

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

Day : Friday

Time : 02:30 PM-05:30 PM

Date : 25-11-2022

W-24441-2022

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.

Q. 1 Elaborate the following terms: (10)

- i) Ideal gas mixture
- ii) Ideal solution
- iii) Partial molar property
- iv) Chemical Potential

OR

State Gibb's theorem and obtain the following expression for ideal gas mixture model: (10)

$$\mu_i^R = \bar{G}_i^R = \bar{G}_i(T) + RT \ln(y_i P)$$

Q. 2 Define fugacity coefficient for a species in solution. Obtain an expression to evaluate fugacity coefficient for species in solution ($\hat{\phi}_i$) using Virial equation of state. (10)

OR

Derive the relation between residual Gibb's free energy and fugacity coefficient of a species in solution. (10)

Q. 3 Obtain an expression which will predict the effect of temperature and pressure on activity coefficient. (10)

OR

Define property change of mixing. Derive expressions for Gibb's energy change of mixing, entropy change of mixing, volume change of mixing and enthalpy change of mixing. (10)

Q. 4 Test the thermodynamic consistency of the VLE data for binary system of Acetone (1) and Dichloroethylene (2), using zero area method. (10)

Mole fraction of Acetone	x	0.023	0.053	0.357	0.516	0.883	0.979
Activity coefficients	γ_1	0.608	0.711	0.854	0.917	0.987	1.0
	γ_2	0.993	0.974	0.934	0.891	0.781	0.694

OR

Enumerate the criteria of vapour liquid equilibrium and criteria of stability. (10)

P. T. O.

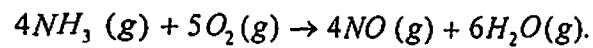
Q. 5 Enumerate the quantitative behaviour of LLE using constant pressure liquid – liquid solubility diagram. (10)

OR

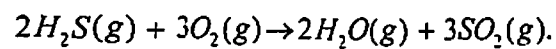
Define distribution coefficient, state and derive Nernst distribution law. (10)

Q. 6 Develop expressions for the mole fractions of reacting species as functions of the reaction coordinate for: (10)

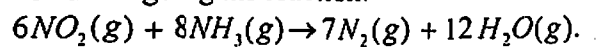
i) A system initially containing 2 mol NH and 5 mol O₂ and undergoing the reaction:



ii) A system initially containing 3 mol H₂S, 5 mol O₂ and undergoing the reaction:



iii) A system initially containing 3 mol NO₂ and 4 mol NH₃ and 1 mol N₂ and undergoing the reaction:



OR

Derive the relationship between the mole fraction of the component taking part in the simultaneous reaction and extent of reaction. (10)

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