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Question Paper Code: 94906

B.E./B.Tech. DEGREE EXAMINATION, MAY 2022

Fourth Semester

Chemical Engineering

19UCH406 – MASS TRANSFER I

(Regulations 2019)

Duration: Three hours

Maximum: 100 Marks

PART A - (10 x 1 = 10 Marks)

1. The binary diffusivity in gas at atmospheric conditions is of the order of CO1- R
(a) 10^{-1} cm² /sec (b) 10^{-5} cm² /sec (c) 105 cm² /sec (d) 10^{-7} cm² /sec
2. The Knudsen diffusivity is proportional to CO1- R
(a) T (b) $T^{3/2}$ (c) $T^{1/2}$ (d) $T^{1/2}$
3. Mass Transfer co-efficient (K) and diffusivity (D) are related according to film theory as CO2- R
(a) $K \propto D$ (b) $K \propto \sqrt{D}$ (c) $K \propto D^{1.5}$ (d) $K \propto D^2$
4. The Chilton – Colburn analogy for mass transfer states that CO2- R
(a) $N_{St} \cdot N_{Sc}^{1/3} = f/8$ (b) $N_{St} \cdot N_{Sc}^{2/3} = f/2$ (c) $N_{St} \cdot N_{Sc}^{3/2} = f/2$ (d) $N_{St} \cdot N_{Sc}^{2/3} = f/8$
5. By differencing the temperature, heat added or removed is CO3- R
(a) latent heat (b) sensible heat (c) heat of vaporization (d) none of the mentioned
6. In an operation, the enthalpy is similar throughout the initial and final condition such operation is CO3- R
(a) Adiabatic (b) non Adiabatic (c) Isothermal (d) Non Isothermal
7. Why direct heating by hot air cannot be done in some cases? CO4- R
(a) the material can degrade (b) high temperature not required
(c) low temperature not required (d) Conduction gives best results
8. What is the drum dryer called if it is open to the atmosphere? CO4- R
(a) Open dryer (b) Box dryer (c) Trough dryer (d) Trench dryer

9. Which of the following is not a common method used for purification? CO5- R
 (a) Acetone (b) Phosphoric acid (c) Ethylene (d) Tartaric acid
10. Soluble impurities from solution during crystallization are removed by CO5- U

 (a) Drying (b) Filtration (c) Heating (d) Cooling

PART – B (5x 2= 10 Marks)

11. Show that $DAB = DBA$ CO1- U
12. State inter phase mass transfer CO2- R
13. Define Humidity or Absolute humidity CO3- U
14. Write the Various drying equipments and their applications CO4- U
15. What are the merits of crystals? CO5- U

PART C - (5 x 16 = 80 Marks)

16. (a) Derive an expression for steady state molecular diffusion through a gas film. CO2 -App (16)
 Or
 (b) Derive an expression for steady state molecular diffusion in liquids. CO2 -App (16)
17. (a) Explain the design of cooling towers and the steps involved in the design of cooling towers. CO2 -App (16)
 Or
 (b) In a wetted wall column carbon dioxide is being absorbed from air by water flowing at 2 atm pressure and 25⁰C. The mass transfer coefficient k_y has been estimated to be $6.78 \times 10^{-5} \text{ kmol}/(\text{m}^2 \cdot \text{s} \cdot \text{mole fraction})$. Calculate the rate of absorption if the partial pressure of carbon dioxide at the interface is 0.2 atm and the air is pure. Also determine k_y and k_g . CO2 -App (16)

18. (a) In an experimental study of absorption of ammonia by water in a wetted wall column, the overall gas phase mass transfer coefficient, K_G was estimated as $2.72 \times 10^{-4} \text{ kmol/m}^2 \text{ s atm}$. At one point in the column the gas contained 10 mol% ammonia and the liquid phase concentration was $6.42 \times 10^{-2} \text{ kmol NH}_3/\text{m}^3$ of solution. Temperature is 293K and the total pressure is 1 atm. 85% of the resistance to mass transfer lies in gas phase. If Henry's law constant is $9.35 \times 10^{-3} \text{ atm.m}^3/\text{kmol}$, calculate the individual film coefficient and the interfacial composition. CO2 -App (16)
- Or
- (b) Explain with a neat sketch the construction and operation of induced draft cooling tower and its significance in chemical processes. CO1 -U (16)
19. (a) Explain Drying rate and time calculations for drying. CO2 -App (16)
- Or
- (b) Explain about rotary drier with neat sketch. CO2 -App (16)
20. (a) Explain about crystal growth in crystallizers. CO2 -App (16)
- Or
- (b) Write about the Design calculations involving of material and energy balances. CO2 -App (16)

