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SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024
FOOD TECHNOLOGY
(2020 SCHEME)

Course Code : 20FTT202

Course Name: Fundamentals of Heat and Mass Transfer

Max. Marks : 100 **Duration: 3 Hours**

PART A

(Answer all questions. Each question carries 3 marks)

1. Define thermal conductivity of a material and write any 2 properties of thermal conductivity.
2. Write the physical significance of Biot number and Fourier number in the context of transient heat conduction.
3. Mention the relationship between individual and overall heat transfer coefficient.
4. Compare free convection and forced convection.
5. State Planck's law of radiation.
6. Define heat exchanger effectiveness.
7. How can you correlate mass flux and molar flux in mass transfer operations?
8. What is the difference between Raoult's law and Henry's law?
9. Distinguish between simple and steam distillation.
10. Write any 3 properties of packings used in absorption column.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) Derive the expression for rate of heat transfer and temperature distribution in a hollow sphere. Also obtain its thermal resistance. (8)

    b) A steel ball of 5 cm in diameter and initially at a temperature of 450 °C is suddenly placed in a controlling environment in which the temperature is maintained at 100 °C. Calculate the time required for the ball to attain a temperature of 150 °C. The property values are K =35 W/m °K; Cp= 0.46 kJ Kg °K; ρ = 7800 Kg/m^3; h= 10 W/m^2 °K. (6)

OR

12. a) A cylindrical wall is 60 cm OD, 40 cm ID and 10m long. The temperatures maintained inside and outside the wall are 1100°C and 100°C respectively. The thermal conductivity of the wall material is 0.15W/m °C. Find the heat loss through the wall. (5)
    b) Derive heat diffusion equation in Cartesian co-ordinate system. (9)

MODULE II

13. a) By dimensional analysis show the dimensionless numbers involved in forced convection. (10)
    b) Write 2 dimensionless numbers and its physical significance associated with boiling heat transfer. (4)

OR

14. a) Explain boiling regimes by drawing the boiling curve for water. (8)
    b) Discuss any 6 dimensionless groups and its physical significance in convective heat transfer. (6)

MODULE III

15. a) With a neat sketch explain the constructional features of 1-2 shell and tube heat exchanger. (9)
    b) What are fouling factors? How does its effect taken into account in heat transfer calculation? (5)

OR

16. a) Discuss Kirchhoff's law and Wein's displacement law of radiation. (6)
    b) The flow rates of hot and cold-water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s respectively. The inlet temperatures on the hot and cold sides are 75℃ and 20℃ respectively. The exit temperature of hot water is 45℃. If the individual heat transfer coefficients on both sides are 650 W/m^2℃, calculate the area of the heat exchanger. (8)

MODULE IV

17. a) Enumerate the dimensionless numbers used in mass transfer. (7)
    b) How do you obtain over all mass transfer coefficient from individual mass transfer coefficients? (7)

OR

18. a) Derive an expression for molar flux in equimolar counter current diffusion in liquids. (8)
    b) Explain the theories used to determine the mass transfer coefficient. (6)

MODULE V

19. a) Explain absorption tower design based on overall mass transfer Coefficient? (10)

b) Explain flash vaporisation. (4)

OR

20. a) State the assumptions of Mc-Cabe Thiele method. With neat schematic give the procedure for obtaining theoretical number of trays. (10)

b) Explain V-L equilibria. (4)

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