M.E. CHEMICAL ENGINEERING 1st YEAR 2nd D SEMESTER EXAM 2025
ADVANCED CHEMICAL ENGINEERING THERMODYNAMICS
Answer all questions

Assume any missing data

1(i) Show with relevant equations and derivations that an ideal solution is always stable and cannot exhibit phase splitting.

(ii) Describes any one of the following model of solution: (a) van Laar (b) Scatchard-Hildebrand (c) Lattice theory (d) two liquid theory (e) Flory-Huggins theory [10 + 15]

2. (a) Calculate fugacity of liquid $CHClF_2$ at -18 °C and 138 bar from the following data [17]

The vapor pressure of $CHClF_2$ at -18 °C is 2.6 bar. The volumetric data at -18 °C is given below

P (bar)	0.7	2.75	34.5	69	104	138
V (m^3/mol)x10^6	182	3.9	3.2	2.5	1.8	1.15

The compressibility factor for saturated vapour at -18 °C is 0.932.

(b) At 25 °C and 20 bar, the fugacity of component 1 in binary mixture of component 1 and 2 is given by . Determine [8]

(I) Fugacity coefficient of pure component 1
(II) Henry's constant for component 1
(III) Expression of activity coefficient of component 1 as a function of

3. (a) The solution behavior of a certain class of substances is derived by the expression

Where are function of T only. Obtain the expression of [10]

(b) The enthalpy change of mixing for a binary liquid solution of components 1 and 2 at 25 °C and 1 atm is given by the equation [8]

The enthalpy of pure liquid at the same T and P are: and . Determine the following

(I) Enthalpy of the solution at =0.4.
(II) Excess enthalpy of the solution at =0.5. Show relevant derivation

© The excess Gibbs free energy for this system can be represented by three suffix Margules equation . Obtain the expression of activity coefficient of component 1 and 2.
[7]

4. The following pair of equations has been suggested for representation of partial molar volume of component 1 and 2 of a simple binary system at constant T and P

Where A and B are functions of T and P only; and are pure component molar volume of component 1 and 2 respectively. Determine [25]

(a) the expression of volume change due to mixing in terms of
(b) Obtain the expression of in terms of
(c) the expression of total volume in terms of
(d) Determine whether the expression of and are thermodynamically consistent