

Total No. of Questions : 10]

SEAT No. :

P3653

[Total No. of Pages : 3

[5560] - 609

T. E. (Chemical)

MASS TRANSFER - II

(2015 Course) (Semester - II) (309351)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8, Q9 or Q10.
- 2) Neat diagrams must be drawn wherever necessary.
- 3) Figures to the right side indicate full marks.
- 4) Assume suitable data, if necessary.

- Q1) a)** A 40% hexane and 60% octane mixture by mole is flash distilled. If the slope of the operating line is -1.0 find the fraction of feed vaporized and the composition of distillate and residue. The equilibrium data: **[5]**

x	0	0.05	0.19	0.41	0.70	1
y	0	0.18	0.54	0.80	0.94	1

- b) What is relative volatility? Derive an equation for it in terms of vapour and liquid mole fraction. **[5]**

OR

- Q2)** A solution containing benzene and toluene in equal masses is to be continuously fractionated at the rate of 5000 kg/h. The overhead product is to contain 90 weight% of benzene and the bottom product is to contain 5 wt% of benzene. The feed is 40% vaporized and a total condenser is to be used. The reflux is saturated. Determine the product rates, number of theoretical plates if actual reflux ratio is twice the minimum and the temperature of the feed. Equilibrium data: **[10]**

x	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
y	0.22	0.38	0.51	0.63	0.7	0.78	0.85	0.91	0.95	1.0

P.T.O.

Q3) a) A solution of 5% acetaldehyde and rest toluene is to be extracted with water in 4 crosscurrent stages. Toluene and water are essentially immiscible. Calculate the amount of acetaldehyde extracted and the final concentration of the raffinate if the equilibrium relation is given by $Y = 2.2 X$, where $Y = \text{kg acetaldehyde/kg water}$ and $X = \text{kg acetaldehyde/kg toluene}$. [5]

b) Describe the different feed conditions in distillation. [5]

OR

Q4) a) A mixture of benzene and toluene containing 50 mole % benzene is distilled to give 90 mole% benzene and a bottom product containing 8 mole % benzene. The feed is half vaporized and a total condenser is used. Find the minimum reflux ratio using if the average reflux ratio is 2.5. [6]

b) Explain with a neat diagram the bimodal curve and explain its salient features. [4]

Q5) a) Oil is be extracted from meal by means of benzene using continuous countercurrent leaching unit. The unit treats 1000 kg of meal (on completely exhausted solids basis) per hour. The untreated meal contains 365 kg of oil and 30 kg of benzene. The solvent used contains 14 kg of oil and 590 kg of benzene. The exhausted solids contain 55 kg of oil and 451 kg of benzene. Find the number of stages required. The entrainment data is: [10]

Kg oil/ kg solution	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Kg solution/ kg solids	0.5	0.505	0.515	0.53	0.55	0.571	0.595	0.62

b) Explain constant and variable underflow. [6]

OR

Q6) a) Explain the method for finding number of stages in continuous countercurrent leaching. [9]

b) Give the functioning of any continuous Extractor for leaching. [7]

Q7) a) A feed is decolourized by adsorption. The equilibrium relation for the process is given by $Y^* = 8.91 \times 10^{-5} X^2$ where Y = colour units / kg solution and X = colour units / kg adsorbent. 1000 kg of initial solution with a colour concentration of 9 colour units / kg solution is to be treated with an adsorbent. Calculate the percent of original colour removed in a single stage using 25 kg of solid. Calculate the quantity of fresh adsorbent required to reduce the colour to 10% of its original value in a two stage process, if the stream leaving the first stage has a colour concentration of 4 times the final colour of the solution. **[10]**

b) Explain the Langmuir and Freundlich isotherms. **[8]**

OR

Q8) a) Explain with a sketch and graphical representation the development of breakthrough curve and explain it in detail. **[10]**

b) Derive the equation for continuous countercurrent adsorber. **[8]**

Q9) a) Explain Mier's supersaturation theory. **[6]**

b) Explain all the spiral wound module in membrane operations and explain the role of composite membrane. **[10]**

OR

Q10) a) What is ultrafiltration? Give details regarding types of membrane used for the process and an application. **[8]**

b) A batch of 500 kg of KCl is dissolved in water to make a saturated solution at 350 K when the solubility is 30% by weight of KCl in water. The solution is cooled to 293 K when the solubility is 25.4% by weight. Determine the quantity of crystals obtained if 3.5% of the original water is lost by evaporation. Also determine the capacity of the vessel if the density of feed is 1200 kg/m³ and the volume of the vessel is 1.2 times the volume of the solution. **[8]**

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