Seat No: _____ **Enrollment No: _____**

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2022 - 23 Examination

Semester: IV **Date: 20-3-2023**
Subject Code: 203103251 **Time: 2.00 pm to 4.30 pm**
Subject Name: Heat Transfer **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: **(15)**

1. The transfer of heat by molecular collision is smallest in _____. (liquids, solids, gases)
2. The unit of overall heat transfer coefficient (U) is:
   a. W/m K
   b. W/m^2K
   c. W/m^2
   d. W/m
3. The rate of heat flow through a body is $Q = [k A (T_1 – T_2)] / \Delta x$. The term "$\Delta x / kA$" is known as _____.
   a. Thermal coefficient
   b. Thermal diffusivity
   c. Thermal resistance
   d. Thermal conductivity
4. Air at 30° C blows over a plate of 50 cm x 75 cm maintained at 250° C. If the convection heat transfer coefficient is 25 $W/m^2°C$, the heat transfer rate is:
   a. 82.5 W
   b. 3.3 W
   c. 2062.5 W
   d. 5500 W
5. All radiations in a black body are _____. (reflected, transmitted, absorbed, refracted)
6. Define hydraulic diameter.
7. What happens when the thickness of insulation on a pipe is greater than the critical value?
   a. Heat transfer rate increases
   b. Heat transfer rate decreases
   c. Heat transfer rate remain constant
   d. none of these
8. What is meant by forced convection?
9. What is meant by Pr = 1?
10. What is the role of baffles in shell and tube heat exchangers?
11. Thermal diffusivity (α) is inversely proportional to material density (ρ) and directly proportional to thermal conductivity (k). (True, False)
12. In heat exchangers, the value of logarithmic mean temperature difference should be:
    a. maximum possible
    b. minimum possible
    c. zero
    d. constant
13. Mention the types of fins used in heat transfer applications.
14. What is a cross-flow heat exchanger?

15. Define fin efficiency.

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

A) How radiation differs from convection mode of heat transfer? Also, describe Stefan-Boltzmann's law and Kirchhoff's law for radiation.

B) Derive the expression for rate of heat flow through a plane composite wall made of three materials having different thermal conductivities.

C) Discuss the temperature dependence of thermal conductivity in liquids and gases.

D) Using a neat diagram, explain the construction, working and applications of plate type heat exchangers.

Q.3 A) Deduce the expression for LMTD and rate of heat flow (q) for a counter-flow double pipe heat exchanger. **(07)**

B) Using a neat labelled sketch, explain the construction, working and applications of falling film evaporators. Also, describe the method of forward and backward feeding in multi-effect evaporator systems. **(08)**

OR

B) Using the concept of dimensional analysis, prove the following correlation applicable to forced convection: **(08)**

$$Nu = f(Re, Pr)$$

Q.4 A) Explain the difference between: **(07)**

i. Boiling and evaporation
ii. Pool boiling and flow boiling
iii. Filmwise and dropwise condensation

OR

A) A black body at 3500 K emits radiation. Calculate the following: **(07)**

i. Wave length at which emission is maximum.
ii. Total emissive power (considering black body)
iii. Total emissive power if it is assumed as a real surface having emissivity = 0.7

Given: Surface temperature T = 3500K

B) A steel rod (k = 30 W/m°C), 1 cm in diameter and 5 cm long, acting as a fin protrudes from a wall which is maintained at 100°C. The rod is insulated at its tip and is exposed to an environment with h = 50 W/m^2°C and T_∞=30°C. Calculate the following: **(08)**

i. Fin efficiency
ii. Rate of heat loss

Equations:

$$\eta_f = \frac{\tanh(mL)}{mL}$$

$$q = \sqrt{h\ P\ k\ A_c}\ \theta_o\ \tanh(mL)$$

$$\theta_o = T_o - T_\infty$$

$$m = \sqrt{\frac{h\ P}{k\ A_c}}$$