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

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

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

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) Define and explain the following. **10**
i. Stage efficiency in absorption and calculation of theoretical stages
ii. Absorption factor and minimum solvent to gas rate ratio for absorber

b) Ammonia is to be removed from a mixture of 20% ammonia and 80% air by counter –current scrubbing with water at 1 atm and 20℃ . Evaluate the minimum solvent rate if 99% of ammonia is to be removed and also the theoretical stages for actual absorption with 1.2 times the minimum solvent rate. The rate of flow of the mixture is 3500 kg/h. **10**
Data:

Partial pressure of ammonia, mm Hg	12	18	32	50	70	166
g of ammonia/10 g of water	0.2	0.3	0.5	0.75	1	2

OR

2 a) Explain the construction of packed column and sieve tray column for gas liquid contact operations. **10**

b) How do you estimate number of transfer units and height of transfer units in absorption operation? Derive the expression using the solute balance to find the height of packing. **10**

UNIT - II

3 a) Steam is supplied into a still containing nitrobenzene with minute water soluble impurities at the total pressure of 130 mmHg. Vapors leaving the still are condensed and separated in a separating funnel. Estimate the temperature of boiling and the composition of the distillate. Find the amount of steam required per mole of feed. Saturation pressure data of major components is given below. **10**

Saturation pressure, mmHg		100	50	30	26
Temperature, ℃	Chlorobenzene	70.4	53.7	42.7	34.5
	Water	51.7	38.5	29.9	22.5

b) Explain flash distillation technique of separating components from a solution with appropriate material balance equations. **10**

OR

4 a) What are the assumptions in using the Rayleigh's equation in differential distillation. Explain the principle and working. Write the modified equation for constant relative volatility. **10**

b) A solution of 60% benzene and rest toluene at saturated liquid state is to be continuously distilled to produce a distillate with 90% benzene and residue with 5% benzene. The column operates at a pressure of 1 atm. A reflux ratio of 2.1 is to be maintained. If the feed is introduced into the 6^{th} plate, how many theoretical plates must the column have? All the percentages are on mole basis. VLE data is given in the table below **10**

x	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
y	0.20	0.38	0.51	0.63	0.71	0.78	0.85	0.91	0.96

UNIT - III

5 a) Explain the stepwise procedure for calculating number of theoretical trays required for separation of components from an ideal binary system using Panchon-Savarit method. **10**

b) With the help of schematic diagrams depicting the working principle and differentiate azeotropic and extractive distillation. **10**

UNIT – IV

6 a) Depict the cross current multistage extraction for a partial soluble system. How do you evaluate the number of stages in multistage cross current operation? **06**

b) With a neat diagram, explain the working and construction of rotating disc contactor used in industries. **06**

c) A multistage cross current extraction system is used to extract dioxane from a binary mixture of dioxane and water using benzene as a solvent. The aqueous feed is available at 150 kg/h containing 20% by weight of dioxane. The system has 3 stages and 120 kg/h of fresh solvent is to be used in each stage. The solvent feed contains 2% dioxane. Assuming that each stage is an ideal one, estimate the final dioxane content in water. The miscibility of benzene in water may be neglected. **08**

The solubility of dioxane in water and benzene at equilibrium is given below.

Weight % of dioxane in water	2.8	5.1	18.9	25.2	33.06
Weight % of dioxane in benzene	3.1	5.23	22.49	32.03	46.35

UNIT – V

7 a) Explain the typical equilibrium diagrams for leaching with the help of neat diagrams. **06**

b) With a neat line diagram, explain the working of Bollman extractor. **06**

c) How do you find the number of stages in counter current leaching operation? Derive the equation and write the stepwise procedure to evaluate number of stages. **08**

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