

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2021****Subject Code:3150501****Date:09/09/2021****Subject Name:Mass Transfer Operations 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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) What are different methods of conducting mass transfer operations at commercial scale? **03**
- (b) With reference to concept of equilibrium, Explain the principles for interphase mass transfer between two insoluble phases. **04**
- (c) State different theories used to explain the meaning of mass transfer coefficients. Explain any one in detail. **07**

- Q.2** (a) Draw classification chart of mass transfer operations. **03**
- (b) Explain the temperature and pressure dependency of diffusivity of gases and liquid. **04**
- (c) State and explain Fick's first law of diffusion Also, differentiate between flux N_A and J_A . Additionally, Prove that for unidirectional binary diffusion $J_A = - J_B$. **07**

OR

- (c) Calculate the rate of diffusion of Acetic acid (A) across a film of non-diffusing water (B) solution 1 mm thick at 17°C when the concentrations on opposite sides of the film are respectively 9 and 3 weight % acid. The diffusivity of acetic acid in the solution is $0.95 \times 10^{-9} \text{ m}^2/\text{s}$. Density of 9 and 3 weight % aqueous solutions is 1012 kg/m^3 and 1003.2 kg/m^3 respectively. $M_A = 60$, $M_B = 18$. **07**

- Q.3** (a) Classify gas-liquid equipment based on phases being dispersed with examples. **03**
- (b) Define the terms : (i) Flooding (ii) Coning (iii) Weeping (iv) Dumping **04**
- (c) Write a short note on minimum liquid gas ratio in case of gas absorption. **07**

OR

- Q.3** (a) Define absorption factor A and Stripping factor S. **03**
- (b) Explain HETP, HTU and NTU for packed bed absorption column. **04**
- (c) Differentiate between Tray tower and Packed tower. **07**

- Q.4** (a) Define ideal and non-ideal solutions with reference to multi-component absorption and state the characteristics of ideal solution. **03**
- (b) Enlist different industrial liquid extraction equipment and explain any one in detail. **04**
- (c) Discuss the system of three liquids- one pair partially soluble and the effect of temperature on these ternary equilibria in case of liquid extraction. **07**

OR

- Q.4** (a) Explain gas absorption with chemical reaction in brief. **03**

- (b) Discuss various factors to be considered in making choice of solvent for liquid extraction. **04**
- (c) 150 kg of nicotine-water solution containing 1% nicotine is to be extracted with 250 kg of kerosene at 20°C. Water and kerosene are essentially immiscible in each other, Determine the % extraction of nicotine after single stage. The equilibrium relationship is $Y^*=0.798 X$, where X and Y* are expressed as kg nicotine/kg kerosene and kg nicotine/kg water respectively. **07**
- Q.5** (a) State different types of packing materials and explain their selection criterion. **03**
- (b) What is crystallization? Discuss effect of temperature on solubility. **04**
- (c) Discuss the preparation of solids in leaching and also explain rate of leaching. **07**
- OR**
- Q.5** (a) Write a note on Ventury scrubber. **03**
- (b) Explain any one crystallization equipment in detail. **04**
- (c) Explain Shanks system for leaching. **07**
