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Question Paper Code: R5902

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2025

Fifth Semester

Chemical Engineering

R21UCH502 – MASS TRANSFER II

(Regulations R2021)

Duration: Three hours

Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

- For the Absorber design, the plotting with mole ratio helps to find the CO1- U
 - Slope of operating line
 - Slope of equilibrium curve
 - Minimum number of trays
 - Maximum number of trays
- Find the most common example for absorption CO1- U
 - Ammonia and air in solvent water
 - Ammonia and Carbon dioxide in solvent water
 - Methane and air in solvent water
 - Methane and Carbon dioxide in solvent water
- Porcelain pieces are put into the distillation flask to avoid _____ CO1- U
 - Overheating
 - Uniform boiling
 - Bumping of the solution
 - None of the mentioned options
- Which distillation is used to separate azeotropes and close boiling mixtures? CO1- U
 - Extractive distillation
 - Salt distillation
 - Pressure-swing distillation
 - Reactive distillation
- Packed tower with _____ packing preferable for liquid extraction. CO1- U
 - Uniform
 - Random
 - Complete
 - None of the mentioned
- The extractor preferred for getting immediate dispersion after piping is CO1- U
 - Don extractor
 - Box extractor
 - Boltzmann extractor
 - Immediate dispersion is not possible

7. Wood ash leaching for alkali is known as _____ CO1- U
 (a) Lixivation (b) Lixartion
 (c) Lixation (d) None of the mentioned
8. The number of theoretical stages, depends on the CO1- U
 (a) Stepping off the tray (b) Reflux ratio (c) Operating line (d) Flow rates
9. A change in pressure has little or no effect on equilibrium loading for liquid adsorption. Which of the following is untrue about pressure swing adsorption? CO1- U
 (a) While one bed adsorbs, the other bed desorbs.
 (b) Mechanical work is used to increase pressure.
 (c) With valving, the cyclic sequence can be programmed to operate automatically.
 (d) Applicable for only liquids.
10. The physical process that occurs when gas or liquid molecules are brought into contact with a solid surface and condense on the surface CO1- U
 (a) Absorption (b) Adsorption
 (c) Both Adsorption and Absorption (d) None of the mentioned

PART – B (5 x 2= 10 Marks)

11. State the three types of equilibrium? CO1- U
12. Write down the difference between steam distillation and simple distillation? CO1- U
13. List out the solvent extraction method? CO1- U
14. Define solid-liquid extraction process? CO1- U
15. State the principle of adsorption? CO1- U

PART – C (5 x 16= 80 Marks)

16. (a) Explain briefly about the equilibrium and operating line in mass transfer calculation. CO1 - U (16)
- Or
- (b) Describe the significance of the equilibrium curve when determining the number of theoretical stages. CO1- U (16)

17. (a) Compute the equilibrium data from the following data at 760mm Hg pressure and calculate the Average relative volatility. $P_T = 760\text{mm Hg}$. CO2-App (16)

VP of A, mm Hg	760	830	920	1060	1200	1360
VP of B, mm Hg	200	350	420	550	690	760

Or

- (b) i) Nitrobenzene (NB) has to be steam distilled if the vaporization efficiency is 85%, estimate amount of nitrobenzene in distillate if 100kg of steam is present in distillate. The distillation takes place at a total pressure of 760mmHg, Boiling Point of Mixture is 99.0°C, Vapour pressure of Nitrobenzene=20mmHg and Vapour pressure of water=740mmHg. CO2-App (16)
- ii) A fractionating column separates a liquid mixture containing 50 weight% chloroform & 50 weight % carbondisulphide into an overhead product of 94 weight % of carbondisulphide and bottom of 95 weight % of chloroform. Find out the mole fraction of feed then flux ratio, $y_D = 0.961, x_w = 0.076$ & $R_{\min} = 0.96$.
18. (a) Discuss the factors affecting the performance of a pulsed extractor. How would you analyze the extraction efficiency and phase disengagement in such equipment? CO4-Ana (16)

Or

- (b) Discuss the importance of equilibrium in ternary systems for the design of liquid-liquid extraction units. How do you use ternary diagrams to analyze separation efficiency? CO4-Ana (16)
19. (a) By Extraction with kerosene two tonnes of waxed paper per day is to be dewaxed in a continuous countercurrent extraction system. The waxed paper contains 25% paraffin wax by weight and 75% paper pulp. The pulp which retains the unextracted wax must not contain over 0.2 kg of wax/100 kg of wax free pulp. The kerosene used for extraction contains 0.05 kg of wax/100 kg wax free kerosene, experiments show that pulp retains 2 kg of kerosene per kg of wax free pulp. The extract from battery contains 5kg of wax /100 kg of wax free kerosene. How many stages are needed? CO2-App (16)

Or

- (b) 10 tonnes/hour of dry seashore sand containing 1% by weight of salt is to be washed with 10 tonnes/hr of fresh water running countercurrent to the sand through two classifiers in series. Assume perfect mixing of sand and water occurs in each classifier and that sand discharged from each classifier contains one part of water for every two parts of sand by weight. If the washed sand is dried in kiln, what percentage of salt will it retain? What wash rate is required in a single classifier in order to wash the sand equally well? CO2-App (16)
20. (a) Compare and critically analyze the Langmuir and Freundlich adsorption isotherms with reference to their assumptions, applicability to gases and liquids, and limitations. How do these models contribute to our understanding of surface adsorption phenomena? CO4-Ana (16)
- Or
- (b) Using your knowledge of different adsorbent materials, explain the key criteria for selecting an adsorbent for industrial applications. Analyze the properties of activated carbon, silica gel and zeolites and justify which would be most suitable for different types of adsorption processes. CO4 - Ana (16)