Seat No.: _____ Enrolment No.

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI (NEW) EXAMINATION – WINTER 2020

Subject Code:2160501 **Date:20/01/2021**

Subject Name:Mass Transfer Operation - II

Time:02:00 PM TO 04:00 PM **Total Marks: 56**

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Draw schematic diagram of conventional fractionating column and explain how mass transfer takes place between two phases in the column. **03**

(b) Prove that 'Relative Volatility (α) is the ratio of vapor pressure of the components'. **04**

(c) Derive operating line equation for Flash Distillation. Draw operating line for (a) Feed is totally vaporized (b) No feed is vaporized. **07**

Q.2 **(a)** What is positive and negative deviation from ideality with reference to Raoult's law? Give example of each type of system. **03**

(b) What is reflux ratio and also explain minimum and total reflux ratio. **04**

(c) 100 kmol of liquid mixture containing 50 mole% n-heptane (more volatile) and 50 mole% n-octane at 30°C is to be subjected to a differential distillation at atmospheric pressure with 60 mole% of liquid distilled. Compute the composition of the composited distillate and the residue using Rayleigh equation. Use equilibrium data for n-heptane and n-octane (in mole fractions of n-heptane in vapour and liquid) is given below. **07**

x	0.5	0.46	0.42	0.38	0.34	0.32
y	0.689	0.648	0.608	0.567	0.523	0.497

Q.3 **(a)** What is the selection criteria employed on the various types of cooling towers? **03**

(b) Discuss concept and application of 'evaporative cooling'. **04**

(c) A mixture of air and water vapor has a dry bulb temperature of 55ºC and an absolute humidity of 0.03 kg water/kg dry air. The system pressure is at 1 atm. *Refer Psychrometric chart for air-water vapor system.* Evaluate **07**

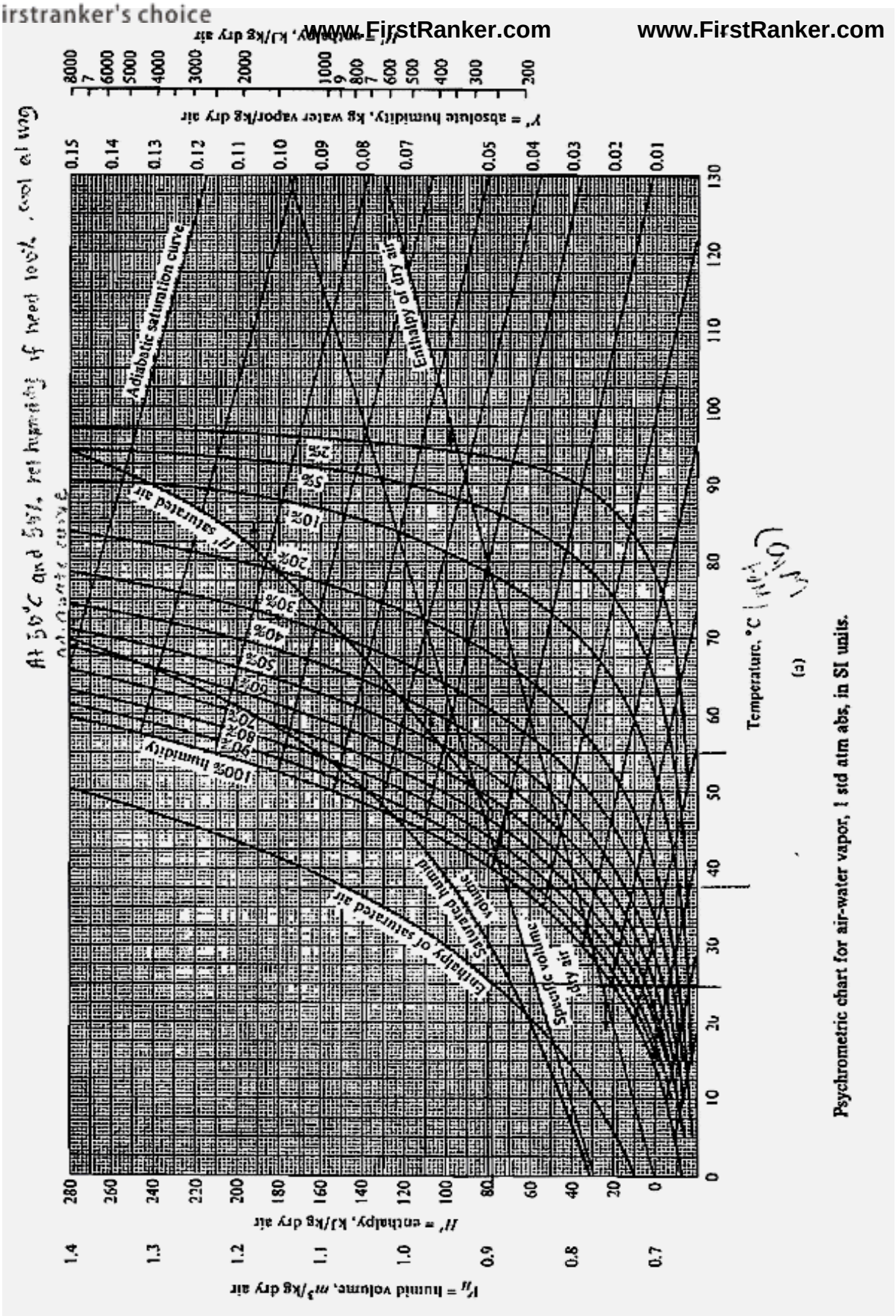
1. % humidity
2. Saturation humidity
3. Dew point temperature
4. Humid volume
5. Humid heat
6. Enthalpy
7. Relative humidity

Q.4 **(a)** Discuss the concept of wet bulb temperature. **03**

(b) Explain the following terms for air-water system: (i) Absolute humidity (ii) Humid volume (iii) Humid heat (iv) Lewis Relation **04**

(c) Discuss Water cooling towers in detail. **07**

Q.5	**(a)**	Differentiate between Bound, Unbound and Free moisture in context with the drying operations.	**03**
	(b)	Classify dryers and discuss selection criteria for dryers.	**04**
	(c)	Derive the relation to determine the time needed for constant and falling rate period of the batch drying operations.	**07**
Q.6	**(a)**	Explain the movement of moisture within the solid by liquid diffusion.	**03**
	(b)	Explain with the sketch, the principle and working of fluidized bed drier?	**04**
	(c)	Slabs of paper pulp 100 cm x 100 cm x 1.5 cm are to be dried under constant drying conditions from 67% to 30% moisture. The value of equilibrium moisture for the material is 0.5%. If the critical moisture content is 60% and the rate of drying at the critical point is 1.5 kg/(m^2/h), Calculate the drying time. The dry weight of each slab is 2.5 kg. All the moisture contents are on wet basis. The falling rate may be assumed to be linear. Consider drying from the two big faces.	**07**
Q.7	**(a)**	Discuss the types of adsorption, nature of adsorbents and also list-out important industrial adsorbents.	**03**
	(b)	What is pressure swing adsorption (PSA)? Discuss PSA with industrial application.	**04**
	(c)	For a cross-current two stage adsorption process, derive the expression given below. $$\left(\frac{Y_1}{Y_2}\right)^{1/n} - \frac{1}{n}\frac{Y_0}{Y_1} = 1 - \frac{1}{n}$$ 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.	**07**
Q.8	**(a)**	Explain Adsorption isotherm and hysteresis.	**03**
	(b)	What do you mean by Ion Exchange? Describe techniques and application of ion exchange.	**04**
	(c)	State the significance of Freundlich equation applicable to adsorption. Derive the relation for single stage adsorption using the Freundlich equation.	**07**



Q-3 (C) Psychrometric chart for air-water vapor system

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