

[3 Hours]

[Total Marks: 80]

(1) Q.1 is compulsory.(2)Attempt any 3 from the remaining 5 questions.(3)Use graph paper, if required.(4)

Assume suitable data if required and justify the same

1. a) What you mean by positive and negative deviation from ideality. 5  
 b) Explain reverse osmosis. 5  
 c) Explain Langmuir adsorption isotherm. 5  
 d) Explain industrial applications of leaching. 5

2. a) Explain differential distillation and derive Rayleigh equation. 10  
 b) A continuous fractionation column has been installed to distill 3000 kg/hour of a mixture of 40 percent benzene and 60 percent toluene by weight. The overhead and bottom products are found to contain 97 percent benzene and 97 percent toluene respectively. The feed consists of three fourth vapours and one fourth liquid. A reflux ratio of 3.5 has been used.(a) Find material balance(b)Find number of theoretical plates and locate feed plate.VLE data for benzene toluene system is given

y	0	0.38	0.61	0.78	0.92	1
x	0	0.2	0.4	0.6	0.8	1

3. a) Explain in detail principles of liquid liquid extraction and compare extraction with distillation 10  
 b) A solution containing 5% acetaldehyde and 95% toluene is to be extracted with water in a five stage crosscurrent extraction unit to extract acetaldehyde. Toluene and water are essentially insoluble. If 25 kg of water each time are used per 100 kg of feed, calculate the amount of acetaldehyde extracted and final concentration of the exit solution. 10  
 Equilibrium relationship,  $Y=2.20 X$   
 $Y=$  kg acetaldehyde/ kg water,  $X=$  kg acetaldehyde/ kg toluene.

4. a) For fixed bed adsorbers, what you mean by breakthrough curve? With suitable diagram, explain the concepts of adsorption wave and break point. Derive equation for length of unused bed. 10  
 b) For multistage cross current adsorption, explain material balance and explain the procedure to estimate minimum amount of adsorbent. 10

5. a) What is crystallization? Explain nucleation theories. 10  
 b) 10 mg of solution containing 0.3 kg  $\text{Na}_2\text{CO}_3$  per kg solution is cooled slowly to 293 K to form crystals of  $\text{Na}_2\text{CO}_3 \cdot 10 \text{H}_2\text{O}$ . The solubility at 293 K is 0.215 kg per kg water. If 3 percent of original solution is lost by evaporation during cooling, What is the crystal yield? 10

6. Write short notes 20  
 a) Advantages and disadvantages of batch distillation  
 b) Solvent selection for liquid liquid extraction  
 c) Characteristics of adsorbents  
 d) Electrodialysis