

Q. No. CHO - 441

0092

ND/B.Tech./Even

Reg/2022-23

2022-23

PROCESS HEAT TRANSFER

CHO - 441

Full Marks : 25

Time : Ninety Minutes

The figures in the margin indicate full marks.

Answer *all* the questions.

Graph paper shall be supplied, if required.

1. Illustrate the fundamental difference between 'Heat Transfer' and 'Thermodynamics'. 2 [CO1]
2. What is conduction? Can this mode of heat transfer occur in liquid and gases? Justify your answer. 1+1+1 [CO1]
3. The terms thermal conductivity and thermal diffusivity are identical. Is the statement true or false? In either case, justify your answer. In case the statement is false, which of the above terms exhibit higher magnitude for a metal body and why? 1+2+2 [CO1]
4. Consider a rectangular block of thickness 'L', thermal conductivity 'k' and area 'A'. The temperature difference between the two walls of the block is ΔT . If the thickness is 'doubled' and the thermal conductivity is 'halved', what will be the percentage increase or decrease in heat transfer rate? 2 [CO2]

P.T.O.

(2)

5. Derive the general unsteady state heat conduction equation with no heat generation term. 4 [CO2]
6. A 2kW-resistance heater wire with thermal conductivity $15 \text{ W/m}^\circ\text{C}$, diameter 0.4 cm , and length 50cm is used to boil the water by immersing it in water. What is the differential equation that describes the variation of the temperature in the wire during the steady operation assuming the thermal conductivity variation with temperature in the wire is negligible? 3 [CO2]
7. What do you mean by critical radius of insulation? Derive the mathematical expression for critical radius of insulation. Evaluate the critical radius of insulation for asbestos with $k = 0.125 \text{ W/mK}$ surrounding a pipe exposed to room air with $h = 2.5 \text{ W/m}^2\text{K}$ 2+3+1 [CO1, CO2]

Course Outcomes :

- CO1 : Illustrate principles of heat transfer of different heat exchanging phenomena.
- CO2 : Apply laws of heat transfer for energy balance of chemical processes.
- CO3 : Solve heat transfer problems of different difficulty levels.
- CO4 : Design and analyze heat transfer equipment.