Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2160501 **Date: 27/04/2017**

Subject Name: Mass Transfer Operation - II

Time: 10:30 AM to 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 Do as directed **14**

1. Name the most commonly used reboiler in the distillation column.
2. At total reflux ratio in continuous distillation column the no. of plates are

   i) Maximum ii) Minimum iii) Infinite iv) None of these
3. The surface on which adsorption takes place is called ….a… and the substance adsorbed is known as ….b….

   i) (a) adsorbate (b) adsorbent ii) (a) adsorbent (b) adsorbate

   iii) (a) Absorbent (b) Absorbate iv) (a) Absorbate (b) Absorbent
4. Define equilibrium moisture X*
5. Adsorption is preferred at

   i) High temp. & low press. ii) Low temp & high press.

   iii) Low temp & low press. iv) High press. & high temp
6. In binary distillation column, if feed contain 40 mole% vapor, calculate the slope of feed line. (Show calculations)
7. For an unsaturated air-water vapor mixture, the ratio of the % saturation and relative saturation is always

   i) Equal to one ii) More than one iii) Less than one iv) none of the above
8. Define wet bulb temperature.
9. If X is the moisture content of the wet solid on dry basis, then the moisture content of the wet solid on wet basis is ……..
10. If the moisture content of the wet solid on dry basis is twice the moisture content on wet basis; what will be the moisture content on wet basis

    i) 0.5 ii) 1 iii) 1.5 iv) 2
11. When feed to the distillation column is saturate liquid; what is the slope of feed line?
12. Rayleigh equation applies to

    i) Simple distillation ii) Flash distillation iii) Molecular distillation

    iv) Steam distillation
13. Define absolute humidity.
14. State the role of solvent in extractive distillation.

Q.2 **a)** Show that the relative volatility of an ideal binary system is equal to the ratio of vapor pressure of two components. **03**

b) In flash distillation prove that $x = y = x_f$ **04**

c) A continuous rectification column is used to separate a binary mixture of A & B. Distillate is produced at a rate 100 kmol/h, containing 98 mole% A. In the enriching section the mole fraction of A in the liquid and vapour from two adjacent plates are as follows **07**

x	y
0.65	0.82
0.56	0.76

If the latent heat of vaporization is same for all mixtures and if the feed is a saturated liquid, calculate

i) Reflux ratio

ii) Vapour flow rate in stripping section

OR

c) A binary distillation column is operating under conditions specified as below: **07**

Feed rate = 350 kmole/h, overhead product rate =150 kmole/h, Overhead product composition (MVC) = 97%, Bottom product = 2%, Bottom product rate = 200 kmole/h, reflux ratio = 3.5. In the stripping section, it was found that the mole fraction of more volatile component in the vapor leaving a plate is 0.33 while its mole fraction in the liquid coming to the same plate is 0.25. Assuming constant molar overflow, determine whether the feed is vapor, liquid or partially vaporized.

Q.3 **a)** Define reflux ratio and how does it helps in improving the purity of the top product in rectification section. **03**

b) State and discuss the types of adsorption with suitable example. **04**

c) Write a short note on ion exchange covering its principles, equilibria and applications. **07**

OR

Q.3 **a)** State the various industrial applications of adsorption. **03**

b) State the significance of Freundlich equation applicable to adsorption. Derive the relation for single stage adsorption using the Freundlich equation. **04**

c) Name the various industrial processes for adsorption of vapors and explain any two in detail. **07**

Q.4	**a)**	In a mixture of benzene (A) vapor and nitrogen (B) gas at a total pressure of 800 mmHg and temperature of $60^{O}C$, the partial pressure of benzene is 100 mmHg calculate the absolute humidity and molal absolute humidity.	**03**
	b)	Define with expression the humid volume and humid heat.	**04**
	c)	Explain with schematic diagram the concept of wet bulb temperature and derive the relation for wet bulb depression.	**07**

OR

Q.4	**a)**	Define relative saturation, percentage saturation and enthalpy.	**03**
	b)	For an air-water–vapor mixture of dry bulb temperature $65^{O}C$ and wet bulb temperature $35^{O}C$ was determined under conditions such that the radiation coefficient can be neglected. The total pressure was 1 atm. Compute the humidity of the air. The data given are latent heat of wet bulb temperature = 2,41,9300 J/kg, Y'_w = 0.0365 kg H_2O/kg dry air, ρ_{Air} = 1.060 kg/m^3, μ_{Air} = 1.95 × 10^{-5} kg/m-s, D_{AB} = 2.58 × 10^{-5} m^2/s	**04**
	c)	Write a short note on azeotropic distillation with suitable example.	**07**
Q.5	**a)**	Define Free moisture, bound moisture and unbound moisture.	**03**
	b)	Explain with neat sketch the rate of drying curve in detail.	**04**
	c)	Explain the working of various indirect type rotary dryers.	**07**

OR

Q.5	**a)**	State the equations for time of drying.	**03**
	b)	Write a short note of drum dryers.	**04**
	c)	A wet solid is to be dried from 35% to 10% moisture under constant drying conditions in five hours. If the equilibrium moisture content is 4% and the critical moisture content is 14%. How long it will take to dry solids to 6% moisture under the same conditions.	**07**

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