

P. Pages : 3

Time : Three Hours

**AW - 3388**

Max. Marks : 80

- Notes :
1. Answer **three** question from Section A and **three** question from Section B.
 2. Due credit will be given to neatness and adequate dimensions.
 3. Assume suitable data wherever necessary.
 4. Diagrams and chemical equations should be given wherever necessary.
 5. Illustrate your answer necessary with the help of neat sketches.
 6. Use of pen Blue/Black ink/refill only for writing the answer book.

SECTION - A

1. a) Explain the mechanism of absorption based on two film theory of mass transfer. 7
- b) Gas from a petroleum distillation, has its concentration of H_2S reduced from 0.03 Kmol H_2S per Kmol of inert hydrocarbon gas to 0.1% of this value by scrubbing with triethanolamine water in a counter current tower operating at 300K and at atmospheric pressure. The equilibrium relation for the solution may be taken as $Y_e = 2X$. 7
- The solvent enters the tower free of H_2S and leaves containing 0.013 Kmol of H_2S per Kmol of solvent. If the flow of inert gas is $0.015 \text{ kmol/m}^2 \cdot \text{sec}$ of tower cross section, estimate height of absorber and the number of transfer units (N_{OG}). The overall coefficient for absorption K_G may be taken as $0.04 \text{ Kmol/m}^3 \cdot \text{sec}$. Unit driving force.

OR

2. a) Discuss interphase mass transfer between gas and liquid phase and the overall mass transfer coefficient. 7
- b) Explain the concept of HETP and HTU in continuous equipment for absorption and how to estimate the total height of the absorption column, when the equilibrium curve is a straight line. 7
3. a) What is differential distillation? Derive an expression for Rayleigh's equation. 6
- b) Explain McCabe-Thiele method to determine number of theoretical plates in a distillation column. 7

OR

4. a) Why reflux ratio is necessary in fractionation? Explain its importance. 6
- b) Discuss the effect of feed temperature on the number of plates in a distillation column. Develop expression for 'q' line and indicate the effect on number of plates in terms of 'q'. 7

5. a) Explain the types of ternary systems and criteria of solvent selection in liquid-liquid extraction. 6
- b) Explain the different types of membranes and the application of membrane separation in paper industries. 7

OR

6. a) Acetaldehyde (5%) is in solution in toluene and is to be extracted with water in a five stage co-current unit. If 25kg of water is used per 100kg feed, determine the amount of acetaldehyde extracted and the final concentration. The equilibrium relation for the system is given as:
 $Y_e = 2.2X$.
 Where Y- Kg of acetaldehyde/kg of water.
 X - kg of acetaldehyde/kg of toluene. 7
- b) How are membranes characterized and discuss the application of membrane separation in biotechnology. 6

SECTION - B

7. a) What is leaching and discuss the parameters on which rate of leaching depends? 7
- b) Derive an expression for the 'fraction unextracted' for single stage multi contact. Washing system of insoluble solids retaining sufficient solute in it. 7

OR

8. a) What is the criteria of solvent selection in solid-liquid extraction? Explain. 7
- b) A plant produces 100kg/sec of titanium dioxide (TiO_2) pigment which must be 99.9% pure when dried. The pigment is produced by precipitation and the material as prepared is contaminated with 1kg of salt solution containing 0.55kg of salt per kg of pigment. The material is washed counter currently with water in a number of thickeners arranged in series. How many thickness will be required if water is added at a rate of 200 kg/sec and the solid discharged from each thickener removes 0.5kg of solvent per kg of pigment. 7
9. a) Explain Mier's supersaturation criteria and nucleation in crystallization process. 7
- b) What will be the yield of $\text{Na}_2 \text{S}_2 \text{O}_3 \cdot 5\text{H}_2\text{O}$ if 100kg of 48% solution of $\text{Na}_2 \text{S}_2 \text{O}_3$ are cooled to 20°C . The solubility of $\text{Na}_2 \text{S}_2 \text{O}_3$ at 20°C is 70 parts per 100 parts of water. Molecular weight of $\text{Na}_2 \text{S}_2 \text{O}_3 = 158$. 6

OR

10. a) How crystal growth occurs? What are the parameters which can affect the crystal growth? 6
- b) Discuss the classification of crystallization equipments and explain the operation of any one. 7

11. a) How to calculate drying rate and explain constant rate and falling rate drying periods. 6
- b) Explain the operation of a rotary dryer and its design procedure. 7

OR

12. a) Test drying of food was carried out in an insulated tray. The temperature of the drying air was 60°C and the dew point 20°C . The dry weight of the material was 3.765kg and the surface area 0.186m^2 . Test data are: 7

Data: Weight of humid material at different drying time.

t hrs.	0	0.4	0.8	1.4	2.2	3.0	4.2	5.0	7.0	9.0	12.0	25.0
weight (G) kg	4.94	4.88	4.8	4.67	4.55	4.4	4.21	4.15	4.09	3.97	3.955	3.955

Determine the equilibrium moisture content and the drying rate as a function of moisture content in both rates.

- b) What are the various theories of drying? Explain in details. 6
