

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER-V • EXAMINATION – WINTER • 2014

Subject Code: 153502

Date: 28-11-2014

Subject Name: Basics of Mass Transfer

Time: 10:30 pm 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.

- Q.1 (a)** State dimensions and SI units of enthalpy, pressure, molar flux. Convert 1 atm., 1 cal/hr, and 1 gm/cm³ to corresponding SI units. **07**
- (b)** Define the following terms : **07**
(1) Relative volatility (2) critical moisture content (3) nucleation (4) wet-bulb temperature (5) vapor pressure (6) absolute humidity (7) partial pressure
- Q.2 (a)** Starting from Fick's law of diffusion, derive an integrated equation to compute the molar flux of gas A diffusing through non-diffusing gas B. A and B are ideal gases. **07**
- (b)** Draw the neat sketch of agitated vessel for gas absorption and write its construction and functioning. **07**
- OR**
- (b)** Write in brief construction and working of drum dryer. **07**
- Q.3 (a)** Write principle of membrane separation. Explain in brief electro dialysis with neat sketch. **07**
- (b)** With neat sketch explain construction and working of vacuum crystallizer. **07**
- OR**
- Q.3 (a)** Describe with a schematic diagram Induced draft cooling tower. **07**
- (b)** Give importance of drying operation. Describe with diagram drying curve. **07**
- Q.4 (a)** Derive a relation between individual and overall mass transfer coefficients according to two film theory. **07**
- (b)** Draw a neat schematic diagram of backward feed triple effect evaporator? **07**
- OR**
- Q.4 (a)** Define leaching and give at least two industrial applications of the process. Describe the effect of various factors on the rate of leaching. Explain the terms overflow and underflow. **07**
- (b)** Derive Rayleigh equation for batch distillation. **07**
- Q.5 (a)** Calculate the equilibrium compositions of the liquid and the vapor phases for a mixture of methanol and water at a temperature of 323 K and under a pressure of 40 kPa. Vapor pressure of methanol and water at 323 K is 53.32 kPa and 12.33 kPa respectively. **07**
- (b)** In Oxygen – nitrogen gas mixture at 101.325 kPa and 25°C, the concentrations of oxygen at two phases 2 mm apart are 10% and 20% by volume respectively. Calculate the flux of diffusion of oxygen for the cases of equimolar counter diffusion of the two gases. Diffusivity of oxygen in nitrogen is $1.18 \times 10^{-5} \text{ m}^2/\text{s}$. $R = 8.314 \text{ m}^3 \text{ kPa/kmol K}$. **07**
- OR**
- Q.5 (a)** A wet solid is to be dried from 35% to 10% moisture under the constant drying conditions in five hours. If the equilibrium moisture content is 4% and the critical moisture content is 14 %, how long it takes to dry solids to 6% moisture under the same conditions? **07**

- (b) Calculate the rate of diffusion of acetic acid (A) across a film of non-diffusing water (B) 07
1mm thick at 290 K if the concentrations of acetic acid on the opposite sides of the film
are 9% and 3% respectively. The densities of 9% and 3% solutions are 1012 kg/m^3 and
 1003.2 kg/m^3 respectively. The diffusivity of acetic acid in water is $0.95 \times 10^{-9} \text{ m}^2/\text{s}$.
