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BACHELOR OF TECHNOLOGY (C.B.C.S.) (2020 COURSE)
B.Tech.Sem - IV CHEMICAL :SUMMER- 2022
SUBJECT : CHEMICAL ENGINEERING THERMODYNAMICS-II

Day : Thursday
Date : 16-06-2022

S-24441-2022

Time : 10:00 AM-01:00 PM
Max. Marks : 60

N. B. :

- 1) All questions are **COMPULSORY**.
 - 2) Figures to the right indicate **FULL** marks.
 - 3) Draw neat and labelled diagrams **WHEREVER** necessary.
 - 4) Use of non-programmable calculator is **ALLOWED**.
 - 5) Assume suitable data, if necessary.
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Q. 1 Define chemical potential and obtain the criteria of phase equilibrium in terms of chemical potential. (10)

OR

Define partial molar property and obtain the following expression for binary system: (10)

$$x_1 \frac{d\bar{M}_1}{dx_1} + x_2 \frac{d\bar{M}_2}{dx_1} = 0.$$

Q. 2 Define fugacity coefficient for a species in solution. Develop a general equation to calculate fugacity coefficient values from compressibility factor data. (10)

OR

Elaborate the concept of residual property and derive the fundamental residual property relation which reflects that $\ln \hat{\phi}_i$ is a partial property with respect to G^R / RT . (10)

Q. 3 Define excess property and derive the relation between excess free energy and activity coefficient. (10)

OR

Define property change of mixing. Derive expressions for property change of mixing for the following properties: (10)

- i) Gibb's energy
- ii) Entropy
- iii) Volume
- iv) Enthalpy

Q. 4 Binary system acetonitrile (1) nitromethane(2) conforms closely to Raoult's Law. Vapour pressures for the pure species are given by the following Antoine equations: (10)

$$\ln P_1 = 14.2724 - \frac{2.945.47}{t + 224.00}$$

$$\ln P_2 = 14.2043 - \frac{2.972.64}{t + 209.00}$$

Pressure in kPa and Temperature in $^{\circ}\text{C}$.

Prepare a graph showing P vs x_1 and P vs y_1 for a temperature of 75°C .

P. T. O.

OR

Enumerate the procedure to determine the liquid phase properties fugacity, activity coefficient and excess free energy from VLE data. (10)

Q. 5 Obtain the basic equations for binary liquid – liquid equilibrium. (10)

OR

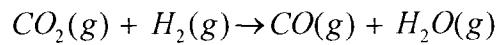
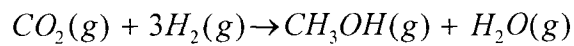
Define distribution coefficient, state and derive Nernst distribution law. (10)

Q. 6 Elaborate the criteria of chemical reaction equilibrium and obtain the following expression for the standard free energy change (10)

$$\Delta G^0 = - RT \ln K.$$

OR

A system formed initially of 2 mol CO₂, 5 mol H₂ and 1 mol CO undergoes the reactions: (10)



Develop expressions for the mole fractions of reacting species as functions of the reaction coordinate for the two reactions.

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