

# 17648

16117

**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.
- (7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

**Marks**

1. a) **Attempt any THREE of the following** **12**
- (i) What is diffusivity? What is the effect of temperature and pressure on diffusivity.
- (ii) State and explain Raoult's law.
- (iii) List the four difference between distillation and extraction.
- (iv) Explain rate of drying curve with diagram.
- b) **Attempt any ONE of the following:** **6**
- (i) Derive the equation of operating line for rectifying section of distillation.
- (ii) Explain Mier's super saturation theory.

P.T.O.

2. Attempt any FOUR of the following:

16

- Draw and explain solubility curve.
- Define critical moisture content and equilibrium moisture, state the meaning of the term.
- Explain triangular diagram for a ternary system.
- Derive the equation for flash distillation.
- Describe the method of steam distillation.

3. Attempt any TWO of the following:

16

- The vapour pressure of n-hexane and n-octane are given below. Obtain an empirical relation between  $y$  and  $x$  for this system at a constant pressure of 101.3 kpa.

T, K	341.7	352.4	366.3	380.2	394.1	398.6
P° Hexane kpa	101.3	136.6	197.3	283.9	399.9	455.9
P° Octane kpa	16.1	23.1	37.1	57.8	87.2	101.3

With the help of empirical equation generate vapour-liquid equilibrium data and construct a plot of  $x$  vs  $y$ .

- A liquid mixture containing 40% methanol and 60% mole% water is fed to a differential distillation at atmospheric pressure with 60 mole% of the liquid is distilled. Find the composition of the composited distillate and the residue.

Equilibrium data:

$x$	0.05	0.1	0.2	0.3	0.4	0.5
$y$	0.27	0.42	0.57	0.66	0.73	0.78

- Derive the equation of 'q' line

$$y = \frac{q}{(1-q)}x + x_F/(1-q)$$

4. a) **Attempt any THREE of the following:** 12
- (i) Explain briefly the selection criteria for solvent to be used for liquid extraction.
  - (ii) Derive the equation of flux for steady state equimolar counter diffusion.
  - (iii) Derive Rayleigh's equation for differential distillation.
  - (iv) What factors should be considered while selecting solvent for gas absorption.
- b) **Attempt any ONE of the following:** 6
- (a) Explain briefly hydrodynamics/pressure drop characteristics of packed column.
  - (b) Explain the working and use of fluidized bed dryer.
5. **Attempt any FOUR of the following:** 16
- a) Define azeotropes and describe the process of azeotropic distillation.
  - b) Draw a neat labelled diagram of bubble cap tray.
  - c) Write down the comparison between packed column (any four points)
  - d) A feed containing 60 mole% hexane and 40 mole% octane is fed to a pipe still through a pressure reducing valve into a flash separator. The vapour and liquid leaving the separator are assumed to be in equilibrium. If 50 mole% of the feed is vaporised, find the composition of the top and bottom product. The equilibrium data is given below.
- |   |     |       |      |       |        |   |
|---|-----|-------|------|-------|--------|---|
| $x$ , mole fraction of hexane in liquid | 1.0 | 0.69  | 0.40 | 0.192 | 0.045  | 0 |
| $y$ , mole fraction of hexane in vapour | 1.0 | 0.932 | 0.78 | 0.538 | 0.1775 | 0 |
- e) Draw a neat sketch of Rotating disk contractor and explain its working.

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

- a) Find the yield of  $\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$  crystals when 100 kg of 48%  $\text{Na}_2\text{S}_2\text{O}_3$  solution is cooled to 293k. Also calculate the percentage yield of the hydrated crystals.

Data : Solubility of  $\text{Na}_2\text{S}_2\text{O}_3$  is 70 parts per 100 parts water at 293k (20°C).

- b) Solids are to be dried under the constant drying condition from 67% to 25% moisture. The value of equilibrium moisture for material is 1%. If the critical moisture content is 40% and rate of drying in constant rate period is 1.5 kg ( $\text{m}^2\text{h}$ ), calculate the drying time.

Drying surface = 0.5  $\text{m}^3/\text{kg}$  dry solid.

- c) Draw the neat labeled diagram of Drum drier and explain its working.

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