Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B.TECH DEGREE EXAMINATION (S), AUGUST 2023

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. State Fourier's law of Conduction.
2. Mention any two examples of heat conduction with heat generation.
3. Differentiate natural convection and forced convection with examples.
4. Explain the classification of boiling.
5. Define Nusselt number with expressions.
6. A furnace inside temperature of 2250 K has a glass circular viewing of 6 cm diameter. If the transmissivity of glass is 0.08, make calculations for the heat loss from the glass window due to radiation.
7. Explain the application of mass transfer in the field of food processing.
8. State Fick's law of diffusion with an example.
9. Explain the phenomenon of equimolar counter diffusion with an example.
10. Define flash distillation.

PART B

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

MODULE I

11. a) A hollow sphere of inner radius 30 mm and outer radius 50 mm is electrically heated at the inner surface at a rate of 105W/m^2. At the outer surface, it dissipates heat by convection into a fluid at 100°C and a heat transfer coefficient of 400 W/m^2K. Determine the temperature at the inside and outside surfaces of the sphere. It may be presumed that there is no energy generation and the thermal conductivity of the material is constant at 15 W/mK. (8)

b) Derive the expression for critical thickness of a cylinder. What is the importance of critical thickness of insulation? (6)

OR

12. Write down the general heat conduction equation in Cartesian coordinates. Reduce the equation for steady state one dimensional heat conduction across a plane wall with internal heat generation. (14)

MODULE II

13. a) Explain the Rayleigh's method and Buckingham's π theorem methods of dimensional analysis. (10)
    b) Describe the regimes of heat transfer in pool boiling. (4)

OR

14. a) Explain the importance of hydrodynamic and thermal boundary layers in heat transfer. (10)
    b) Differentiate film wise and drop wise condensation. (4)

MODULE III

15. a) Describe the LMTD analysis for counter flow heat exchanger by indicating the assumptions. (8)
    b) Explain with a neat diagram the working of shell and tube heat exchanger. (6)

OR

16. a) Explain with a neat diagram the working of plate heat exchanger. (7)
    b) Derive an expression for the shape factor in case of radiation exchange between two surfaces. (7)

MODULE IV

17. a) Explain the "Penetration theory model" to determine the Mass transfer coefficient. (6)
    b) Derive the expression of molar flux for steady state molecular diffusion of fluids at rest and in laminar flow. (8)

OR

18. a) Explain the following (6)
        i) Self Diffusion
        ii) Surface Diffusion
        iii) Knudsen Diffusion
    b) Explain the following for the determination of diffusion coefficients (8)
        (i) Stefan tube method
        (ii) Twin -bulb method

MODULE V

19. a) What is the significance of relative volatility in distillation? (4)
    b) Explain Vapor-Liquid equilibrium in distillation. (10)

OR

20. Explain briefly the design of packed tower with a neat sketch. (14)

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