A **Reg. No. :** | | | | | | | | | | |

Question Paper Code: 56901

B.E./B.Tech. DEGREE EXAMINATION, APRIL 2019

Sixth Semester

Chemical Engineering

15UCH601 - MASS TRANSFER - II

(Regulation 2015)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. The partial pressure of solute in the gas phase_____ as the process moves towards equilibrium. CO1- R

   (a) Increases (b) Decreases (c) Remains constant (d) Can't say

2. The operating line drawn in terms of _____ gas and liquid component will be a linear. CO1- U

   (a) Mole fraction (b) Volume fraction (c) Mole ratio (d) Weight ration

3. When the distillation column at total reflux, its reflux ratio is CO2- R

   (a) 0 (b) ∞ (c) <1 (d) >1

4. Distillation column operated at _____ percentage of flooding velocity. CO2- U

   (a) 50 (b) 65 (c) 70 (d) 100

5. If the solution retained in the solid has the same composition as that of the solid-free overflow, then the tie lines on the right-triangular plot CO3- U

   (a) Are horizontal (b) Are vertical

   (c) Pass through the vertex representing 100% solid (d) Are parallel

6. In solvent extraction of oil seeds, which of the following forms of the solid gives the highest rate of extraction? CO3- U

(a) Whole seeds (b) Broken seeds (c) Flakes of the seeds (d) None of the above

7. Which of the following factor favors formation of a stable and more effective dispersion? CO4- U

(a) Low interfacial tension (b) Large density

(c) Low viscosity of the dispersed phase (d) Higher impeller speed

8. Consider the distribution of the solute C in two partially miscible solvents A and B. What is the selectivity of separation at the plait point? CO4- U

(a) 1 (b) 0 (c) Infinite (d) <1

9. A hollow – fibre membrane with isotropic dense wall is suitable for CO5- R

(a) Micro filtration (b) Reverse osmosis (c) Pervaporation (d) Electrodialysis

10. The metallic electrode which does not take part in the electrolytic reaction. CO5- R

(a) Ni (b) Fe (c) Ag (d) Cu

PART – B (5 x 2= 10 Marks)

11. Distinguish between Raoult's law and Henry's law. CO1- U

12. A binary liquid mixture of benzene and toluene contains 20 mole% benzene. At 350K the vapour pressures of the pure benzene and toluene are 92kPa and 35kPa respectively. The mixture follows Raoult's law. Estimate the equilibrium vapour phase mole fraction of benzene in contact with this liquid mixture at 350K. CO2- U

13. What is selectivity in extraction operation? CO3- U

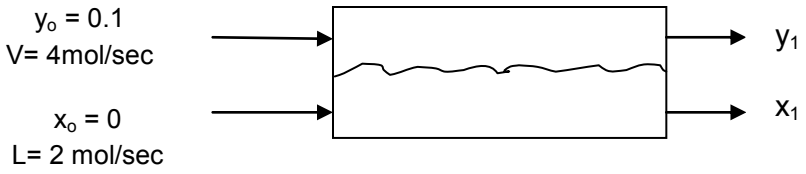
14. Define heap leaching. CO4- U

15. How pressure swing adsorption is facilitated? CO5- U

PART – C (5 x 16= 80 Marks)

16. (a) (i) Define the term number of transfer unit and develop the expression to calculate height of the packed column? CO1- U (10)

(ii) Water is used to absorb ammonia from a gas mixture in a single separation stage contactor. The process is schematically represented in the figure CO1- U (6)



The inert gas and liquid flow rates, and the inlet mole ratios are given in the figure. If the exit liquid stream contains 0.08 moles of ammonia,

(i) Develop the equilibrium relation between Y and X.

(ii) If the stage efficiency is 50% what would be the outlet gas and liquid compositions.

Or

(b) (i) A gas is absorbed in water using a packed tower. The equilibrium relationship may be taken as $Y_e = 0.06\ X_e$ where Y_e and X_e are ratios of moles of solute to moles of inert component. The terminal conditions are: soluble CO1- U (8)

	Top	Bottom
X	0	0.08
Y	0.001	0.009

(ii) List the factors to be considered during the selection of absorbent. CO1- U (8)

17. (a) A feed mixture containing equimolar quantities of A and B is distilled differentially such that 60 mole% of the feed is distilled out. Estimate the composition of the residue and distillate. Equilibrium data: CO2- E (16)

x_A	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
y_A	0	0.21	0.38	0.51	0.63	0.72	0.78	0.85	0.91	0.96
x_A	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
y_A	0	0.21	0.38	0.51	0.63	0.72	0.78	0.85	0.91	0.96

Or

(b) A bubble-cap fractionating column of 12 plates working at an average efficiency of 75% is being used to distill 1000 kg/hr of aqueous methanol at its bubble point enters the tower. The feed, overhead product and bottom product are 50 mole%, 90 mole% and 10 mole% methanol respectively. A total condenser is placed at the top of the column. The reflux is sent at its bubble point. If the reflux ratio is 1.7 times the minimum value, test whether the column available is satisfactory. The VLE data are: CO2- E (16)

Mole % of methanol in liquid	8	10	20	30	40	50	70	80	90
Mole % of methanol in vapour	36.5	41.8	57.9	66.5	72.9	77.8	87	95.8	97.9

18. (a) Explain working principle of the mechanically agitated and centrifugal extractors with neat sketch. CO3- U (16)

Or

(b) A solution containing 18 wt% acetone in water is to be extracted with pure monochlorobenzene by countercurrent extraction process. Monochlorobenzene and water are immiscible in the operating conditions. Estimate the percentage of extraction and weights of final raffinate and extract. CO3- U (16)

X' kg acetone/kg water	0.0258	0.0739	0.1658	0.267
Y' kg acetone/ kg monochlorobenzene	0.0288	0.0704	0.1560	0.237

19. (a) (i) Sketch the typical equilibrium diagram of leaching operation. CO4- U (2)

(ii) 2.3 Kg/s of solid containing 0.55 Kg/s soluble material is to be washed with 2.8 Kg/s pure solvent in a counter – current unit. The final residue is to contain not more than 0.1% solute when dried. Find the number of stages given that the amount of solution in under flow varies with solute concentration according to the relation: $W = 0.2 X + 0.3$, Also find the concentration and quantities in and out from each stage CO4- U (14)

Or

(b) A vegetable seed material containing 0.4 kg oil/kg insoluble solid is washed with hydrocarbon solvent in order to recover 90% of the oil in a counter current unit. It is found that the under flow varies with the concentration of classifier as given below. If the solvent input flow 0.5 kg/kg insoluble solid. Find the number of stages required? CO4- U (16)

Kg solution / kg insoluble solid	0.3	0.32	0.34	0.36	0.38	0.4
Kg solute / kg solution	0	0.1	0.2	0.3	0.4	0.5

20. (a) (i) Why did we not take osmotic pressure in account for microfiltration and ultra filtration? CO5- U (4)

(ii) Explain the method of estimating the retention and permeability of membrane. CO5- U (4)

(iii) Differentiate between single stage and multistage reverse osmosis process with neat sketch. CO5- U (8)

Or

(b) (i) Justify that for cross current two-stage treatment of liquid solution by contact filtration, when the adsorption isotherm is linear, the least total adsorbent results if the amounts used in each stage are equal. CO5- U (8)

(ii) Explain the principles of ion exchange process. CO5- U (8)