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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2023 Semester End Main Examinations

Programme: B.E. **Semester: V**
Branch: Chemical Engineering **Duration: 3 hrs.**
Course Code: 19CH5DCMT2 **Max Marks: 100**
Course: Mass Transfer-II **Date: 27.02.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Enumerate the selection criteria for solvent in gas absorption. **08**

b) Benzene is to be recovered from coal gas by scrubbing it with wash oil as an absorbent. Absorber handles 900 m^3/h of coal containing 2% by volume benzene. Coal gas enters at a temperature at 300 K and 107.32 kPa pressure. 95% of the benzene should be recovered by the solvent. The solvent enters at 300 K containing 0.005 mole fraction of benzene and has an average molecular weight of 260. Calculate the circulation rate of oil (solvent) per hour if the column is to be operated at 1.5 times the minimum oil circulation rate. **12**

Equilibrium data: $Y/(1+Y) = 0.125\ X/(1+X)$
Where
Y is mole ratio of benzene to dry coal gas.
X is mole ratio of benzene to benzene free solvent.

OR

2 a) Present the classification of gas-liquid contacting equipment. Elaborate on the different types of trays and packings used with their relative advantages and disadvantages. **12**

b) Compare the packed column and plate column. **08**

UNIT - II

3 a) Define reflux ratio and explain the different reflux ratios used in the industry. Also discuss the effect of reflux ratio over the design of distillation column. **08**

b) A mixture of benzene and toluene containing 44 mol% benzene and 56 mol% toluene is to be separated in fractionating column to give the distillate containing 97 mol% benzene and a bottom product containing 94 mol% toluene. Feed is a mixture of two third vapor and one third liquid. Find out the number of the theoretical stages required if the reflux ratio of 1.5 times the minimum is used and if relative volatility is 2.5. **12**

Data:

x	0	0.2	0.4	0.6	0.8	1.0
y	0	0.34	0.58	0.76	0.89	1.0

OR

4 a) Illustrate the principle of equilibrium flash vaporization with the help of a neat sketch. Derive the equation of the operating line. **10**

b) Compute the VLE data for a mixture of n-heptane and n-octane at 1 atm which may be expected to form ideal solutions. Find the average relative volatility of this mixture using the data in the Table 1. **10**

Table 1

T, ℃	98.4	110	115	120	125.6
$p_{A,\ mm\ Hg}$	760	1050	1200	1350	1540
$p_{B,\ mm\ Hg}$	333	484	561	650	760

UNIT - III

5 a) With the help of P-x,y and T-x,y diagrams, explain the positive and negative deviations from ideality. **08**

b) With a neat sketch, explain the principle and operation of azeotropic and extractive distillation. Give their applications in industries. **12**

UNIT – IV

6 a) Enumerate the criteria for selecting the solvent for liquid-liquid extraction. **04**

b) Explain the equilateral triangular diagram and its salient features by considering any one example. **06**

c) 100 kg of solution of acetic acid (C) and water (A) containing 30% acid is extracted in a single stage with isopropyl ether (B) at 20 ℃ , to get a final raffinate concentration of 20 % acid. Calculate the amount of solvent required. The solvent is pure. **10**

Data:

Water Layer (wt. % basis)			Ether Layer (wt. % basis)		
% Acetic acid	% Water	% Ether	% Acetic acid	% Water	% Ether
0.69	98.1	1.2	0.18	0.5	99.3
2.89	95.5	1.6	0.79	0.8	98.4
13.3	84.4	2.3	4.82	1.9	93.3
36.7	58.9	4.4	21.6	6.9	71.5
46.4	37.1	16.5	36.2	15.1	48.7

UNIT – V

7 a) Illustrate the construction, operation and working principle of a Dorr thickener. **10**

b) Explain with schematic diagrams, the single stage, multistage cross and multistage countercurrent leaching operations. Comment on the percentage extraction of these operations. **10**

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