Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2150501 **Date: 17/12/ 2015**

Subject Name: Mass Transfer Operation - I

Time:10:30am to 1:00pm **Total Marks: 70**

Instructions:

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

Q.1 **(a)** A counter current plate absorber is to be installed for scrubbing of an air mixture containing 5% ammonia by volume. The scrubber is fed with water containing 0.002 mole NH_3/mole of water. The scrubber water flows at a rate of 1 mole water/mole of air. It is necessary to absorb 85% of the ammonia present in the gas by operating the absorber at 20 ^{0}C. Assume dilute solution, take Henry's law constant = 0.8 mole NH_3 / (mole NH_3/mole H2O). Calculate number of stages necessary for this operation. **10**

(b) Classify the mass transfer operations based on direct contact of two immiscible phases with examples. **04**

Q.2 **(a)** Solute in water solution containing 1% solute is to be extracted with solvent containing 0.2% solute. Water and solvent are completely insoluble. Determine the number of stages required for 70% extraction of solution of that in the feed. Feed solution = 100 kg, solvent in each stage = 99 kg. Use following equilibrium data: **07**

Kg solute/ kg water	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0204
Kg solute/ kg solvent	0	0.000807	0.001961	0.00456	0.00686	0.00913	0.01870

(b) Define : (i) F- type mass transfer co-efficient (ii) k-type mass transfer co-efficient (iii) Sherwood number (iv) Peclet number (v) Film Reynold's number (vi) Diffusional sub layer (vii) Mean free path **07**

OR

(b) Explain the film theory for mass transfer co-efficient. **07**

Q.3 **(a)** Explain the empirical correlation for determination of diffusivity of gases. **07**

(b) State Fick's first law and compare : (i) Molecular diffusion and Eddy diffusion (ii) N- type flux and J-type flux **07**

OR

Q.3 **(a)** Discuss the concept of equilibrium in gas absorption for ideal liquid solution and non ideal liquid solution. **07**

(b) Show that overall resistance in diffusion between two phases follows two resistance theory. **07**

Q.4 **(a)** State the operational difficulties in tray tower and discuss briefly. **07**

(b) Describe the working of venture scrubber and wetted wall tower. **07**

OR

Q.4 **(a)** Discuss the selection between tray tower and packed tower. **07**

(b) In oxygen – nitrogen mixture at 10 atm and 25 ^{0}C, the concentrations of oxygen **07**

at two places of 0.2 cm apart are 10 and 20 volume % respectively. Calculate the rate of diffusion of oxygen expressed as gm/cm^2hr for the case of unicomponent diffusion. Take diffusivity = 0.181 cm^2/sec

Q.5	**(a)**	Classify the equipments used for leaching of vegetable seeds and explain working of Boll man extractor.	**07**
	(b)	A crystallizer is charged with 100 kg of a solution containing 25% $Ba(NO_3)_2$ in water. On cooling 10% of the original water present evaporates. Calculate the yield of crystals when the solution is cooled to 283 K. The solubility at 283 K is 7 kg $Ba(NO_3)_2$ /100 kg total water.	**07**

OR

Q.5	**(a)**	Explain the types of equilibrium curves occur in leaching.	**07**
	(b)	Define 'Supersaturation' and explain Mier's supersaturation theory.	**07**

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