
Question Paper Code: 2035174

B.E. / B.Tech. DEGREE EXAMINATIONS, NOV/ DEC 2024
Fifth Semester
Chemical Engineering
U20CH503 – MASS TRANSFER - I
(Regulation 2020)

Time: Three Hours Maximum: 100 Marks

Answer ALL questions

PART – A (10 x 2 = 20 Marks)

1. Define diffusivity and explain its significance in mass transfer operations.
2. Differentiate between molecular diffusion and eddy diffusion.
3. Evaluate the impact of increased surface roughness on mass transfer in turbulent flow.
4. How would you apply the theory of mass transfer in designing a gas absorption column?
5. How do the operating and equilibrium lines differ in an absorption system?
6. What is the definition of "equilibrium solubility"?
7. How the capacity of an adsorbent in a batch process is is calculated?
8. What is a breakthrough curve in adsorption processes?
9. What is wet-bulb temperature?
10. What are the unit of humidity ratio and the unit of moisture content?

PART – B (5 x 16 = 80 Marks)

11. (a) Derive the expression for steady-state diffusion through a stagnant film and explain its significance in mass transfer operations. (16)

(OR)

(b) (i) Explain the factors influencing eddy diffusion in turbulent flow. (8)
(ii)Discuss the importance of multicomponent diffusion in separation processes. (8)

12. (a) (i) Explain about film theory, surface renewal theory, and penetration theory of mass transfer and give their limitations. (8)
(ii)Compare and contrast mass transfer under laminar and turbulent flow past solids. (8)

(OR)

(b) Derive the expression for mass transfer coefficient (k) in terms of Sherwood (Sh), Reynolds (Re), and Schmidt (Sc) numbers, and explain its significance in mass transfer operations. (16)

13. (a) NH_3 – air mixture containing 5% NH3 is scrubbed with water to remove NH_3, 5000 kg/hr of gas mixture is to be processed with 2,00,000 kg/hr of water to reduce NH_3 in the exit gas to 0.15%. Calculate the height of packing required assuming dilute solutions are involved. Equilibrium relation is given by Y = 20 X where X, Y = mole fraction of NH3 in liquid and vapor. HTU = 2m. (16)

(OR)

(b) (i) Describe the types of contactors used in absorption processes. (8)
(ii)Discuss the thermal effects in absorption processes, including heat of absorption and temperature gradients. (8)

14. (a) Derive the Langmuir and Freundlich adsorption isotherms and explain their significance. (16)

(OR)

(b) (i) Explain the principles of ion-exchange and describe the types of ion-exchange resins. (8)
(ii)Describe the regeneration methods for ion-exchange resins. (8)

15. (a) (i) The flue gas from a boiler house has following composition by volume on dry basis: CO_2 = 10%, O_2 = 7.96%, N2 = 82% and SO_2 = 0.04%. The flue gases are at 463 K and 100 kPa. The dew point of the flue gas is 320 K (47°C). Find the absolute humidity of the flue gases. Data: Vapour pressure of water at 320 K = 10.612 kPa. (8)

(ii)Describe the types of fill materials used in cooling towers. (8)

(OR)

(b) Explain the principle of operation of a cooling tower, including the natural draft and mechanical draft cooling towers with their limitations. (16)

-------xxx------