

GUJARAT TECHNOLOGICAL UNIVERSITY
B. E. - SEMESTER – VI • EXAMINATION – WINTER 2012

Subject code: 160405**Date: 07/01/2013****Subject Name: Principles of Process Engineering-III****Time: 02.30 pm - 05.00 pm****Total Marks: 70****Instructions:**

1. Attempt any five questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Notations used have their conventional meanings.

- Q.1** (a) With reference to humidification operations, define and explain... **08**
 (i) Saturated and unsaturated vapor-gas mixtures
 (ii) Molal and mass Absolute humidity
 (iii) Percentage and relative humidity
 (iv) Humid heat and enthalpy
- (b) Explain concepts of adsorption hysteresis and adsorption wave with neat sketches. **06**

- Q.2** (a) Discuss single stage liquid-solid adsorption operation, with the help of diagrams, equilibrium curves and Freundlich adsorption isotherm. **07**
- (b) With special emphasis on adiabatic saturation temperature, derive the equation of adiabatic saturation curve on the psychrometric chart for adiabatic gas-liquid contact. **07**

OR

- (b) At equilibrium the concentration of water in vapor phase (C^*) in kg/m^3 of air space and the amount of water (m) adsorbed per kg of dry silica gel are related by $C^* = 0.0667m$. To maintain dry conditions in a room of air space 100 m^3 containing 2.2 kg of water vapor initially, 10 kg of dry silica gel is kept in the room. What is the fraction of initial water remaining in the air space after a long time? **07**

- Q.3** A feed solution contains 100 moles of benzene-toluene mixture having 70 mole percent benzene. One third of the feed is vaporized. The total pressure is 1 atm . Calculate the distillate composition (vapor) and bottoms (liquid) composition using (a) flash distillation, and (b) differential distillation. For benzene-toluene system take $\alpha_{\text{avg}} = 2.5$. **14**

OR

- Q.3** A mixture of benzene and toluene containing 45 mole % benzene is to be separated to give an overhead product of 95 mole % benzene and a bottom product containing 5 mole % benzene. The feed is at its boiling point, and the vapor leaving the column is condensed but not cooled and provides reflux and product. Equilibrium data for mol fractions of benzene in liquid, x and vapor, y is given as follows: **14**

x	0.78	0.581	0.411	0.258	0.130	0.017
y	0.90	0.777	0.632	0.486	0.261	0.039

Using McCabe-Thiele method, calculate:

- (a) Minimum reflux ratio.
- (b) Number of theoretical plates required when total reflux is used.

- Q.4** (a) Explain azeotropic distillation in detail with examples. Also, state the important characteristics of the entrainer for azeotropic distillation. **07**
(b) Describe various methods to find out time of drying in falling rate period in detail. **07**

OR

- Q.4** (a) State the assumptions made in Lewis-Sorel method for determining the number of plates required in a distillation column. Also, give stepwise procedure to find out number of theoretical plates. **07**
(b) Explain in detail various moisture movement mechanisms in drying. **07**

- Q.5** (a) Explain Mier's supersaturation theory of crystallization with neat diagram. **07**
(b) With the help of diagram, define and explain following types of moistures. **07**
(a) Moisture content on dry and wet basis
(b) Bound and Unbound moisture
(c) Free and equilibrium moisture

OR

- Q.5** (a) Mention various crystallizers and discuss any one in detail with neat diagram. **07**
(b) Explain positive and negative deviations from ideality- Raoult's law, with examples in brief. **07**
