

17648

11819

3 Hours / 100 Marks

Seat No.

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- Instructions :**
- (1) All Questions are *compulsory*.
 - (2) Answer each next main Question on a new page.
 - (3) Illustrate your answers with neat sketches wherever necessary.
 - (4) Figures to the right indicate full marks.
 - (5) Assume suitable data, if necessary.
 - (6) Use of Non-programmable Electronic Pocket Calculator is permissible.

Marks

1. (A) Attempt any THREE of the following :

12

- (a) Differentiate between distillation and extraction (Any four points).
- (b) Calculate the equilibrium compositions of the liquid and the vapour phases for a mixture of methyl alcohol and water at a temperature of 323°K and under a pressure of 40 kPa. Assume that both liquid and vapour behave ideally.
Data : Vapour pressure of methanol = 53.32 kPa
Vapour pressure of water = 12.33 kPa
- (c) Draw a rate of drying curve and mention various zone on it.
- (d) State any four salient features of Whitman's two film theory.

(B) Attempt any ONE of the following :

6

- (a) Gas containing 2% by volume solute 'A' is fed to an absorption tower at a rate of 0.35 m³/sec at 299 °K and 106.658 kPa pressure, and 95% of original solute is removed by absorbing it in solvent 'B'. Solvent containing 0.005 mole fraction of solute enters the tower at top and exit liquid streams from absorption tower contains 0.12 mole 'A' per mole 'B'. Find out the flow rate of liquid solvent entering the absorption tower on solute free basis.
- (b) Write in brief on flash distillation and draw its sketch.

2. Attempt any FOUR of the following :**16**

- (a) Define the following terms :
- (i) Critical moisture content
 - (ii) Equilibrium moisture content
 - (iii) Bound moisture content
 - (iv) Unbound moisture content
- (b) Explain construction and working of packed column with neat sketch.
- (c) Define the following :
- (i) Crystallisation
 - (ii) Solubility
 - (iii) Nucleation
 - (iv) Super saturation
- (d) Explain azeotropic distillation in brief.
- (e) Derive the equation of q-line.

$$Y = \left(\frac{-q}{1-q} \right) X + \left(\frac{X_F}{1-q} \right)$$

3. Attempt any TWO of the following :**16**

- (a) Compare any eight points between plate column and packed column
- (b) A mixture of benzene and toluene containing 60 mole % benzene is to be separated to give a product of 95 mole % benzene and bottom product containing 10 mole % benzene. The feed enters the column at its bubble point. It is proposed to operate the column with reflux ratio of 2.5. It is required to find the number of theoretical plates needed and position of feed plate. The vapour – Liquid equilibrium data are given as below.

X	O	0.05	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Y	O	0.13	0.21	0.375	0.5	0.6	0.7	0.77	0.83	0.9	0.95	1.0

- (c) Explain construction and working of tray dryer with neat sketch.

4. (A) Attempt any THREE of the following :**12**

- (a) State the factors on which rate of drying depends.
- (b) Derive the expression :

$$Y = \frac{\alpha X}{1 + (\alpha - 1)X}$$

- (c) State Fick's law of diffusion. Give its mathematical expression and explain the term involved in it.
- (d) A solution of sodium nitrate in water contains 48% NaNO_3 by weight at 313 °K temperature. Calculate the percentage yield of NaNO_3 crystals that may be obtained when temperature is reduced to 283 °K. Also calculate the yield of NaNO_3 crystals from 100 kg of solution.

Data : Solubility of NaNO_3 in water at 283 °K is 80.18 kg NaNO_3 per 100 kg water.

(B) Attempt any ONE of the following :**6**

- (a) Derive the equation of operating line for rectifying section and stripping section of distillation.
- (b) Explain in brief the construction and working of sieve plate column for extraction with neat sketch.

5. Attempt any FOUR of the following :**16**

- (a) Describe working of Swenson – walker crystalliser with neat sketch.
- (b) State any four factors while selecting solvent for gas absorption.
- (c) Define following terms :
 - (i) Relative volatility
 - (ii) Reflux ratio
 - (iii) Volatility
 - (iv) Azeotrope
- (d) State various methods of generating super saturation.

P.T.O.

- (e) Methane diffuses at steady state through the tube containing helium. At Point 1, the partial pressure of Methane is 55 kPa and at point 2 it is 15 kPa. The point 1 and 2 are 30 mm apart. The total pressure is 101.3 kPa and temperature is 298° K. Calculate the flux of methane at steady state for equimolar counter diffusion. Take the value of diffusivity as $6.75 \times 10^{-5} \text{ m}^2/\text{s}$.

6. Attempt any TWO of the following :

16

- (a) Describe construction and working of rotary dryer with neat sketch.
- (b) Explain Triangular diagram for system with one pair partially miscible.
- (c) 100 K mol of mixture containing 50 mole % n-heptane and 50 mole% n-octane is 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.

Equilibrium data :

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
