Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – SUMMER • 2013

Subject code: 1721604 Date: 03-06-2013

Subject Name: Property Prediction for Mixtures - CAD Group

Time: 10.30 am – 01.00 pm Total Marks: 70

Instructions:

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

Q.1 Explain the concept of ñPartial Molal Quantitiesò. Under different sets of conditions, elaborate the evaluation of ñPartial Molal Enthalpies for binary mixtureò by Graphical Technique. **14**

Q.2 **(a)** Starting from first principles, derive the following relationship for properties C_P and C_V: **07**

$$C_P - C_V = -T\left(\frac{\delta V}{\delta T}\right)_P^2 \cdot \left(\frac{\delta p}{\delta v}\right)_T$$

(b) Derive the following relationships for properties C_P and C_V: **07**

(i) $$dS = \frac{C_V}{T} \cdot \frac{\partial T}{\partial P}\Big)_V dP + \frac{C_P}{T} \cdot \frac{\partial T}{\partial V}\Big)_P \cdot dV$$

(ii) $$dH = C_P \cdot dT + \left[V - T\frac{\partial V}{\partial T}\Big)_P\right] dP$$

OR

(b) Derive the following relationship for ratio of properties Cp and Cv: **07**

$$\frac{C_P}{C_V} = \frac{\frac{\partial P}{\partial V}\Big)_S}{\frac{\partial P}{\partial V}\Big)_T}$$

Q.3 **(a)** Outline the Concept of ñHypothetical Ideal Gas Stateò and derive relevant generalized equation for ΔH^1_{TP} under reduced state conditions. **07**

(b) Outline stepwise procedure in detail with relevant equations for calculations of H and G at any temperature (T) and any pressure (P) under ideal gas conditions. **07**

OR

Q.3 **(a)** Outline the Concept of ñHypothetical Ideal Gas Stateò and derive relevant generalized equation for ΔS^1_{TP} under reduced state conditions. **07**

(b) Outline stepwise procedure in detail with relevant equations for calculations of S and U at any temperature (T) and any pressure (P) under ideal gas conditions. **07**

Q.4 **(a)** Using concept of Hypothetically Ideal Component (Carlson and Coulburn Method) how constants of Van Laarôs Equations could be determined conveniently ? **07**

(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 equilibrium 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. **07**

OR

Q.4 **(a)** A wild gasoline contains 15% CH_4, 10% C_2H_6, 30% C_3H_8, 5% i-C_4H_{10}, 10% C_4H_{10}, 15% C_5H_{12} and 15% $C_6H_{12}^{+}$(heavier) as feed. Vaporization is carried out at 232 psia (15.78 atm) and 50 ºC. What is the composition of residue gasoline and that of the gas that is vaporized ? Also show that $\left(\frac{V}{L}\right)$ ratio of 0.429 is the suitable ratio. **07**

Use following data of vapour pressures at 50 ºC for different components:

Component	CH_4,	C_2H_6,	C_3H_8,	i-C_4H_{10},	C_4H_{10},	C_5H_{12},	$C_6H_{14}^{+}$
V.P. (psia)	4100,	750,	194,	78,	56,	19,	04

(b) Derive the following relationship for multi-component mixture: **07**

$$F_i \cdot P = L_i\left[P + P_i'\left(\frac{V}{L}\right)\right]$$

All symbols used have conventional meanings.

Q.5 Critically evaluate any two of the following. **14**

(i) Use of Maxwell's Relations in Property Predictions.
(ii) Estimation of low pressure gas viscosity.
(iii) Outline various methods to evaluate fugacity of mixtures.
(iv) Effect of high pressure on liquid viscosity.

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