

[3 Hours]

[Total Marks: 80]

- (1) Q.1 is compulsory.
- (2) Attempt any 3 from the remaining 5 questions.
- (3) Use graph paper, if required.
- (4) Assume suitable data if required and justify the same
1. a) What you mean by azeotropic distillation. 5
  - b) Explain pervaporation. 5
  - c) Explain Freundlich adsorption isotherm. 5
  - d) Explain industrial applications of adsorption. 5
2. a) Explain fractional distillation with suitable diagram. Also Explain concept of  $q$  line for various feed conditions. 10
  - b) A batch of crude pentane containing 15 mole percentage butane and 85 mole percentage pentane is subjected to simple batch distillation at atmospheric pressure to remove 90 percentage of butane. What should be the composition of remaining liquid? Also determine quantity of pentane removed per kmol of feed. Average relative volatility of butane to pentane is 3.5. 10
3. a) Explain with suitable diagram, multistage countercurrent extraction with reflux. 10
  - b) If 1000 kg/h of nicotine(C) and water (A) solution containing 1% nicotine is to be counter currently extracted with kerosene at 20 °C to reduce the nicotine content to 0.1%. Determine a. Minimum kerosene rate b. The number of stages required if 1150 kg of kerosene is used per hour 10

$x'$ nicotine/kg water	0	0.001011	0.00246	0.00502	0.00751	0.00998	0.0224
$Y'$ nicotine/kg kerosene	0	0.000807	0.001961	0.00456	0.00686	0.00913	0.01870

4. a) A waste stream of alcohol vapours in air from a process was adsorbed by activated carbon particles in a packed column having diameter of 4 cm and length of 14 cm containing 79.2 grams of carbon. The inlet gas stream having a concentration  $C_0$  of 600 ppm and density of 0.00115 g/cm<sup>3</sup> entered the bed at flow rate of 754 cm<sup>3</sup> per sec. The breakpoint  $C/C_0 = 0.01$ . Determine the breakpoint time, the fraction of total capacity used upto breakpoint and length of unused bed. Also determine the saturation loading capacity of carbon. 10

Time, hrs	0	3	4	5	6	6.5	6.8
$C/C_0$	0	0	0.03	0.396	0.93	0.975	0.993

- b) For multistage cross current adsorption, explain material balance and the procedure to estimate minimum amount of adsorbent. 10
5. a) What is crystallization? Explain nucleation theories. 10
  - b) 10 mg of solution containing 0.3 kg Na<sub>2</sub>CO<sub>3</sub> per kg solution is cooled slowly to A hot solution containing 5000 kg of Na<sub>2</sub>CO<sub>3</sub> and water with a concentration of 25 percent by weight is cooled to 293 K and crystals of Na<sub>2</sub>CO<sub>3</sub> · 10 H<sub>2</sub>O are precipitated. At 293 °K, the solubility is 21.5 kg unhydrous Na<sub>2</sub>CO<sub>3</sub> per 100 kg of total water. Calculate yield of the Na<sub>2</sub>CO<sub>3</sub> crystals obtained if 5 percent of 10

Turn Over

original water in the system evaporates on cooling.

6. Write short notes
- a Advantages and disadvantages of batch distillation
  - b Solvent selection for liquid liquid extraction
  - c Characteristics of adsorbents
  - d Electrodialysis

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