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RM-7023

B. E. - III (Sem. VI) (Chemical) Examination

May / June – 2010

Chemical Engg. Thermo. - II

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ **B. E. - 3 (Sem. 6) (Chemical)**

Name of the Subject :

☛ **Chemical Engg. Thermo. - 2**

☛ Subject Code No. : **7 0 2 3** ☛ Section No. (1, 2,.....) : **1&2**

Seat No. :

Student's Signature

(2) Answer to the two sections must be written in **separate** answer books.

(3) Assume suitable data wherever necessary.

(4) Use graph paper and steam table wherever required.

(5) Figures to the right indicate full marks.

SECTION - I

1 (a) Answer the following : 1×8=8

(i) Define chemical potential

(ii) What is excess property?

(iii) Write down Gibbs theorem for ideal gas.

(iv) Define activity coefficient.

(v) Write down Van Hour equation for activity coefficient.

(vi) State the criterion for phase equilibrium.

(vii) Explain intensive property with examples.

(viii) State Henry's law.

(b) A molar enthalpy of a binary solution of constant temperature and pressure is given by the relation: **8×1=8**

$h = 500\ x_1 + 1000\ x_2 + (50\ x_1 + 40\ x_2)\ x_1 x_2$

where h is in J/mol.

Determine $\bar{h}_1$ and $\bar{h}_2$ as a function of x_1 and the numerical value of the pure component enthalpies h_1 and h_2. Also determine the partial molar enthalpies at infinite dilution.

2 Attempt any **two** : **8×2=16**

(a) Methanol (1) - acetone (2) forms an azeoprope at 760 torr with $x_1 = 0.2$ and t = 55.7C. Estimate the Van Haur constraints for the system and predict the p-x-y data at 55.7°C. The anotoine constents for the systems are given below

	A	B	C
Methanol	8.08097	1582.271	239.726
Acetone	7.11714	1210.595	229.664

(b) The system n-pentane (1)-n-hexane(2)-n-heptane(3) forms an ideal solution. Calculate the bubble temperature and vapor composition at 760 torr if the composition of the liquid solution is $X_1 = 0.4$, $x_2 = 0.3$ and $x_3 = 0.3$. The antoine constants for the system are given in the table :

	A	B	C
n-pentane	6.87632	1075.780	233.205
n-Hexane	6.91058	1189.640	226.280
n-Heptane	6.89386	1264.770	216.640

(c) Assuming 2-propanal and 1-propanol forms and ideal solution prepare t-x-y diagram at 760 torr. The antoine constants for the system are given below :

	A	B	C
2-psopanol	8.8729	2010.330	252.636
1-propanol	8.37895	1788.020	227.438

3 Answer any **three** :

(a) Ideal solution

(b) Derive Margule's equation

(c) What is partial property and derive Wibb's Duhem equation.

(d) Retrograde condensation.

SECTION - II

4 (a) Attempt the following : **1×5=5**

(i) What is the criteria of phase equilibrium?

(ii) What is the value of stochiometric number for any inert species?

(iii) Define the term :

$$\Delta G - \sum v_i G_i$$

(iv) What is the full form of VLLE?

(v) Mention the relation between mole fraction (Y_i) to reaction co-ordinate for a single reaction.

(b) What is LCST and UCST in liquid-liquid equilibrium? Explain with liquid-liquid solubility diagram. 8

(c) Write Dchum's theorm. **2**

5 Attempt any **two** : **2×8=16**

(a) Derive the equilibrium and stability criteria for closed system.

(b) Determine the number of degrees of freedom F for each of the following systems.

(i) A system of two miscible non reacting species which exists as an azetrope in vapour/liquid equilibrium.

(ii) A system prepared by partially decomposing NH_4Cl into an evacuated space.

(c) Acetic acid is esterified in the liquid phase with ethanol at 100°C at atmospheric pressure to producer.ethul acetate and water according to the reaction.

$CH_3COOH_{(l)} + C_2H_5OH_{(l)} \rightarrow CH_3COOC_2H_5 + H_2O$

if initially there is one mole each of acetic acid and ethanol, estimate

The mole fraction of ethylacetate in the reacting mixture at equilibrium. Reacting species from an ideal solution (assume).

6 Attempt any **three** : **19**

(a) Fugacity coefficient of species in solution

(b) liquid-liquid equilibrium

(c) Role of reaction thermodynamics in chemical engineering.

(d) Reaction coordinate.