Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V(New) • EXAMINATION – WINTER 2016

Subject Code:2150501 **Date:24/11/2016**

Subject Name:Mass Transfer Operation - I

Time:10:30 AM to 01:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **Short Questions** **14**

1 State Fick's law of diffusion.

2 For the decomposition of N_2O_5 (A) as per the reaction $N_2O_5 \rightarrow .NO_2 + 1/2O_2$, If O_2 (B) diffuses back then Calculate the value of NA/(NA+NB)

3 State the unit of diffusivity.

4 For sparingly soluble gas which phase is controlling?

5 Define chemical equilibrium.

6 For low pressure drop which column is suitable tray or packed?

7 Name any four packings used in packed tower

8 State typical example of extraction system.

9 Define selectivity.

10 State any two industrial applications of leaching.

11 Define Magma.

12 Define supersaturation.

13 Name any two types of trays used in tray tower

14 Define N and J type flux.

Q.2 **(a)** State and discuss the types of diffusion with suitable example. **03**

(b) For equimolar counter diffusion show that $D_{AB} = D_{BA}$ **04**

(c) Methane diffuses at steady state through a tube containing helium for the case equimolar counter diffusion. At point 1, the partial pressure of methane is 55 kPa and at point 2, 0.03 m apart is 15 kPa. The total pressure is 101.325 kPa and temperature is 298 k, at this temperature and pressure the value of diffusivity is 6.75×10^{-5} m^2/s. Calculate the partial pressure of methane at point 0.02 m apart from point 1 for the above case. **07**

OR

(c) Define F-type and k-type mass transfer coefficients. Also derive the relationship for steady state equimolar counter diffusion between F and k type coefficients. **07**

Q.3	**(a)**	Explain the concept of penetration theory and state its assumptions.	**03**
	(b)	Derive the relation for steady state equimolar counter diffusion for gases.	**04**
	(b)	Discuss the analogy among Heat, momentum and mass transfer.	**07**

OR

Q.3	**(a)**	Write a short note on loading and flooding.	**03**
	(b)	In a mass transfer apparatus operating at 1 atmosphere the individual mass transfer coefficient have the following values kx = 22 kg mol/m^2.h, ky = 1.07 kg mol/m^2.h. The equilibrium compositions of the gaseous and liquid phases are characterized by Henry's law $\mathbf{p^* = 0.08 \times 10^6\ X}$ mm Hg. Determine i) the overall mass transfer coefficients, ii) How many times the diffusion resistance of liquid phase differs from that of gas phase?	**04**
	(c)	Explain schematically the working of tray tower and its associated problems.	**07**
Q.4	**(a)**	Define Conning, weeping and dumping.	**03**
	(b)	State and explain the characteristics of packing.	**04**
	(c)	Compare tray tower and packed tower in terms of its advantages and disadvantages.	**07**

OR

Q.4	**(a)**	Write a short note on heap leaching.	**03**
	(b)	Differentiate between ideal and non-ideal solutions with suitable example. Also state the characteristics of ideal solution.	**04**
	(c)	1000 m^3/h of a gas mixture containing 10 mole% solute and rest inert enters the absorber at 300 k temperature and 106.658 kPa pressure. 90% of the original solute is removed. Solute free water used for absorption contains 5 mole% solute when it leaves the tower at the bottom. Calculate the solvent molar flow rate to tower.	**07**
Q.5	**(a)**	Derive the mixture rule.	**03**
	(b)	Discuss the criteria for solvent selection in extraction	**04**
	(c)	A solution containing 5% acetaldehyde and 95% toluene is to be extracted with water in five stage crosscurrent extraction unit to extract acetaldehyde. Toluene and water are essentially insoluble. If 25 kg of water each time are used per 100 kg of feed, calculate the amount of acetaldehyde extracted and final concentration of exit solution. The equilibrium relationship is given as: **Y = 2.20 X** where Y = kg acetaldehyde/kg water And X = kg acetaldehyde/kg toluene	**07**

OR

Q.5	**(a)**	Explain the working of Shank's system in detail with schematic diagram.	**03**

(b)	State and discuss the various techniques for achieving super saturation with suitable example	**04**
(c)	Explain the working of Oslo krystal evaporative crystallizer	**07**

****