Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER 2013

Subject Code: 150501 Date: 14-05-2013

Subject Name: Mass Transfer Operations - I

Time: 10.30 am - 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 **(a)** Define ñDiffusivityò. Derive equation for steady-state diffusion of A through non diffusing B. **07**

(b) Discuss film theory for prediction of mass transfer co-efficient. **07**

Q.2 **(a)** Discuss in detail classification of mass transfer operations and explain with examples. **07**

(b) In an oxygen-nitrogen mixture at 10 atmosphere and 25°C,the concentrations of two plates of 0.2 cm apart are 10 and 20 volume % respectively. Calculate the rate of diffusion of O_2 in gm/cm^2 hr,through non diffusing N_2. **07**

Given that $D_{O2\text{-}N2}$ =0.181 cm^2/sec. Take R=82.06 atm. cm^3/gm.mole K

OR

(b) Define with respect to tray tower and packed tower: **07**

1) Downspouts 2) Weir 3) Tray efficiency 4) Flooding
5) Loading 6) Entrainment 7) Tray spacing

Q.3 **(a)** Define : HETP. Derive equation for height of a gas transfer unit(Ht_G) for a continuous packed absorption tower. **07**

(b) Discuss: 1) Absorption factor 2) Number of overall gas transfer units **07**

OR

Q.3 **(a)** CS_2 is to be absorbed from a dilute gas mixture of CS_2 ï N_2 into a pure non-volatile oil at atm. pressure in a counterï current absorber. The mole fraction of CS_2 in inlet gas stream is 0.05 and the flow rate of gas stream G, is 1500 k mole/hr. The equilibrium relation is given by : **07**

$y = 0.5x$,where x is the mole fraction of CS_2 in liquid stream. It is desired to reduce the mole fraction of CS_2 exit gas stream to 0.005.

Calculate minimum value of L/G, where L is liquid flow rate in k mole/hr.

(b) Discuss criteria for selection of solvent for liquid-liquid extraction. **07**

Q.4 **(a)** Discuss different co-ordinate systems used in liquid extraction. **07**

(b) If 1000 kg/h of a nicotine (C)-water(A) solution containing 1 % Nicotine is to be counter currently extracted with kerosene at 20 °C To reduce the nicotine content to 0.1% .Determine the minimum kerosene rate. The equilibrium data is given as follows: **07**

X'=kg nicotine/kg water	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0204
Y'*=kg nicotine/kg kerosene	0	0.000807	0.001961	0.00456	0.00686	0.00913	0.01870

OR

Q.4 **(a)** Discuss continuous counter current decantation with neat sketch. **07**

(b) Derive equation for material balance for multistage counter current leaching. **07**

Q.5 **(a)** Discuss agitated batch crystallizer with neat sketch. **07**

(b) With neat sketch discuss Venturi scrubber for gas-liquid contact operation. **07**

OR

Q.5 **(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 ammonia per mole of water. The scrubbing water flows at the rate of 1 mole water per mole of air. It is required to absorb 85% of ammonia present in the gas operating absorber at 20 ° C. The equilibrium relation is given as $y = 0.80\ x$. Calculate 1) concentration of ammonia in the outgoing liquid 2) number of stages necessary for this operation. **07**

(b) Discuss types of packing and their selection criteria. **07**

****