \left(\frac{\partial V}{\partial T}\right)_P$$

(b) $$K_T = K_S + \left[\frac{T \cdot \alpha^2 \cdot V}{C_P}\right]$$

Where K_T = Coefficient of isothermal compressibility
K_S = Coefficient of adiabatic compressibility
K_T = Volumetric expansion coefficient

OR

Q.3 Derive following thermodynamic relationships for properties **12**

(a) $$C_v = -\frac{T\left(\frac{\partial P}{\partial T}\right)_V}{\left(\frac{\partial T}{\partial V}\right)_S}$$

(b) $C_p - C_v = \frac{T\alpha^2 V}{\beta_T}$ where α = volumetric expansion coefficient and

β_T = Coefficient of isothermal compressibility.

Q.4 **(a)** Outline construction of T-X-Y diagram for Partially Miscible Systems with relevant thermodynamic relationships. **06**

(b) Discuss the importance of Property Prediction for mixtures. **06**

OR

Q.4 **(a)** Give a critical account of Partially Miscible Systems with reference to temp-composition diagram at several pressures. **06**

(b) Give the elemental Kinetic theory for viscosity. **06**

Q.5 **(a)** Discuss the estimation of Low-Pressure gas viscosity. **06**

(b) Estimate the viscosity of sulfur dioxide gas at atmospheric pressure and 300 ^{0}C by using the Chung et al. method. The experimental viscosity is 246 μP. **06**
Tc = 430.8 K, Vc= 122 cm^3/ mole , ω = 0.256, M=64.063 and the dipole moment is 1.6 debyes. Assume k as negligible

OR

Q.5 Give a brief account of thermal conductivity prediction methods. **12**

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