Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–VI EXAMINATION – WINTER 2025

Subject Code: 3160501 Date: 02-12-2025

Subject Name: Mass Transfer Operations II

Time: 02:30 PM TO 05:00 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: 1) Relative humidity 2) Dew point 3) Minimum reflux	**03**
	(b)	Prove that 'Relative Volatility (α) is the ratio of vapor pressure of the components'.	**04**
	(c)	1000 kmol/h of an ethanol-propanol mixture containing 65 mole percent ethanol is to be separated in a continueous plate column operating at 101.325 kPa total pressure. The desired terminal composition in terms of mole fraction of ethanol are- x_d = 0.92 and x_w = 0.07. The feed is saturated vapour and total condenser is used. When the reflux flow rate is 4 times the amount of top product, find the number of theoretical plates required for the separation. Relative velocity of ethanol-propanol system is 2.10.	**07**
Q.2	**(a)**	Define: 1) Azeotrope 2) Reflux Ratio 3)Total reflux	**03**
	(b)	Explain effect of increased pressure on vapour-liquid equilibrium.	**04**
	(c)	A charge of 50 kmol of a mixture of benzene and chlorobenzene having 55 mol% of the less volatile is to be batch distilled. A) If 25 moles of the solution is vaporized and condensed as the distillate, calculate the concentration of the accumulated distillate. B) If the concentration of the accumulated product is found to be 72 mole% benzene, calculate its amount. The relative volatility of benzene in the mixture is 4.15.	**07**
		OR	
	(c)	A feed of 60 mole% hexane and 40 mole% octane is fed to a pipe still through a pressure reducing valve into a flash disengaging chamber. The vapour and liquid leaving the chamber are assumed to be in equilibrium. If 50 mole% of feed is vaporized, find the composition of the top and bottom products. Equilibrium data is given below:	**07**

x	1	0.69	0.4	0.192	0.045	0
y	1	0.932	0.78	0.538	0.1775	0

x = mole fraction of hexane in liquid and y = mole fraction of hexane in vapour.

Q.3	**(a)**	Define: 1) Absolute Humidity 2) Lewis relation 3) Humid heat	**03**
	(b)	Explain natural draft cooling tower.	**04**
	(c)	Derive the expression for wet bulb depression.	**07**

OR

Q.3	**(a)**	Define: 1) Percentage saturation 2) Humid Volume 3) Dry bulb temperature	**03**
	(b)	Explain concept of wet bulb temperature.	**04**
	(c)	Derive the equation of adiabatic saturation curve.	**07**
Q.4	**(a)**	State any four commercial adsorbents.	**03**
	(b)	Explain selection criteria of adsorbents and adsorption process.	**04**
	(c)	Explain Freundlich isotherm. Write material balance for a single stage adsorption and apply Freundlich equation in it.	**07**

OR

Q.4	**(a)**	State the various industrial applications of adsorption operation.	**03**
	(b)	Explain Adsorption hysteresis.	**04**
	(c)	Explain the principles of ion exchange and describe its various techniques and industrial applications.	**07**
Q.5	**(a)**	Classify dryers and discuss selection criteria for dryers.	**03**
	(b)	Explain flash distillation operation.	**04**
	(c)	A 50 Kg batch of granular solids containing 25% moisture is to be dried in a tray dryer to 12% moisture by passing a stream of air at 363 K (90 ^{o}C) tangentially across its surface at a velocity of 1.8 m/s. If the constant rate of drying under these conditions is 0.0008 Kg moisture/m^2s and the critical moisture content is 10%, calculate the drying time. The surface area available for drying is 1 m^2.	**07**

OR

Q.5	**(a)**	Describe the factors affecting on rate of drying.	**03**
	(b)	Explain differential distillation operation.	**04**
	(c)	Slabs of paper pulp 100 cm x 100 cm x 1.5 cm is 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 rate of drying at the critical point is 1.5 kg/m^2h, calculate the drying time. The dry weight of each slab is 2.5 Kg. All moisture contents are on weight basis.	**07**

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