

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-V (NEW) EXAMINATION – SUMMER 2019****Subject Code: 2150501****Date: 06/06/2019****Subject Name: Mass Transfer Operation - I****Time: 02:30 PM TO 05:00 PM****Total Marks: 70****Instructions:**

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

	MARKS
Q.1 (a) Define Diffusivity and state its assumptions for penetration.	03
(b) State and Explain Fick's law of diffusion?	04
(c) Ammonia gas (A) diffuses through nitrogen gas (B) under steady state conditions with nitrogen non-diffusing. The partial pressure of A at location 1 is 1.5×10^4 Pa and that at location 2 is 5×10^3 Pa. the location 1 and 2 are 15 cm apart. The total pressure is 1.103×10^5 Pa and temperature is 298 K. calculate the flux of diffusion of ammonia. Also calculate flux of diffusion for equimolar counter diffusion assuming that nitrogen is also diffusing. Take diffusivity at prevailing conditions are $2.30 \times 10^{-5} \text{ m}^2/\text{s}$.	07
Q.2 (a) Define N and J type flux. What is the difference between N and J?	03
(b) For equimolar counter diffusion show that $D_{AB} = D_{BA}$	04
(c) Explain the film theory for mass transfer co-efficient.	07
OR	
(c) Explain molecular diffusion in gases in detail. Also discuss steady state diffusion of A through non diffusing B.	07
Q.3 (a) State characteristics of various types of packing.	03
(b) Describe the working of wetted wall tower.	04
(c) A packed tower is designed to recover 98% CO_2 from a gas mixture containing 10% CO_2 and 90% by volume air using water. The equilibrium relation used is $y' = 14x'$, where, $y' = \text{kg CO}_2/\text{kg dry air}$ and $x' = \text{kg CO}_2/\text{kg water}$. The water to gas rate is kept 30% more than minimum value. Calculate actual mole ratio of water to solute free gas.	07
OR	
Q.3 (a) What is minimum liquid – gas ratio in case of gas absorption?	03
(b) State selection criteria for solvent in extraction.	04
(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.4 (a) Write short note on Absorption factor.	03
(b) Define: (i) Weeping (ii) Dumping (iii) Flooding (iv) Tray efficiency	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 $Y^* = 0.798X$, where X and Y^* are expressed as kg nicotine/kg kerosene and kg nicotine/kg water respectively.	07

OR

- Q.4** (a) Outline the industrial applications of leaching **03**
(b) How the height of absorption column is determined? **04**
(c) Differentiate between Packed Towers and Tray Towers. **07**

- Q.5** (a) Define HTU, NTU and give its significance. **03**
(b) Discuss the concept with principle of crystallization. **04**
(c) Explain selection criteria for choice of solvent in case of gas absorption. **07**

OR

- Q.5** (a) Define selectivity of solvent used in liquid extraction. Draw a neat sketch of the Shanks system for countercurrent multiple contact. **03**
(b) State and discuss the various techniques for achieving super saturation with suitable example. **04**
(c) Explain construction and working of Swenson-Walker Crystallizer with the help of a neat sketch. **07**

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