



BRAINWARE UNIVERSITY

Term End Examination 2023-2024

Programme – B.Tech.(ME)-2021

Course Name – Heat Transfer

Course Code - PCC-ME501

(Semester V)

Full Marks : 60

Time : 2:30 Hours

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question)

1 x 15=15

1. Choose the correct alternative from the following :

- (i) Choose the material has poor heat conduction properties and is often used for insulation.
- | | |
|-------------|-----------|
| a) Copper | b) Glass |
| c) Aluminum | d) Silver |
- (ii) The rate of heat transfer through a material is directly proportional to the temperature difference across the material and inversely proportional to the thickness. This is described by_____.
- | | |
|-------------------------|------------------|
| a) Fourier\'s Law | b) Newton\'s Law |
| c) Stefan-Boltzmann Law | d) Boyle\'s Law |
- (iii) The extended surface used for the enhancement of heat dissipation is defined as
- | | |
|---------------------------|----------------------|
| a) Convective coefficient | b) Fourier number |
| c) Fin | d) No finned surface |
- (iv) The transfer of heat by radiation is most efficient in_____ mediums.
- | | |
|--------------------------|-----------|
| a) Transparent materials | b) Metals |
| c) Non-metallic solids | d) Vacuum |
- (v) In a vacuum, heat transfer can only associated through_____.
- | | |
|---------------|-------------------------|
| a) Conduction | b) Convection |
| c) Radiation | d) All of the mentioned |
- (vi) Select the primary mode of heat transfer in a vacuum flask that keeps hot liquids hot and cold liquids cold.
- | | |
|---------------|---------------|
| a) Conduction | b) Convection |
| c) Radiation | d) Insulation |
- (vii) Select the materials that is a poor conductor of both electricity and heat.
- | | |
|-----------|-------------|
| a) Copper | b) Aluminum |
|-----------|-------------|

- c) Rubber
d) Silver
- (viii) Choose the mechanism behind a metal spoon becoming hot when placed in a hot cup of coffee.
- a) Conduction
b) Convection
c) Radiation
d) Induction
- (ix) Select the mode of heat transfer do particles in a fluid carry thermal energy by physically moving from one place to another.
- a) Conduction
b) Convection
c) Radiation
d) Insulation
- (x) In the electromagnetic spectrum, _____ type of radiation has the longest wavelength.
- a) X-rays
b) Gamma rays
c) Microwave
d) Ultraviolet
- (xi) Select the materials typically has a high emissivity.
- a) Shiny metal surfaces
b) Polished glass
c) Matte black paint
d) Highly reflective surfaces
- (xii) Identify the objects that is closest to being a perfect blackbody.
- a) A mirror
b) A white wall
c) A glass pane
d) A hollow cavity with small opening
- (xiii) Identify the primary purpose of a heat exchanger.
- a) To generate electricity
b) To store thermal energy
c) To transfer heat from one fluid to another
d) To cool electronic devices
- (xiv) Molecular transmission of heat is smallest in case of _____
- a) solids
b) Gases
c) Alloys
d) Liquids
- (xv) Identify the very good insulator
- a) Saw dust
b) Cork
c) Glass wool
d) Asbestos sheet

Group-B

(Short Answer Type Questions)

3 x 5=15

2. Distinguish between laminar flow and turbulent flow. (3)
3. Define boundary layer thickness. (3)
4. Discuss about parallel flow heat exchangers. (3)
5. Discuss about LMTD. (3)
6. Explain Kirchhoff's law in detail. (3)

OR

Explain Stefan-Boltzmann law. (3)

Group-C

(Long Answer Type Questions)

5 x 6=30

7. The filament of a 75 W light bulb may be considered as a black body radiating into a black enclosure at 70 degrees C. The filament diameter is 0.10 mm and the length is 5 cm. considering the radiation, determine the filament temperature. (5)
8. Discuss the various regimes of nucleate boiling and explain the conditions for the growth of bubble (5)

9. Explain the analogy between heat transfer by conduction and flow of electricity through ohmic resistance. Illustrate the concept by considering composite wall of building. Three layers of materials of thermal conductivities k_1, k_2, k_3 and thickness $\delta_1, \delta_2, \delta_3$ are placed in good contact. Deduce from first principle an expression for the heat flow through the composite slab per unit surface area in terms of the overall temperature difference across the slab (5)
10. The sun emits maximum radiation at $\lambda = 0.52 \mu$. Assuming the sun to be a black body, calculate the surface temperature of the sun. Also calculate the monochromatic emissive power of the sun's surface. (5)
11. A mild steel tank of wall thickness 10 mm contains water at 90 degree C. The thermal conductivity of mild steel is 50 W/m degree C, and the heat transfer coefficient for inside and outside of the tank area are 2800 and 11 W/m square degree C, respectively. If the atmospheric temperature is 20 degree C, calculate (i) The rate of heat loss per m square of the tank surface area. (ii) The temperature of the outside surface tank (5)
12. Two large plates are maintained at a temperature of 900 K and 500 K respectively. Each plate has area of 6 m square. Compare the net heat exchange between the plates for both plates are black. (5)

OR

Water flows at the rate of 65 kg/min through a double pipe counter flow heat exchanger. Water is heated from 50 degree C to 75 degree C by an oil flowing through the tube. The specific heat of the oil is 1.780 kJ/kg.K. The oil enters at 115 degree C and leaves at 70 degree C. The overall heat transfer co-efficient is 340 W/m²K. Calculate the following: 1. Heat exchanger area 2. Rate of heat transfer (5)
