

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VI • EXAMINATION – WINTER • 2014****Subject Code: 160501****Date: 26-11-2014****Subject Name: Mass Transfer Operations - II****Time: 02:30 pm - 05:00 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)** Vapor pressures of Benzene and Toluene mixture are given in the table below. **07**
Assuming that this mixture follow Raoult's law, Calculate and plot the boiling point diagram and the equilibrium composition curve. The total pressure is 1 atm.

Temp (°C)	P_{Ben}^0 (mm Hg)	P_{Tol}^0 (mm Hg)
80.1	760	0
85	877	345
90	1016	405
100	1344	557
110	1748	743
110.6	1800	760

- (b)** What do you understand by quantity 'q'? Derive q-line equation for introduction of feed in the distillation column. **07**
- Q.2 (a)** Experiments on decolourisation of oil yielded the equilibrium relationship as **07**
 $y = 0.5x^{0.5}$, where y = gm colour removed/gm adsorbent and x = colour in oil, gm colour/1000 gm colour free oil. 100 kg oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of adsorbent. Calculate the percentage colour removed if all 25 kg of adsorbent is used in one step.
- (b)** Derive the equation for the rate of adsorption in a fixed bed and explain the concept of degree of saturation. **07**

OR

- (b)** What is an azeotrope? With suitable example explain the advantages, disadvantages and industrial application of azeotropic distillation. **07**
- Q.3 (a)** Qualitatively, explain the apparent adsorption of solute from solution. **07**
- (b)** Prove that for crosscurrent two-stage treatment of liquid solutions by contact filtration, when the adsorption isotherm is linear, the least total adsorbent results if the amounts used in each stage are equal. **07**

OR

- Q.3 (a)** What is reflux ratio? Derive Fenske Equation. **07**
- (b)** The charge to a simple batch still consists of an equimolar binary mixture of A and B. For values of α_{AB} of 2, 5, 10, 100, and 1000, and 50% vaporization of A, determine the percent vaporization of B and the mole fraction of B in the total distillate. **07**
- Q.4 (a)** With neat diagram explain the theory of wet-bulb temperature and derive the equation for wet-bulb temperature determination. **07**

- (b) In a mixture of benzene vapor (A) and nitrogen gas (B) at a total pressure of 800 mm Hg and a temperature of 60 °C, the partial pressure of benzene is 100 mm Hg. Express the benzene concentration in terms of mole fraction, volume fraction, molar absolute humidity and mass absolute humidity. 07

OR

- Q.4 (a) Explain the theory of adiabatic saturation temperature and derive the equation for adiabatic saturation temperature determination. 07

- (b) The temperature of air in a room is 40.2 °C and the total pressure is 101.325 kPa absolute. The air contains water vapor with a partial pressure of 3.74 kPa. The vapor pressure of water at this temperature is 7.415 kPa. Calculate the humidity, the saturation humidity, percentage humidity and the percentage relative humidity. 07

- Q.5 (a) Derive the relation to determine the time needed for constant & falling rate period of the batch drying operations. 07

- (b) List out various types of cooling towers and discuss their selection criteria in detail. 07

OR

- Q.5 (a) With a neat sketch explain the construction, working principle and industrial application of spray dryer. 07

- (b) Explain the mechanism of through circulation drying. Derive the relation for the rate of drying of unbound moisture. 07
