

GUJARAT TECHNOLOGICAL UNIVERSITY**BE- VIth SEMESTER-EXAMINATION – MAY- 2012****Subject code: 160501****Date: 09/05/2012****Subject Name: Mass Transfer Operation-II****Time: 10:30 am – 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)** Explain Raoult's Law for ideal solutions. Compute the vapor-liquid equilibria at constant pressure of 1 standard atmosphere for mixtures of n-heptane (A) with n-octane (B), which may be expected to form ideal solutions. Also calculate the relative volatility for each temperature and its average value. **07**

T ($^{\circ}$ C)	98.4	105	110	115	120	125.6
p _A , mm Hg	760	940	1050	1200	1350	1540
p _B , mm Hg	333	417	484	561	650	760

- (b)** Explain Azeotropic distillation OR Extractive distillation. **07**

- Q.2 (a)** Derive Rayleigh Equation for binary mixture. How it is useful experimentally? **07**
- (b)** Discuss in detail about Steam Distillation with example and compare it with vacuum distillation. **07**

OR

- (b)** Explain Enriching section for total condenser – reflux at bubble point and Exhausting section for reboiled vapour in equilibrium with residue. **07**

- Q.3 (a)** Explain the following terms for air-water system: (i) Absolute humidity (ii) Dew point (iii) Dry bulb temperature (iv) Wet bulb temperature (v) Humid volume (vi) Humid heat (vii) Lewis Relation **07**
- (b)** Explain the various types of cooling towers and discuss their selection criteria. **07**

OR

- Q.3** A continuous distillation column is to be designed to separate 3000 kg/hr of a mixture of 60% (by wt.) benzene (A) and 40% (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. **14**

- Q.4 (a)** Discuss in detail the types of adsorption and nature of adsorbents and list out principal adsorbents generally used. **07**

- (b) Write Freundlich equation and explain its application for two stage cross current adsorption. **07**

OR

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

- Q.5 (a)** Explain with the sketch, the principle and working of rotary drier. **07**

- (b)** Explain with the sketch, the principle and working of spray drier. **07**

OR

- Q.5** A batch of solid for which the material is dried from 25 to 9% moisture has the initial weight of solid to be 160 kg. The drying surface is $1 \text{ m}^2/40 \text{ kg dry weight}$. Determine the time of drying for constant rate period and falling rate period using graphical method. The data are as follows: **14**

X	0.35	0.3	0.25	0.2	0.18	0.16	0.14	0.12	0.10	0.09
N	0.30	0.3	0.30	0.3	0.266	0.239	0.208	0.18	0.15	0.097

Where X= kg moisture / kg dry solid

N= rate of drying $\times 10^3$, kg evaporated / m^2 -sec.
