	Utech
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### CS/B.Tech/BT(N)/SEM-5/CH-515/2012-13 2012

### TRANSFER OPERATIONS-II

Time Allotted: 3 Hours Full Marks: 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

#### **GROUP - A**

#### (Multiple Choice Type Questions)

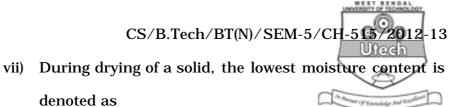
- 1. Choose the correct alternatives for any ten of the following :  $10 \times 1 = 10$ 
  - i) The diffusivity (D) in a binary gas mixture is related to the temperature (T) as
    - a)  $D\alpha T$

- b)  $D\alpha T^{0.5}$
- c) D $\alpha$ T <sup>1.5</sup>
- d)  $D\alpha T^2$ .
- ii) Duffusivity has the same dimension as
  - a) absolute viscosity
  - b) kinematic viscosity
  - c) density
  - d) concentration.

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iii)		slope of operating line	for t	he stripping section of	
	a)	0	b)	α	
	c)	< 1	d)	> 1.	
iv)	Sch	midt number is analogo	us to		
	a)	Pradtl number			
	<b>b</b> )	Sherwood number			
	c)	Nusselt number			
	d)	Froude number.			
v)	In	azeotropic mixture,	the	equilibirum vapour	
	composition in  a) more than liquid composition				
	<b>b</b> )	less than liquid compo	sition	ı	
	c) same as liquid composition				
	d)	none of these.			
vi)	What is reflux ratio at total reflux ?				
	a)	Zero	<b>b</b> )	Infinity	
	c)	Unity	d)	None of these.	
5 (N)		2			



- a) critical moisture content
- b) equilibrium moisture content
- c) free moisture content
- d) bound moisture content.
- viii) Rayleigh equation is applicable to
  - a) azeotropic distillation
  - b) batch distillation
  - c) steam distillation
  - d) fractional distillation.
- ix) In batch distillation with constant reflux overhead product composition with time
  - a) increases
  - b) decreases
  - c) does not vary.

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- x) In which of the following extraction system one of the solute is immiscible to the solvent?
  - a) Acetic acid-water-isopropyl ether
  - b) water-chloroform-acetone
  - c) nicotin-water-kerosene
  - d) benzene-water-acetic acid.
- xi) Which of the following is/are not a membrane separation process?
  - a) Ultra-filtration
- b) Reverse osmosis
- c) Electro dialysis
- d) none of these.
- xii) The driving force of Reverse osomosis is
  - a) Trans-membrane pressure
  - b) Concentration gradient
  - c) Osmotic pressure( $\pi$ )
  - d) External pressure applied- $\pi$ .



### GROUP - B

( **Short Answer Type Questions** ) Answer any *three* of the following.

In distillation, what is meant by q? State with a neat

diagram the values/range of values of q and nature q lines for different feed conditions. 1+4

- 3. Describe the following operations :
  - a) Azeotropic distillation

2.

- b) Membrance fouling & cleaning.
- 4. Define or state the following:
  - a) Fick's first law of Diffusion
  - b) Mechanism of interphase mass tranfer.
- 5. A crystallizer is charged with 100 kg of a solution containing 25% Ba( NO  $_3$  )  $_2$  in water. On cooling 10% of the original water present evaporates. Calculate the yield of crystals when the solution is cooled to 283K. The solubility at 283K is 7.0 kg Ba( NO  $_3$  )  $_2$  / 100 kg total water.
- 6. Describe the operating priciple of reverse osmosis & its application in industry.

# **GROUP - C** (Long Answer Type Questions) Answer any *three* of the following. $3 \times 15 = 45$

- A liquid mixture of A and B containing 42 mol% A, is to be 7. fractionated at  $1.013 \times 10^{5}$  Pa to give a distillate having 97mol% A and bottoms containing 1.1 mol% A. saturated liquid feed enters into the tower at 200 mol/hr. Assuming the relative volatility between A and B is about 2.5, calculate the following:
  - a) Amount of distillate and bottom produced in mol/hr.
  - b) Minimum number of theoretical plated required at total reflux using Fenske equation.
  - Number of actual plates required at  $R = 1.5^* R_{min}$  and c) plate efficiency is 80%. 4 + 4 + 7
- A packed tower is to be designed to absorb SO 2 from air by 8. scrubbing the gas with water. The entering gas is 20% by volume and the leaving gas is to contain 0.5% SO 2 by volume. The entering water is SO  $_2$  free. The water flow is to be twice the minimum. The air flow rate (  $SO_2$  free basis ) is  $975 \text{ kg/hr.m}^2$ . The temperature is  $30^{\circ}\text{C}$  and total pressure is 2 atm. Calculate the amount of solvent required actually when the equilibrium relationship is 21.8x.
- 9. Define the following: a)
  - i) Percentage humidity
  - ii) Distribution coefficient in extraction
  - Wet bulb temperature iii)
  - Adiabatic saturation temperature iv)
  - Dew point. v)



- b) What is the difference between minimum boiling and maximum boiling azeotrop?
- c) Sodium acetate solution is available at temperature of 70°C with a solute content of 58%. Find out
  - i) Percentage saturation
  - ii) Yield of crystal if 2000 kg of this solution is cooled to  $10^{\circ}\text{C}$
  - iii) Percentage yield of crystal.

Given : solubility of sodium acetate at  $70^{\circ}\text{C}$  is 146 gm acetate/100 gm water and at  $10^{\circ}\text{C}$  is 121 gm acetate/100 gm water. 5 + 4 + 6

- 10. a) Establish and prove a relationship between overall mass transfer coefficient and local mass transfer coefficients.
  - b) Draw the schematic for electro dialysis.
  - c) Define crystallization ? Describe meir's theory of crystallization. 5+3+7
- 11. Describe any three unit operations :

 $3 \times 5$ 

- a) Ultrafiltration
- b) Electrodialysis
- c) Pervaporation
- d) Cross microfiltration.