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CBCS SCHEME

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21ME62

Sixth Semester B.E./B.Tech. Degree Examination, June /July 2026
Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: **1. Answer any FIVE full questions, selecting one Full question from each module.**
2. Use of Heat transfer Data hand book, Thermodynamics Data hand Book are permitted.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain different modes of Heat Transfer with examples. **(06 Marks)**

b. Explain experimental method of determining the thermal conductivity of Metal Rod. **(06 Marks)**

c. A brick wall 25 cm thick faced with concrete of 5 cm. The Thermal conductivity of brick is 0.69 W/mk and that of concrete 0.93 w/mk. The temperature of exposed brick face is 30°C that of concrete is 5°C. Find the heat lost through the wall of 10 × 5 m^2 area, also determine interface temperature. **(08 Marks)**

OR

2 a. Explain the Boundary conditions of 1st, 2nd and 3rd kind. **(06 Marks)**

b. Explain the significance of critical radius of Insulation over the cylinder. **(04 Marks)**

c. A 100 mm diameter steam pipe is covered by 2 layer of lagging. The inside layer is 40 mm thick and has thermal conductivity of 0.07 W/mk. The outside layer is 25 mm thick and has thermal conductivity = 0.1 W/mk. The pipe conveys steam at a temperature of 130° C. The outside temperature of lagging is 24°C. If the steam pipe is 20 m long, determine heat lost per hour. Interface temperatures. **(10 Marks)**

Module-2

3 a. Derive Expression for rate of heat transfer through Round fin with end insulated. **(10 Marks)**

b. A copper fin (K = 396 W/mk) 0.25 cm in diameter protrudes from a wall at 95°C into ambient air at 25°C. The heat transfer co-efficient is 10 W/m^2K.

Find the heat loss if :
i) The Fin is infinitely long. ii) The fin is 3 cm long and end is not insulated. **(10 Marks)**

OR

4 a. Define Biot number and Fourier number and explain their significance in transient conduction. **(10 Marks)**

b. An Iron sphere of diameter 5 cm is initially at uniform temperature 225°C. It is suddenly exposed to an ambient at 25°C with convection co-efficient of 500 W/m^2K.

i. Calculate the centre temperature 2 min after the start of exposure.

ii. Calculate the temperature at a depth of 1 cm from the surface after 2 min of exposure.

iii. Calculate the energy removed from sphere during this period.

Take K = 60 W/mk ρ = 7850 Kg/m^3 Cp = 460 J/Kg K $\alpha = 1.6 \times 10^{-5}$ m^2/S **(10 Marks)**

Module-3

5 a. Differentiate between the experimental analytical and numerical methods of determining the solution of a heat transfer problem. **(10 Marks)**

b. Explain how numerical solution is obtained for an one dimensional transient heat transfer problem using finite difference method. **(10 Marks)**

OR

6 a. Write a brief note on the concept of black body. **(04 Marks)**

b. State and explain :
i. Kirchhoff's Law
ii. Planks Law
iii. Stefan – Boltzmann Law **(06 Marks)**

c. Two large parallel plates with emissivities 0.5 and 0.8 are maintained at 800 K and 600 K respectively. A Radiation shield having emissivity of 0.1 on one side and 0.05 on the other side is placed between. Calculate the heat transfer per unit area with and with out the radiation shield. **(10 Marks)**

Module-4

7 a. Define the following non dimensional numbers and explain their significance.

i. Reynolds number
ii. PrandtL number
iii. Nusselt number
iv. Grashoff's number
v. Stanton number **(10 Marks)**

b. Calculate the heat transfer from 60 W incandescent bulb at 125°C to ambient air at 25°C. Assume bulb as a sphere of 50 mm diameter. Also find the percentage of power lost by free convection. Take $N_u = 0.6 (Grpr)^{1/4}$. **(10 Marks)**

OR

8 a. Obtain the Expression for Nusselt (N_u) number in terms of Reynold's number (Re) and prandtl number (pr) by using dimensionless analysis in forced convection. **(10 Marks)**

b. Air at 20°C is flowing along a flat plate maintained at 134°C with a velocity of 3 m/s. The plate is 2 m long and 1.5 m wide. Calculate the local heat transfer co-efficient at 40 cm from leading edge. Also determine heat transferred from the first 40 cm of plate to air.
Take following properties of air $\rho = 0.998$ Kg/m^3 , pr = 0.697, Cp = 1.009 KJ/KgK
$\nu = 20.76 \times 10^{-6}$ m^2/s , K = 0.03 W / mk. **(10 Marks)**

Module-5

9 a. Discuss the regimes of pool boiling curve. **(10 Marks)**

b. The outer surface of vertical tube of diameter 2.5 m and 1.5 m long condenses saturated steam at 90°C. The tube is maintained at 70°C. Assuming film wise condensation. Calculate heat transfer and condensate flow rate. Use properties of water at 80°C
$h_{fg} = 2309$ KJ/Kg $\rho = 974$ Kg/m^3 K = 0.668 W/mk $\mu = 0.355 \times 10^{-3}$. **(10 Marks)**

OR

10 a. Derive the equation of LMTD for a parallel flow heat exchanger. **(10 Marks)**

b. Water at the rate of 1Kg/s is heated from 35°C to 75°C by oil in a double pipe counter flow heat exchanger. Oil has specific heat 1.9 KJ/Kgk and it enters the heat exchanger at 110°C and 2.5 Kg/s. The overall heat transfer co-efficient is 300 W/m^{2}K. Calculate the area of heat exchanger. **10 Marks)**

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