GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER– VI (NEW) EXAMINATION – WINTER 2021

Subject Code:3160501   **Date:24/11/2021**
Subject Name:Mass Transfer Operations 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.**
   4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define relative volatility. Discuss its importance.	**03**
	(b)	What is the effect of increasing pressure on separation of components in binary distillation column? Justify with appropriate y vs x diagram.	**04**
	(c)	100 moles of mixture of components A and B containing 60 mole % of A is subjected to a differential distillation at atmospheric pressure till the composition of A in the residue is 30%. Calculate the total moles of distillate and residue. Average relative volatility is constant at 2.25. Also draw an equilibrium diagram (y vs x diagram).	**07**
Q.2	**(a)**	Define: Reflux ratio, Total reflux, minimum reflux	**03**
	(b)	Write in brief,” Thermosyphon reboiler, its applications and limitations”	**04**
	(c)	Compute the vapour liquid equilibria at constant pressure of 1 atm for the mixture of n- heptane and n-octane, which may be expected to form ideal solution.	**07**

Data:
B.P. of n-Heptane = 98.38 °C and B.P. of n-Octane = 125.2°C
Antoine equation and Antoine constants

$$\log_{10}P = A - \frac{B}{T+C} \qquad \text{where, P is in bar and T is in K}$$

Component	A	B	C
n heptane	4.02832	1268.636	-56.199
n-octane	4.04867	1353.126	-63.633

OR

	(c)	Derive equation of q-line	**07**
Q.3	**(a)**	Define: Relative saturation, Percentage saturation, Dew point	**03**
	(b)	Discuss the classification of cooling tower.	**04**
	(c)	Explain the theory of adiabatic saturation temperature and derive the equation for adiabatic saturation temperature determination.	**07**

OR

Q.3	**(a)**	Compare forced draft and induced draft cooling tower.	**03**
	(b)	Explain the following terms for air-water system: (i) Absolute humidity (ii) Humid volume (iii) Humid heat (iv) Lewis Relation	**04**
	(c)	A mixture of gas B and benzene (A) is saturated at 1 std. atmosphere and 50 °C. Calculate the absolute humidity if B is (a) Carbon dioxide and (b) Nitrogen. Assume a mixture is saturated. (Refer Figure 1 for calculation)	**07**

Q.4 **(a)** Explain physical adsorption. **03**

(b) What is pressure swing adsorption (PSA)? Discuss PSA with industrial application **04**

(c) Using Freundlich equation, derive the following expression **07**

$$\left(\frac{Y_0}{Y_2}-1\right)=\left(\frac{Y_1}{Y_2}\right)^{\frac{1}{n}}\left(\frac{Y_1}{Y_2}-1\right)$$

for a two-stage counter current adsorption operation. Where Y_0, Y_1 and Y_2 represents initial, intermediate and final concentrations terms for an adsorption operation and 'n' is a constant of Freundlich equation.

OR

Q.4 **(a)** Explain chemical adsorption. **03**

(b) What do you mean by Ion Exchange? Describe techniques and application of ion exchange. **04**

(c) Write Freundlich equation and explain. Write material balance for a single stage adsorption and apply Freundlich equation in it. **07**

Q.5 **(a)** Discuss the working of freeze dryer with **03**

(b) List out the factors which affects the drying. Differentiate between drying and evaporation? **04**

(c) What is pressure swing adsorption (PSA)? With a neat and clean diagram discuss PSA with industrial applications and advantages. **07**

OR

Q.5 **(a)** Discuss in detail. "Types of moisture" with suitable figure. **03**

(b) A 25 cm x 25 cm x 1 cm flat sheet weighing 1.2 kg initially was dried from both sides under constant drying rate condition. It took 1500 sec for the weight of the sheet to reduce to 1.05 kg. Another 1 m x 1 m x 1 cm flat sheet of the same material is to be dried from one side only. Under the same drying rate condition, what is the time required for the drying (in sec) from its initial weight of 19.2 kg to 17.6 kg? **04**

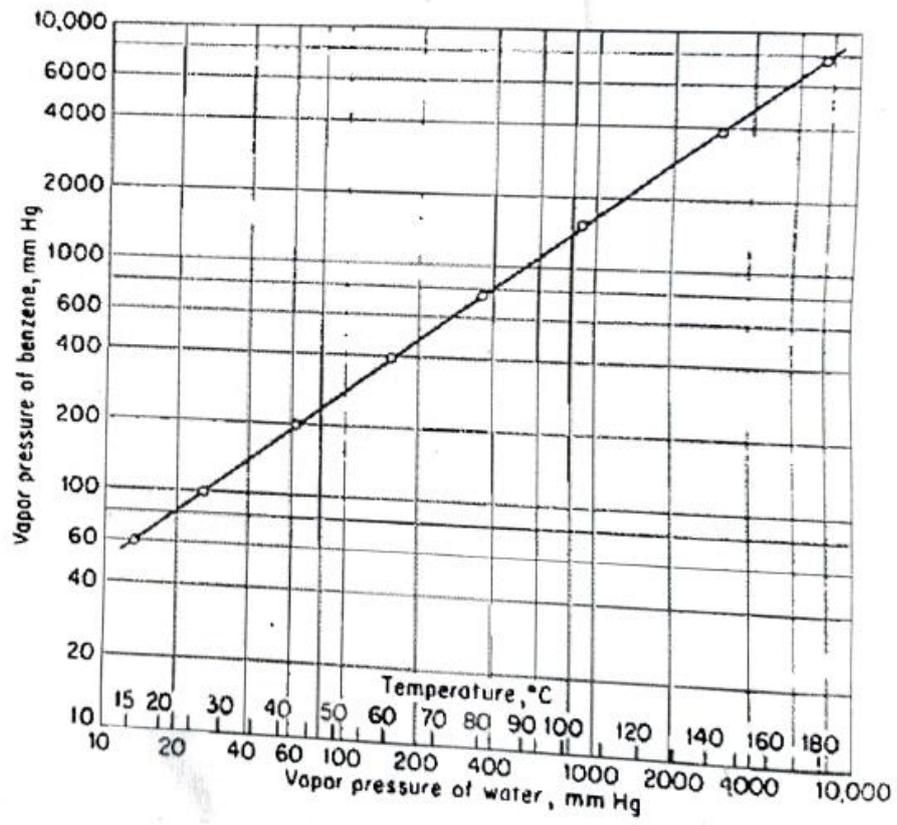**(c)** Derive equation for time required in constant and falling rate drying. **07**

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Figure 1