Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E –II[st] SEMESTER–EXAMINATION – JULY- 2012

Subject code: 1721604 Date: 10/07/2012

Subject Name: Property Prediction for Mixtures

Time: 10:30 am – 13:00 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 **(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% $C_5H_{12}^+$(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 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.2 **(a)** Derive following relationship for properties Cp and Cv. **07**

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

(b) $Cp = \dfrac{(-V)}{\left(\frac{\delta T}{\delta P}\right)_H - \left(\frac{\delta T}{\delta P}\right)_S}$ and $\dfrac{\delta Cv}{\delta v} = T \cdot \left(\frac{\delta^2 P}{\delta T^2}\right)_V$ **07**

OR

(b) $ds = \left(\frac{C_V}{T} \cdot \frac{\partial T}{\partial P}\right)_V dp + \left(\frac{C_P}{T} \cdot \frac{\partial T}{\partial V}\right)_P \cdot dv$ and $\left(\frac{\partial C_P}{\partial P} = -T\frac{\partial^2 V}{\partial T^2}\right)_P$ **07**

Q.3 Using concept of "Hypothetical Ideal Gas State", explain in detail how to calculate any energy function at any temp (T) and pressure(P). **14**

Obtain relevant generalized equation for $\Delta H'_{T'P}$ under reduced conditions using an equation: PV=ZRT.

OR

Q.3 Using concept of "Hypothetical Ideal Gas State", explain in detail how to calculate any energy function at any temp (T) and pressure(P). **14**

Obtain relevant generalized equation for $\Delta S'_{T'P}$ under reduced conditions using an equation: PV=ZRT.

Q.4 **(a)** Discuss briefly about the "Use of Maxwell's Relations in Properties Prediction". **07**

(b) Write a note on – "Partial Molal Enthalpy (PMQ) and its estimation". **07**

OR

Q.4 Discuss the importance of property Prediction in Chemical Engineering, giving examples. **14**

Q.5 **(a)** Using concept of Hypothetically Ideal Component (Carlson and Coulburn Method) how constants of Van Laar's Equation could be determined conveniently ? **07**

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

OR

Q.5 **(a)** Discuss property predicction for viscosity. **07**

(b) Discuss property predicction for pressure. **07**