

B.Tech. SEM -VI (Chemical 2014 Course (CBCS) : WINTER - 2018

SUBJECT : SEPARATION TECHNIQUES

Day : Tuesday
Date : 13/11/2018

W-2018-2440

Time : 10.00 AM TO 01.00 PM
Max. Marks : 60

N. B. :

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Draw neat and labeled diagram **WHEREVER** necessary.
- 4) Assume suitable data, if necessary.

- Q. 1** a) What is Raoult's law? How it can be used to obtain vapour equilibrium? (05)
- b) What is the role of entrainer in azeotropic distillation? What should be the criteria of choice of entrainer in azeotropic distillation? (05)

OR

A liquid mixture containing 50 mol % heptane (A) and 50 mole % octane (B) is to be containing flash vaporized at 1 standard atmosphere pressure to vaporize 60 mole % of the feed. What will be the composition of the vapor and liquid in the separator for an equilibrium stage? (10)

X_A	1.0	0.656	0.488	0.311	0.157	0
Y_A	1.0	0.812	0.674	0.491	0.279	0

- Q. 2** What are the assumptions of McCabe and Thiele method? Derive the equations of operating line for enriching and exhausting sections. Draw a neat sketch of fractionators. (10)

OR

A fractionating column separates a liquid mixture entering at 5000 kmol/h containing 50 mole % A and 50 mole % B into an overhead product of 95 mole % A and a bottom product containing 96 mole % of B. A reflux ratio of twice the minimum will be used and the feed enters at its boiling point. Determine the number of stages required and location of feed plate. Equilibrium data: (10)

x	0.03	0.06	0.11	0.14	0.26	0.39	0.53	0.66	0.76	0.86	1.0
y	0.08	0.16	0.27	0.33	0.50	0.63	0.71	0.83	0.88	0.93	1.0

- Q. 3** 100 kg oil containing 1 part of colour to 3 parts of oil is agitated with 25 kg of adsorbent. Calculate the % of colour removed if 12.5 adsorbent is used initially followed by another 12.5 of adsorbent. The equilibrium relationship is $Y = 0.004 X^2$ where Y = colour units / kg colour free oil and X = colour units / kg adsorbent. (10)

OR

Draw a schematic arrangement of multistage cross current adsorption operation and state the material balance equations. Also explain with graphical representation, the steps involved in the determination of number of stages needed. (10)

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- Q. 4 a)** Explain the binodal solubility curve. (05)
- b)** Explain the steps for finding number of stages in continuous countercurrent liquid-liquid extraction. (05)

OR

A 25 % solution of a solute in water is to be extracted continuously @ 1500 kg/h in a continuous counter current system with an organic solvent to remove 90 % of the solute. The equilibrium distribution of solute between the two phases is as follows: (10)

wt % of solute in water	6.1	19.0	26
wt % of solute in organic solvent	6.2	23.0	33

- Q. 5 a)** Draw a schematic diagram of multistage crosscurrent leaching operation and state the solute balances. Also explain the graphical stepwise procedure to obtain the no. of theoretical stages in the said process. (05)
- b)** Describe a typical trend of N vs X , Y and equilibrium relation for leaching operation. (05)

OR

Oil is to be extracted from solid in a counter current extraction battery. The entrainment data is given as: (10)

$N =$ Kg exhausted solid/ kg solution retained	0	0.1	0.2	0.3	0.4	0.5	0.6	0.68
Y Kg oil / kg solution (x, y)	28.6	23.8	20	17.25	14.7	12.35	10.1	8.3

In the extraction battery charge is to be 100 kg based on completely exhausted solid. The unextracted solid contains 0.043 kg of oil/kg of exhausted solid. 95 % recovery is desired. The final extract is to contain 0.65 kg oil/kg of extract. The ether used as solvent is free from oil. How many stages are required? Calculate the solvent required per kg of feed solid.

- Q. 6 a)** Explain ultra filtration and its applications. (05)
- b)** What is electrodialysis? (05)

OR

- a)** What are the different types of Membrane modules? (05)
- b)** What are the various driving forces in membranes? (05)

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