Name : .....

Roll No. : .....

Invigilator's Signature : .....

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) $D \alpha T^{1.5}$ d) $D \alpha T^{2}$.

ii) Duffusivity has the same dimension as

a) absolute viscosity

b) kinematic viscosity

c) density

d) concentration.

iii) The slope of operating line for the stripping section of distillation column is

a) 0 b) α

c) < 1 d) > 1.

iv) Schmidt number is analogous to

a) Pradtl number

b) Sherwood number

c) Nusselt number

d) Froude number.

v) In azeotropic mixture, the equilibirum vapour composition in

a) more than liquid composition

b) less than liquid composition

c) same as liquid composition

d) none of these.

vi) What is reflux ratio at total reflux ?

a) Zero b) Infinity

c) Unity d) None of these.

vii) During drying of a solid, the lowest moisture content is denoted as

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.

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(π)

d) External pressure applied-π.

GROUP – B
(Short Answer Type Questions)
Answer any *three* of the following. 3 × 5 = 15

2. 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

   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 × 15 = 45

7. A liquid mixture of *A* and *B* containing 42 mol% *A*, is to be fractionated at 1.013×10^5 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.

   c) Number of actual plates required at $R = 1.5^* R_{min}$ and plate efficiency is 80%. 4 + 4 + 7

8. A packed tower is to be designed to absorb SO_2 from air by 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 kg/hr.m^2. The temperature is 30°C and total pressure is 2 atm. Calculate the amount of solvent required actually when the equilibrium relationship is $21.8x$.

9. a) Define the following :

      i) Percentage humidity

      ii) Distribution coefficient in extraction

      iii) Wet bulb temperature

      iv) Adiabatic saturation temperature

      v) Dew point.

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°C

iii) Percentage yield of crystal.

Given : solubility of sodium acetate at 70°C is 146 gm acetate/100 gm water and at 10°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 × 5

a) Ultrafiltration

b) Electrodialysis

c) Pervaporation

d) Cross microfiltration.