

GUJARAT TECHNOLOGICAL UNIVERSITY
BE – SEMESTER – VI (NEW).EXAMINATION – WINTER 2016

Subject Code: 2160501**Date: 22/10/2016****Subject Name: Mass Transfer Operation - II****Time: 10:30 AM 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)** 1000 kmol/hr of an ethanol-propanol mixture containing 65 mole percent ethanol is to be separated in a continuous plate column operating at 101.325 kPa total pressure. The desired terminal composition in terms of mole fraction of ethanol are $x_D = 0.92$ and $x_W = 0.07$. The feed is saturated vapour and total condenser is used. When the reflux flow rate is four times the amount of top product, find the number of theoretical plate required for the separation and location of feed plate. Relative volatility of ethanol-propanol system may be taken as 2.10 **07**

- (b)** A feed of 70 mole % hexane and 30 mole % octane is fed to a pipe still through a pressure reducing valve into a flash disengaging chamber. The vapour and liquid leaving the chamber are assumed to be in equilibrium. If 50 mole % of feed is vaporized, find the composition of the top and bottom products. Equilibrium data are given below **07**

x, mole fraction of hexane in liquid	1	0.69	0.40	0.192	0.045	0
y, mole fraction of hexane in vapour	1	0.932	0.78	0.538	0.1775	0

- Q.2 (a)** Define Differential distillation and derive material balance equation for the same **07**

- (b)** What do you mean by deviation of Ideality, discuss with examples **07**

OR

- (b)** What is reflux ratio? Explain minimum and total reflux ratio, How to calculate minimum reflux ratio when feed is saturated vapour. **07**

- Q.3 (a)** Explain following terms for air- water system (i) Relative humidity (ii) Absolute humidity (iii) Wet bulb temperature. **07**

- (b)** Why cooling towers are used in chemical process industries, give the classification and explain in detailed about cooling tower used in power plants. **07**

OR

- Q.3 (a)** Explain following terms (i) Range and approach in cooling tower (ii) Dew point temperature (iii) Dry bulb temperature **07**

- (b)** Write a note on adiabatic saturation temperature **07**

- Q.4 (a)** Discuss about pressure swing adsorption (PSA) **07**

- (b)** Write a note on various commercial applications of ion-exchange process **07**

OR

- Q.4 (a)** Define adsorption and discuss various adsorbents and their applications **07**

- (b)** Explain principle of ion exchange and its application in softening of water **07**

- Q.5 (a)** A porous solid is dried in a batch dryer under constant drying conditions. Eight hours are required to reduce the moisture content from 40 % to 10 %. The critical moisture content was found to be 20 % and equilibrium moisture content 4 %. All moisture content is on dry basis. Assuming that the rate of drying falling rate period is proportional to free moisture content, how long should it take to dry a sample of the same solid from 40 % to 5 % under the same drying conditions. **07**
- (b)** Discuss the factors on which rate of drying depends and derive the equation to calculate the time of drying during constant rate period **07**

OR

- Q.5 (a)** Discuss construction and working of Rotary dryer **07**
- (b)** 3000 kg dry mass of non-porous solid is dried under constant drying conditions. The area of drying surface is 60 m^2 . How long it will take to dry a material from 0.15 to 0.025 kg water/ kg of dry solids? The equilibrium moisture content is assumed to be zero. The critical moisture content is 0.125 kg water/kg of dry solids. If the initial rate of drying is $3 \times 10^{-4} \text{ kg/m}^2 \text{ s}$, Assume that the falling rate is linear. **07**
