Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. Sem. – II[nd] - Examination – June/July- 2011

Subject code: 1721604

Subject Name: Property Prediction for Mixtures

Date:27/06/2011 **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 Out line in detail with the help of relevant data, graphs etc, the estimation of H and S at any temperature (T) and any pressure (P) using a Model – based on **"Hypothetical Ideal Gas State".** **14**

Q.2 **(a)** Give critical account of the following: **07**
Estimation of Partial Molal Quantity (PMQ) by Graphical Methodology.

(b) In a proposed natural gasoline fractionating column, the product taken from top of the condenser will contain 20% mole ethane, 40% mole propane, 15% mole iso-butane and balance 25% mole n-butane. This material is completely liquefied in a condenser with cooling water at 20°C. Assuming 10°C approach, what must be pressure in the condenser? **07**

Use following data: K values at 30°C at different pressures are as under:

Component	K at 150 Psia	K at 175 Psia	K at 200 Psia
Ethane	3.10	2.17	2.10
Propane	1.00	0.87	0.74
Iso-butane	0.46	0.39	0.34
n-butane	0.30	0.27	0.23

OR

(b) Outline various methods to evaluate constants of Van Laar's equations **07**

Q.3 Derive the following thermodynamic relationships for properties: **14**

(i) $$\left(\frac{\partial V}{\partial T}\right)_P = \left(\frac{\partial C_P}{\partial P}\right)_T + \eta \cdot \left(\frac{\partial C_P}{\partial T}\right)_P + C_P \left(\frac{\partial \eta}{\partial T}\right)_P \quad \text{where in} \quad \eta = \left(\frac{\partial T}{\partial P}\right)_S$$

= isentropic temp – pressure coefficient.

(ii) $$C_P - C_V = -T\left(\frac{\partial V}{\partial T}\right)_P^2 \cdot \left(\frac{\partial P}{\partial V}\right)_T$$

(iii) $$\frac{C_P}{C_V} = \frac{\left(\frac{\partial P}{\partial V}\right)_S}{\left(\frac{\partial P}{\partial V}\right)_T}$$

P.T.O.

OR

Q.3 Derive the following thermodynamic relationships for properties: **14**

(i) $$\frac{\partial C_P}{\partial P} = -T\frac{\partial^2 V}{\partial T^2}\Big)_P \;\&\; \frac{\partial C_V}{\partial V} = T\frac{\partial^2 P}{\partial T^2}\Big)_V$$

(ii) $$ds = \frac{C_V}{T}\cdot\frac{\partial T}{\partial P}\Big)_V dp + \frac{C_P}{T}\cdot\frac{\partial T}{\partial V}\Big)_P \cdot dv$$

(iii) $$C_P = \frac{[-V]}{\left[\frac{\partial T}{\partial P}\Big)_H - \frac{\partial T}{\partial P}\Big)_S\right]}$$

Q.4 **(a)** Outline various methods to evaluate fugacity of mixtures. **07**

(b) Derive Equilibrium relationships between F, V and L for complex mixtures. **07**

OR

Q.4 **(a)** Give a brief account of selection of thermodynamic models. **07**

(b) Discuss the estimation of surface tension. **07**

Q.5 **(a)** Describe briefly the gas transport theory. **07**

(b) Discuss viscosities of gas mixtures. **07**

OR

Q.5 **(a)** Discuss diffusion coefficient for binary gas system. **07**

(b) Discuss the effect of temperature on surface tension **07**

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