Register No.: …… Name: ……..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FOURTH SEMESTER B. TECH DEGREE EXAMINATION (S), SEPT 2022
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. What is LMTD? Why correction factor for LMTD is required?
2. Explain why there is more heat transfer in forced convection as compared to natural convection.
3. Write the difference between conduction and convection modes of heat transfer with examples.
4. What is lumped capacity analysis? Write its criterions for application.
5. Compare a Blackbody with Gray body
6. What is Stefan Boltzmann law?
7. Differentiate between Fick's first and second law of diffusion.
8. Name any two dimensionless numbers used in mass transfer and their physical significance.
9. Mention three major industrial applications of extraction.
10. Define bubble point and dew point.

PART B

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

MODULE I

11. a) A plane brick wall, 25 cm thick, is faced with 5 cm thick concrete layer. If the temperature of the exposed brick face is 70°C and that of the concrete is 25°C, find out the heat lost per hour through a wall of 15 m x10 m. Also, determine the interface temperature. Thermal conductivity of the brick and concrete are 0.7 W/m K and 0.95 W/m K respectively. (10)

    b) Explain lumped capacity analysis with its derivation. (4)

OR

12. a) Develop the expression for steady state one-dimensional heat flow through a plane wall with and without heat generation. (10)

    b) What is critical insulation thickness? How do you calculate it? (4)

MODULE II

13. a) Distinguish between (i) Nucleate boiling and Film boiling, (ii) Drop wise Condensation and Film wise Condensation. (8)
    b) Illustrate the phenomena of condensation on a vertical and a horizontal plate. (6)

OR

14. a) Develop an empirical correlation for natural convection problem by using Buckingham pi theorem. (10)
    b) List out any five dimensionless numbers which are frequently used in heat transfer with their significance. (4)

MODULE III

15. a) Explain the classification of heat exchangers. (7)
    b) Explain the working and construction of any condenser used in food industry. (7)

OR

16. a) Explain the laws of radiation with the necessary equations. (6)
    b) Illustrate the effectiveness of heat exchanger using LMTD Method and NTU method. (8)

MODULE IV

17. a) Distinguish between molecular and eddy diffusion. Explain mass diffusivity. (7)
    b) Ammonia is diffusing through a uniform tube containing nitrogen gas maintained at 298K and 100KPa pressure. The partial pressure of ammonia at two planes 0.4 m apart are 10KPa and at 7KPa respectively. The diffusivity of ammonia in nitrogen is 1.88×10^{-5} m^2/s. Calculate the molar flux of ammonia. (7)

OR

18. a) Derive the relation between individual and overall mass transfer coefficient (6)
    b) Using Fick's law derive equations for molar flux for gaseous mixtures for the following conditions: (i) One component transferring to non- diffusing component, (ii) Equimolar counter diffusion. (8)

MODULE V

19. A feed of 50 mole % hexane and 50 moles % octane is fed into a pipe still through a pressure reducing valve and then into a flash disengaging chamber. The vapor and liquid leaving the chamber are assumed to be in equilibrium. If the fraction of the feed converted to the vapor is 0.5, find the compositions of the top and bottom products. The following table gives the equilibrium data for this system. (14)

Mole fractions of hexane in liquid x	1.00	0.69	0.40	0.192	0.045	0.00
Mole fractions of hexane in vapor y	1.00	0.932	0.78	0.538	0.1775	0.00

OR

20. a) Describe the criteria for selection of the solvent in liquid-liquid extraction (7)
b) Derive the operating line equations for enriching section and stripping section considering Mc-Cabe Thiele assumptions. (7)

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