



Printed Pages : 4

CH-505

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 9015

Roll No.

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B. Tech.

(SEM. V) EXAMINATION, 2007-08 MASS TRANSFER OPERATIONS - I

Time : 3 Hours]

[Total Marks : 100

- Note :
- (1) Attempt all questions. All questions carry equal marks.
 - (2) Assume missing data if any.
 - (3) Graph paper will be provided, if required.

1 Attempt any **four** of the following :

- (a) Define relative volatility. A binary system has constant relative volatility. Only one data point $x=0.3$ and $y=0.4$ known. Determine relative volatility of the system. 5
- (b) What is dew point ? How will you determine if wet bulb and dry bulb temperatures are given? 5
- (c) Differential between wet bulb lines and adiabatic lines. 5
- (d) Define overall mass-transfer coefficient at a gas-liquid interface? Can these be expressed in terms of individual coefficients? 5
- (e) HCl gas diffuses across an air film of 0.0005 m thickness. The partial pressure of the HCl on one side of the film is 0.08 atm and zero on the other side. Estimate the rate of diffusion if the total pressure is 0.1 atm. The diffusivity of HCl vapour is 0.6×10^{-6} gmol/cm²s. 5

(f) Discuss the temperature dependency of diffusivity in gases on temperature. 5

2 Attempt any **four** of the following :

(a) What is ΔH_{vap} point on H-x-y plot? What does it represent when using Saveret Ponchon method? 5

(b) What is the driving force in humidification operation ? How to determine NTU for a cooling tower ? 5

(c) What kind of equipment is used for gas absorption ? 5

(d) What is entrainment ? How does it affect the performance of the distillation column ? 5

(e) A gas is heated. Show that which of these will increase: wet bulb temperature, relative volatility and wet bulb temperature. Explain with the help of sketches. 5

(f) How does the vapour pressure vary with temperature ? Give any one equation, which can be used to correlate the vapour pressure-temperature data. 5

3 Attempt any **two** of the following :

(a) It is required to separate 2000 kg/hr of a solution of ammonia in water, containing 30% by weight of ammonia to give a top product of 99.5% purity and a weak solution containing 10% by weight of ammonia. Feed is at boiling point. Total condenser is used. The reflux returns at boiling point. Heating is done using steam in the reboiler. Calculate minimum method number of plate using Savant Ponchon method. Locate the feed plate. Equilibrium data : Enthalpy – composition diagram. 10

<i>X, Mole fraction of Ammonia in water</i>	<i>Enthalpy, H_x kcal/kg</i>	<i>Enthalpy, H_y kcal/kg</i>	<i>Y</i>
0	188.9	655.6	0
0.1	144.5	638.9	0.5
0.2	105.6	611.1	0.78
0.3	69.4	583.3	0.9
0.4	38.9	555.5	0.95
0.5	22.2	527.8	0.96
0.6	5.6	497.2	0.97
0.7	5.6	466.7	0.98
0.8	11.1	433.3	0.99
0.9	22.2	388.9	0.995
1.0	33.3	316.7	1.0

(b) How to determine minimum solvent required in a gas-liquid absorber ? Discuss the graphical method. 10

(c) How to determine the actual number of plates using McCabe Thiele method for distillation of a binary system. What additional information is required ? 10

4 Attempt any **two** of the following :

(a) How does the pressure drop vary in tray column ? What is flooding ? How to determine the maximum vapour velocity in the column ? 10

(b) A multicomponent system has more than two components. How to determine number of ideal plates for such a system ? Discuss the role of partition coefficient and key components. 10

(c) Plot the following data on a triangular plot. 10
Equilibrium data : Water-Acetic Acid-Methyl Isobutyl Ketone (MIBK)

Weight% in raffinate			Weight% in extract		
Water	Acetic acid	MIBK	Water	Acetic acid	MIBK
98.45	0	1.55	2.12	0	97.88
95.46	2.85	1.7	2.80	1.87	95.33
85.8	11.7	2.5	5.4	8.9	85.7
75.7	20.5	3.8	9.2	17.3	73.5
67.8	26.2	6.0	14.5	24.6	60.9
55.0	32.8	12.2	22.0	30.8	47.2
42.9	34.6	22.5	31.0	33.6	35.4

A mixture contains 20% Water-40% Acetic Acid-40% Methyl Isobutyl Ketone. How many phases are there? If equal amount of water is added to this mixture what will be the composition of the mixture?

5 Attempt any **two** of the following :

- (a) A granular material containing 40% moisture is fed to dryer handling 200 kg of dry solid at a temperature of 20°C . It is withdrawn at 35°C and contains 5% moisture. The air supplied, contain 0.006 kg of water vapour/kg dry air. Determine the weight of dry air supplied and the humidity of air leaving it. 10
 Data: Latent heat of water vapour = 585 kcal/kg
 Specific heat: dry solid = $0.21 \text{ kcal/kg}^{\circ}\text{C}$, dry air = $0.228 \text{ kcal/kg}^{\circ}\text{C}$ water = $0.48 \text{ kcal/kg}^{\circ}\text{C}$.
- (b) Derive the expression to determine the rate of drying during falling rate period. 10
- (c) Write short notes on : (i) Freeze drying and (ii) Azeotropic distillation. 10