Seat No.: _____ Enrolment No._____

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. Assuming that this mixture follow Rault's law, Calculate and plot the boiling point diagram and the equilibrium composition curve. The total pressure is 1 atm. **07**

Temp (^oC)	P^0_{Ben} (mm Hg)	P^0_{Tol} (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 $y = 0.5x^{0.5}$, 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. **07**

(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 ^{o}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 ^{o}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**

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