## **GUJARAT TECHNOLOGICAL UNIVERSITY** BE – SEMESTER – VI EXAMINATION – WINTER 2015

Subject Code:160501 Subject Name: Mass Transfer Operation II Time:2:30pm to 5:00pm Instructions: Date:15/12/ 2015

## Total Marks: 70

- 1. Attempt all questions.
- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q.1 (a) A continuous distillation column is to be designed to separate 2500 kg/hr of a mixture of 55% (by wt.) benzene (A) and 45% (by wt.) toluene (B) into an overhead and bottom product containing 97 wt% benzene and a bottom product containing 98 wt% toluene. A reflux ratio of 3.5 moles to 1 mole of product is to be used. Calculate the rates of overhead and bottom products. Calculate the number of theoretical plates using McCabe & Thiele method and position of feed plate if the feed is liquid at its boiling points. Calculate also minimum reflux ratio. The distillate is totally condensed and reflux returned at its boiling point. Relative volatility = 2.44.
- Q.2 (a) Define quantity 'q'. Derive equation for q-line and discuss location of 'q' line 07 for typical feed condition in brief.
  - (b) A mixture of 45 mole % A and remaining B is to be separated in distillation 07 column. The concentration of A in the distillate is 94 mole % and 95 mole % of all A is in distillate. Compute the composition of A and B in distillate and residue. Relative volatility of A to B is 2.5.

#### OR

- (b) What is Azeotrope? Distinguish between minimum and maximum boiling 07 azeotropes with examples of each.
- Q.3 (a) Explain the concept of wet-bulb temperature and adiabatic saturation 07 temperature.
  - (b) What is the selection criteria employed on the various types of cooling towers? 07

#### OR

- Q.3 (a) An air (B)-water vapor (A) sample has a dry bulb temperature 55 °C and an absolute humidity 0.030 kg water/ kg dry air at 1 atm pressure. Determine the following
  - (i) the absolute molal humidity
  - (ii) the partial pressure of water vapor
  - (iii) relative humidity (vapor pressure of water at 55  $^{\circ}C = 118 \text{ mmHg}$
  - (iv) Humid heat
  - (v) Humid volume, where pressure in  $N/m^2$
  - (b) Explain the following terms for air- water system (a) Dew point (b) Wet bulb 04 temperature (c) dry bulb temperature.

# Q.4 (a) Explain Adsorption isotherm and hysteresis. 07

(b) Write Freundlich equation and explain its application for two stages cross07current adsorption.

#### OR

Q.4 (a) Define Ion Exchange. Explain principles of ion exchange. Describe techniques 14 and application of ion exchange. List out the factors on which rate of ion exchange is dependent.

- Q.5 (a) A 150 kg batch of granular solids containing 32% moisture is to be dried in a tray dryer to 17 % moisture by passing a current of air at 350 k across its surface at a velocity of 1.8 m/s. If the constant rate of drying under these conditions is 0.75 x 10<sup>-3</sup> kg/m<sup>2</sup>s and the critical moisture content is 15 %. The drying surface is 0.03 m<sup>2</sup>/kg dry weight. Calculate the drying time.
  - (b) Differentiate between Bound, Unbound and Free moisture in context with the 06 drying operations.

### OR

Q.5	<b>(a)</b>	Explain design and working of spray dryer with figure. Also discuss benefits of	07
		spray drying in brief.	
	(1)		~ -

(b) Explain rate of drying curve.

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