Code No: R05310803 **R05** **Set No. 2**

III B.Tech I Semester Examinations,November 2010
CHEMICAL ENGINEERING THERMODYNAMICS-II
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive Clapeyron equation

   (b) Calculate the amount of heat given off when 1 m^3 of air (at S.T.P) cools from 500 ^oC to -100 ^oC at constant pressure of 1 atmosphere. Heat capacity constants:
   C_p= a + bT +cT^2 (cal/ mol. K). [6+10]

	a	B * 10^3	C * 10^6
N_2	6.457	1.389	-0.069
O_2	6.117	3.167	-1.005

2. In a laboratory investigation, acetylene is catalytically hydrogenated to ethylene at 1,120^{0}C And 1 bar. If the feed is an equimolar mixture of acetylene and hydrogen, what is the composition of the product stream at equilibrium? The reactions are
   $C_2H_2 \rightarrow 2C + H_2$
   $2C + 2H_2 \rightarrow C_2H_4$ K_1= 4x10^5, K_2 =2.5x10^{-6}. [16]

3. Carbon monoxide at 100 ^{0}C is burned under atmospheric pressure with dry air at 400 ^{0}C is 30% excess of that theoretically required. The products of combustion leave the reaction chamber at 900 ^{0}C. Calculate the heat evolved in the reaction chamber in k cal/ kg mole of CO burned, assuming complete combustion:
   ΔH_{25} = -67,636 k cal
   Mean molal heat capacities in the temp. range involved are
   CO = 7.017 gm cal/ gm mole ^{0}K
   Air = 7.225 gm cal/ gm mole ^{0}K
   CO_2 =11.92 gm cal/ gm mole ^{0}K
   O_2 = 7.941 gm cal/ gm mole ^{0}K
   N_2 = 7.507 gm cal/ gm mole ^{0}K. [16]

4. Flash calculations are simpler for binary system than for multicomponent case, show that, for a binary system in VLE, $x_1 = \frac{1-k_2}{k_1-k_2}$, $y = \frac{k_1(1-k_2)}{k_1-k_2}$
   $\vartheta = \frac{Z_1(k_1-k_2)-(1-k_2)}{(k_1-1)(1-k_2)}$. [16]

5. Discuss about liquid-liquid Equilibrium (LLE). Draw liquid-liquid solubility diagram with proper labeling. [16]

6. (a) Discuss about Bubble point and dew point using P-xy diagram.

   (b) Discuss about flash calculations. [8+8]

7. The enthalpy of a binary liquid system of species 1 and 2 at fixed T and P is represented by the equation $H=400x_1+600x_2+ x_1 x_2 (20 x_2+40x_1)$ Where H is in J mol^{-1}. Determine the expression for partial property for enthalpy for component 1 and 2 as function of x_1, numerical values for the pure species, and also numericall values for the partial enthalpies at infinite dilution. [16]

8. Plot equilibrium curve (p-x-y) for ethyl alcohol- water system using Vanlaar method. The data needed to solve the problem by Vanlaar method is as follow:- Ethanol-water system forms an azetrope at 78.15 ^oC, 1 atm and corresponding ethanol composition is 89.43 mole% Vapour pressure of water and ethanol at 78.15 ^oC are 329 mm Hg and 755 mm Hg respectively. [16]

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Code No: R05310803 **R05** **Set No. 4**

III B.Tech I Semester Examinations,November 2010
CHEMICAL ENGINEERING THERMODYNAMICS-II
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. In a laboratory investigation, acetylene is catalytically hydrogenated to ethylene at 1,120^{0}C And 1 bar. If the feed is an equimolar mixture of acetylene and hydrogen, what is the composition of the product stream at equilibrium? The reactions are
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$2C + 2H_2 \rightarrow C_2H_4$ $K_1 = 4\text{x}10^5$, $K_2 = 2.5\text{x}10^{-6}$. [16]

2. Plot equilibrium curve (p-x-y) for ethyl alcohol- water system using Vanlaar method. The data needed to solve the problem by Vanlaar method is as follow:- Ethanol-water system forms an azetrope at 78.15 ^{o}C, 1 atm and corresponding ethanol composition is 89.43 mole% Vapour pressure of water and ethanol at 78.15 ^{o}C are 329 mm Hg and 755 mm Hg respectively. [16]

3. (a) Derive Clapeyron equation

   (b) Calculate the amount of heat given off when 1 m^3 of air (at S.T.P) cools from 500 ^{o}C to -100 ^{o}C at constant pressure of 1 atmosphere. Heat capacity constants:
   C_p= a + bT +cT^2 (cal/ mol. K). [6+10]

	a	B * 10^3	C * 10^6
N_2	6.457	1.389	-0.069
O_2	6.117	3.167	-1.005

4. The enthalpy of a binary liquid system of species 1 and 2 at fixed T and P is represented by the equation $H=400x_1+600x_2+ x_1 x_2 (20 x_2+40x_1)$ Where H is in J mol^{-1}. Determine the expression for partial property for enthalpy for component 1 and 2 as function of x_1, numerical values for the pure species, and also numericall values for the partial enthalpies at infinite dilution. [16]

5. (a) Discuss about Bubble point and dew point using P-xy diagram.

   (b) Discuss about flash calculations. [8+8]

6. Discuss about liquid-liquid Equilibrium (LLE). Draw liquid-liquid solubility diagram with proper labeling. [16]

7. Carbon monoxide at 100 ^{0}C is burned under atmospheric pressure with dry air at 400 ^{0}C is 30% excess of that theoretically required. The products of combustion leave the reaction chamber at 900 ^{0}C. Calculate the heat evolved in the reaction chamber in k cal/ kg mole of CO burned, assuming complete combustion:
ΔH_{25} = -67,636 k cal
Mean molal heat capacities in the temp. range involved are

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Air = 7.225 gm cal/ gm mole ^{0}K
CO_2 =11.92 gm cal/ gm mole ^{0}K
O_2 = 7.941 gm cal/ gm mole ^{0}K
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8. Flash calculations are simpler for binary system than for multicomponent case, show that, for a binary system in VLE, $x_1 = \frac{1-k_2}{k_1-k_2}$, $y = \frac{k_1(1-k_2)}{k_1-k_2}$
$\vartheta = \frac{Z_1(k_1-k_2)-(1-k_2)}{(k_1-1)(1-k_2)}$. [16]

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Code No: R05310803 **R05** **Set No. 1**

III B.Tech I Semester Examinations,November 2010
CHEMICAL ENGINEERING THERMODYNAMICS-II
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. In a laboratory investigation, acetylene is catalytically hydrogenated to ethylene at 1,120^{0}C And 1 bar. If the feed is an equimolar mixture of acetylene and hydrogen, what is the composition of the product stream at equilibrium? The reactions are
   $C_2H_2 \rightarrow 2C + H_2$
   $2C + 2H_2 \rightarrow C_2H_4$ K$_1$= 4x10^5, K$_2$ =2.5x10^{-6}. [16]

2. Flash calculations are simpler for binary system than for multicomponent case, show that, for a binary system in VLE, $x_1 = \frac{1-k_2}{k_1-k_2}$, $y = \frac{k_1(1-k_2)}{k_1-k_2}$
   $\vartheta = \frac{Z_1(k_1-k_2)-(1-k_2)}{(k_1-1)(1-k_2)}$. [16]

3. (a) Derive Clapeyron equation
   (b) Calculate the amount of heat given off when 1 m^3 of air (at S.T.P) cools from 500 ^{o}C to -100 ^{o}C at constant pressure of 1 atmosphere. Heat capacity constants:
   C$_p$= a + bT +cT^2 (cal/ mol. K). [6+10]

	a	B * 10^3	C * 10^6
N_2	6.457	1.389	-0.069
O_2	6.117	3.167	-1.005

4. Discuss about liquid-liquid Equilibrium (LLE). Draw liquid-liquid solubility diagram with proper labeling. [16]

5. Carbon monoxide at 100 ^{0}C is burned under atmospheric pressure with dry air at 400 ^{0}C is 30% excess of that theoretically required. The products of combustion leave the reaction chamber at 900 ^{0}C. Calculate the heat evolved in the reaction chamber in k cal/ kg mole of CO burned, assuming complete combustion:
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   Mean molal heat capacities in the temp. range involved are
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   N_2 = 7.507 gm cal/ gm mole ^{0}K. [16]

6. The enthalpy of a binary liquid system of species 1 and 2 at fixed T and P is represented by the equation H=400x$_1$+600x$_2$+ x$_1$ x$_2$ (20 x$_2$+40x$_1$) Where H is in J mol^{-1}. Determine the expression for partial property for enthalpy for component 1 and 2 as function of x$_1$, numerical values for the pure species, and also numericall values for the partial enthalpies at infinite dilution. [16]

7. (a) Discuss about Bubble point and dew point using P-xy diagram.
   (b) Discuss about flash calculations. [8+8]

8. Plot equilibrium curve (p-x-y) for ethyl alcohol- water system using Vanlaar method. The data needed to solve the problem by Vanlaar method is as follow:- Ethanol-water system forms an azetrope at 78.15 ^{o}C, 1 atm and corresponding ethanol composition is 89.43 mole% Vapour pressure of water and ethanol at 78.15 ^{o}C are 329 mm Hg and 755 mm Hg respectively. [16]

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Code No: R05310803 **R05** **Set No. 3**

III B.Tech I Semester Examinations,November 2010
CHEMICAL ENGINEERING THERMODYNAMICS-II
Chemical Engineering

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. In a laboratory investigation, acetylene is catalytically hydrogenated to ethylene at 1,120^{0}C And 1 bar. If the feed is an equimolar mixture of acetylene and hydrogen, what is the composition of the product stream at equilibrium? The reactions are
$C_2H_2 \rightarrow 2C + H_2$
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2. (a) Discuss about Bubble point and dew point using P-xy diagram.
   (b) Discuss about flash calculations. [8+8]

3. (a) Derive Clapeyron equation
   (b) Calculate the amount of heat given off when 1 m^3 of air (at S.T.P) cools from 500 ^{o}C to -100 ^{o}C at constant pressure of 1 atmosphere. Heat capacity constants:
   C_p= a + bT +cT^2 (cal/ mol. K). [6+10]

	a	B * 10^3	C * 10^6
N_2	6.457	1.389	-0.069
O_2	6.117	3.167	-1.005

4. Flash calculations are simpler for binary system than for multicomponent case, show that, for a binary system in VLE, $x_1 = \frac{1-k_2}{k_1-k_2}$, $y = \frac{k_1(1-k_2)}{k_1-k_2}$
$\vartheta = \frac{Z_1(k_1-k_2)-(1-k_2)}{(k_1-1)(1-k_2)}$. [16]

5. Discuss about liquid-liquid Equilibrium (LLE). Draw liquid-liquid solubility diagram with proper labeling. [16]

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