

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE SEM-V Examination-Nov/Dec.-2011

Subject code: 150501

Date: 22/11/2011

Subject Name: Mass Transfer Operation-I

Time: 2.30 pm -5.00 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) Answer the followings: **07**
1. Define gas absorption. Give its industrial significance. **04**
 2. Define: (i) Selectivity (ii) Nucleation (iii) Absorption factor **03**
- (b) Answer the followings: **07**
1. Explain in brief, triangular diagram for system with one pair partially miscible **05**
 2. Define: (i) Leaching (ii) Extract **02**
- Q.2** (a) 150kg of nicotine-water solution containing 1% nicotine is to be extracted with 250kg 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**
- (b) A packed tower is designed to recover 98% CO₂ from a gas mixture containing 10% CO₂ and 90% by volume air using water. The equilibrium relation used is **07**
- $$y' = 14x',$$
- where, y' = kg CO₂/kg dry air and x' = kg CO₂/kg water
- The water to gas rate is kept 30% more than minimum value. Calculate actual mole ratio of water to solute free gas.

OR

- (b) A hot solution containing 2000kg of MgSO₄ and water at 57°C and with a concentration of 30 weight % MgSO₄ is cooled to 30°C and MgSO₄.7H₂O crystals are removed. The solubility at 30°C is 35.5 kg MgSO₄ per 100kg water. Calculate the yield of crystals. Assume that no water is vaporized. Atomic weight: Mg=24, S=32, O=16, H=1 **07**
- Q.3** (a) What are the problems encountered while operating packed columns for gas absorption. **07**
- (b) Explain preparation of solids for leaching. **07**
- OR**
- Q.3** (a) Derive Fick's law of diffusion and explain N_A and J_A . Also prove that For unidirectional binary diffusion $J_A = -J_B$. **07**
- (b) Write a short note on analogy between transport processes. **07**
- Q.4** (a) Give detailed classification of mass transfer operations. **07**

- (b) The diffusivity of carbon tetrachloride through oxygen was determined at a steady state. The cross section area for diffusion was 0.82cm^2 and was operated at 273K and 755 mmHg pressure. The average length of the diffusion path was 17.1cm. If 0.0208cc of carbon tetrachloride was evaporated in 10 hours of steady state operation, what should be the value of the diffusivity of carbon tetrachloride through oxygen? **07**

OR

- Q.4 (a)** Define F-type and k-type mass transfer coefficients. Also derive the following relationship for steady state diffusion of gas A through non-diffusing gas B. **07**

$$F = k_G P_{B,M} = k_y P_{B,M} / P_I = K_C P_{B,M} / RT$$

- (b) State various theories used as models for explaining and predicting the mass transfer coefficients. **07**

- Q.5 (a)** Explain mass transfer operation between two immiscible phases. **08**

- (b) Define: (i) Stage (ii) Stage efficiency (iii) Equilibrium (iv) Channeling (v) Mass transfer co-efficient (vi) Entrainment **06**

OR

- Q.5 (a)** Classify gas-liquid equipments based on phases being dispersed and describe any one in detail with neat diagram. **08**

- (b) Define: (i) Tie-line (ii) Operating line (iii) Solutropic solution (iv) Raffinate (v) Extract (vi) Diffusion **06**
