Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2020

Subject Code:3153617 **Date:27/01/2021**

Subject Name:Basics of Mass Transfer

Time:10:30 AM TO 12:30 PM **Total Marks: 56**

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

			MARKS
Q.1	**(a)**	Define: (a) HETP (b) Humid Heat (c) Reflux ratio	**03**
	(b)	Mention the factors affecting choice of separation method.	**04**
	(c)	Explain in detail about various application of mass transfer	**07**
Q.2	**(a)**	Explain in brief about Azeotropic distillation.	**03**
	(b)	Explain temperature and pressure dependency of diffusivity of gases and liquids.	**04**
	(c)	Derive the relation for steady state molecular diffusion in fluids at rest and in laminar flow.	**07**
Q.3	**(a)**	Write short note on Absorption factor.	**03**
	(b)	Define Diffusivity and state its assumptions for penetration.	**04**
	(c)	Starting from the basics of diffusion, derive the equation to calculate N_A for steady state equimolal counter diffusion of A through B for unidirectional binary gas phase.	**07**
Q.4	**(a)**	Define relative saturation, percentage saturation and enthalpy.	**03**
	(b)	Write down the selection criteria for the solvent in liquid extraction process.	**04**
	(c)	A gas (B) – benzene (A) mixture is saturated at 1 std atm, 50°C. Calculate the absolute humidity if B is (a) nitrogen and (b) carbon dioxide. Vapor pressure of nitrogen at 50°C = 0.362 std atm	**07**
Q.5	**(a)**	Discuss Raoult's law for ideal solutions.	**03**
	(b)	With respect to interphase mass transfer, explain mass transfer operation between two immiscible phases.	**04**
	(c)	CO_2 and Air are in equimolal counter diffusion with each other in the tube of 50 mm diameter and 1 m length. The total pressure is 1 atm and the temperature is 25°C. The partial pressure of CO2 at one end of the tube is 190 mm Hg while at the other end of the tube is 95 mm Hg. Estimate the mass transfer rates (in kg/s) of CO2 and air through the tube. Diffusivity is $0.16 \times 10^{-4} m^2/s$.	**07**
Q.6	**(a)**	Explain in brief about Two resistance theory.	**03**
	(b)	Explain with neat sketch the rate of drying curve in detail.	**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	**07**

temperature is 298 k, at this temperature and pressure the value of diffusivity is $6.75 \times 10\text{-}5\ m^2/s$. Calculate the partial pressure of methane at point 0.02 m apart from point 1 for the above case.

Q.7 **(a)** Write down the various applications of liquid-liquid extraction. **03**

(b) Discuss the concept with principle of crystallization. **04**

(c) A continuous rectification column is used to separate a binary mixture of A & B. Distillate is produced at a rate 100 kmol/h, containing 98 mole% A. In the enriching section the mole fraction of A in the liquid and vapour from two adjacent plates are as follows. **07**

x	y
0.65	0.82
0.56	0.76

If the latent heat of vaporization is same for all mixtures and if the feed is a saturated liquid, calculate i) Reflux ratio ii) Vapour flow rate in stripping section

Q.8 **(a)** Write a short note on flash distillation. **03**

(b) Explain in brief about Fluidized bed dryer. **04**

(c) Compute the vapor-liquid equilibria at constant pressure of 1 standard atmosphere for mixtures of n-heptane (A) with n-octane (B), which may be expected to form ideal solutions. Also calculate the relative volatility for each temperature and its average value. **07**

T (^oC)	98.4	105	110	115	120	125.6
p_A,mm Hg	760	940	1050	1200	1350	1540
p_B, mm Hg	333	417	484	561	650	760

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