

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Summer 2022-23 Examination

Semester: 4
Subject Code: 203144257
Subject Name: Heat and Mass Transfer

Date: 27/03/2023
Time: 02:00 pm to 04:30 pm
Total Marks: 60

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 Objective Type Questions - (Fill in the blanks, one word answer, MCQ-not more than Five in case of MCQ) (All are compulsory) (Each of one mark) (15)

- 1 Thermal conductivity is lower for

(a) Wood	(c) air
(b) Water at 100°C	(d) steel
- 2 The unit of heat transfer coefficient is

(a) W	(c) W/mK
(b) W/m ² K	(d) W/m ²
- 3 In shell and tube heat exchanger, baffles are mainly used to

(a) Increases the mixing of fluid	(c) deflect the flow in desired direction
(b) Increase the heat transfer area	(d) reduce fouling of the tube surface
- 4 Fick's law is given by the formula

(a) $N_b = -D_{bc} dC_b / dx$	(c) $N_b = -3 D_{bc} dC_b / dx$
(b) $N_b = -2D_{bc} dC_b / dx$	(d) $N_b = -4 D_{bc} dC_b / dx$
- 5 Heat transfer through electromagnetic wave is

(a) Conduction	(c) Radiation
(b) Convection	(d) None of the above
- 6 For an opaque surface, the absorptivity (α), transmissivity (τ) and reflectivity (ρ) are related by the equation _____.
- 7 Conduction heat transfer takes place in _____.
- 8 For a current carrying wire of 20 mm diameter exposed to air ($h = 20 \text{ W/m}^2\text{K}$), maximum heat dissipation occurs when thickness of insulation (0.5 W/mK) is _____ mm.
- 9 In liquids and gases, heat transmission is primarily caused by _____.
- 10 NTU stands for _____.
- 11 Define: Fourier's law of conduction
- 12 State "Stefan Boltzmann's law of radiation".
- 13 Define: Heat Exchanger
- 14 State application of fins.
- 15 Assuming the sun is to be a black body emitting radiation with maximum intensity at $\lambda = 0.49 \mu\text{m}$. Calculate the surface temperature of the sun.

Q.2 Answer the following questions. (Attempt any three) (15)

- A) Define following terms:
1. Moisture content
 2. Bound moisture
 3. Unbound moisture
 4. Equilibrium moisture
 5. Free moisture
- B) What is meant by crystallization? Draw flow process of crystallization.
- C) Define the terms thermal conductivity and thermal diffusivity with physical significance and unit.
- D) The literature of heat transfer generally recognizes distinct modes of heat transfer. How many modes are there? Explain it shortly.

Q.3 A) (i) Draw the temperature distribution graph of counter and Parallel flow type heat exchanger and write the LMTD equation for same. (03)

(ii) A wall of furnace is made up of inside layer of silica brick 120 mm thick covered a layer of magnesite brick 240 mm thick. The temperature at inside surface of silica brick wall and outside surface of magnesite brick wall are 725°C and 110°C respectively. If the thermal conductivities of silica and magnesite are $1.7 \text{ W/m}^{\circ}\text{C}$ and $5.8 \text{ W/m}^{\circ}\text{C}$. Calculate the rate of the heat transfer per unit area of wall (04)

B) Explain Henry's law with limitation and Enlist Factors Affecting the Henry's Law Constant. (08)

OR

B) Explain the concept of Height equivalent of theoretical plate (HETP). (08)

Q.4 A) (i) Distinguish between natural and forced convection heat transfer. (07)

(ii) Explain Overall heat transfer coefficient concept in detail.

OR

A) Explain tunnel truck dryer with neat sketch. (07)

B) Find out the heat flow rate through the composite wall as shown in figure. Assume one dimensional flow. $K_A = 150 \text{ W/m}^{\circ}\text{C}$, $K_B = 30 \text{ W/m}^{\circ}\text{C}$, $K_C = 65 \text{ W/m}^{\circ}\text{C}$, $K_D = 50 \text{ W/m}^{\circ}\text{C}$ (08)

