

# 17648

21819

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.
  - (8) Use of Steam table, logarithmic, Mollier's chart is permitted.

**Marks**

1. a) **Attempt any THREE of the following:** **12**
  - (i) Derive the expression for steady state diffusion of A through non-diffusing B with meaning of each term.
  - (ii) Generate X-Y data when relative volatility is 2:1.
  - (iii) State Fick's law of diffusion and explain the importance of diffusion in mass transfer.
  - (iv) Derive Rayleigh equation for simple distillation.
  
- b) **Attempt any ONE of the following:** **6**
  - (i) Explain steam distillation and give its any two applications.
  - (ii) Describe boiling point diagram at constant pressure.

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- 2. Attempt any FOUR of the following:** **16**
- a) State the factors considered for selection of solvent in gas absorption.
  - b) Distinguish between extraction and distillation. (any four points).
  - c) Derive the expression for time of drying under constant rate period.
  - d) Explain pressure drop in packed column
  - e) Explain with neat sketch Oslo evaporative crystallizer.
- 3. Attempt any TWO of the following:** **16**
- a) Explain construction and working of drum drier with neat sketch.
  - b) Describe triangular diagram with a neat sketch and give its use in extraction.
  - c) A wet solid is to be dried from 35% to 10% moisture under constant drying conditions in five hours. If equilibrium moisture content is 4% and critical moisture content is 14% how long it will take to dry solids to 6% moisture under same conditions.
- 4. a) Attempt any THREE of the following:** **12**
- (i) Explain rectification on ideal plate.
  - (ii) State the factors on which rate of drying depends.
  - (iii) Explain caking of crystals. State the effect of impurities on crystal formation.
  - (iv) List the different types of packings used in industry and state its characteristics.
- b) Attempt any ONE of the following:** **6**
- (i) Derive equation of q-line. Draw q-line for various feed conditions.
  - (ii) State the criteria for solvent selection in extraction.

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

- a) Define HETP. Explain in brief about channeling in packed column.
- b) Describe Mier's supersaturation theory.
- c) 1000 m<sup>3</sup>/hr of gal mixture containing 10 mole % solute and rest inerts enters the absorber at 300 k and 106.6 kpa 90% of the original solute is removed. Solute free water used for absorption contains 5 mole % solute when it leaves the towers at the bottom. Calculate solvent flow rate to tower.
- d) A wet solid is to be dried from 80 % to 5 % moisture on wet basis. Calculate the amount of moisture to be evaporated per 100 kg of dried product.
- e) In an oxygen-nitrogen gas mixture at 101.3 kpa and 298 k, the concentration of oxygen at two phases 2 mm apart are 10 % and 20% by volume respectively . Calculate the flux of diffusion of oxygen for the case where nitrogen is non-diffusing. Diffisivity of oxygen in nitrogen is  $1.81 \times 10^{-5} \text{ m}^2/\text{sec}$

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

- a) Calculate the yield of MgSO<sub>4</sub>·7H<sub>2</sub>O crystal when 1000 kg saturated solution of MgSO<sub>4</sub> at 353 k is cooled to 303 k assuming 10% of water is lost by evaporation during cooling.

Data

Solubility of MgSO<sub>4</sub> at 353 k

= 64.2 kg/100 kg water

Solubility of MgSO<sub>4</sub> at 303 k

= 40.8 kg/100 kg water.

- b) A liquid mixture containing 40 mole % methanol and 60 mole % water is fed to differential distillation at atmospheric pressure when 60 mole % of the liquid is distilled. Find the composition of the composite distillate and 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

- c) A mixture of benzene and toluene containing 40% benzene and 60% toluene is to be separated in a fractionating column to give a distillate containing 96% benzene and bottom product containing 95% toluene. Feed is a mixture of two third vapor and one third liquid. Find the number of theoretical stages required if reflux ratio is 1.5 times the minimum reflux ration. Relative volatility is 2.5.
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