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Total No. of Questions : 09

B.Tech (ME) (Sem.–5)
HEAT TRANSFER
Subject Code : ME-303
Paper ID : [A0815]

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY.**
2. **Attempt any FOUR questions from SECTION-B.**
3. **Attempt any TWO questions from SECTION-C.**

SECTION-A (10 × 2 = 20 Marks)

l. (a) In what way is the science of heat transfer different from-thermodynamics?

(b) State Fourier's law for Heat Conduction.

(c) What do you mean by the term 'thermal diffusivity'?

(d) Define Critical thickness for insulation.

(e) Why fins are generally used on gas side in a gas-to-liquid Heat Exchanger?

(f) Differentiate between hydrodynamic and thermal boundary layers.

(g) Differentiate between Pool Boiling and Flow Boiling.

(h) Define Overall Heat Transfer Coefficient.

(i) Define Wein's Displacement Law.

(j) Define absorptivity, reflectivity and transmissivity.

SECTION-B (4 × 5 = 20 Marks)

2. A 3.2 *mm* diameter Steel wire, 30*cm* long has a voltage of 10V impressed on it. The outer surface temperature of wire is maintained at 93°C, Calculate the centre temperature of wire. Take the resistivity of wire as 70μ *ohm*$^{\times}$ cm and thermal conductivity as 22.5 W/m K.

3. A steel rod (k= 30W/m °C), 10*mm* in diameter and 50*mm* long, with an insulated end is to be used as a fin. It is exposed to surrounding with temperature of 65 °C and heat transfer coefficient 50W/m^2 °C. The temperature at base is 98 °C. Determine (a) fin efficiency (b) temperature at the end of fin.

4. A metallic ball of 5*cm* diameter initially at a uniform temperature of 450°C is suddenly placed in an environment at 100°C. Heat transfer coefficient between the steel ball and fluid is 10W/m^2K. For metal C_p= 0.46 *kJ/kg* K, ρ = 7800 kg/m^3, k= 35 *W/m K*. Calculate time required for ball to reach at temperature of 150°C.

5. Differentiate between film and drop-wise condensation. In which case is the heat transfer higher? Why?

6. Using dimensional analysis, derive an expression for heat transfer coefficient in forced convection.

SECTION-C **(2 × 10 = 20 Marks)**

7. Derive three-dimensional General Heat Conduction equation in Rectangular Co-ordinate System.

8. Consider a Heat Exchanger for cooling of hot oil which enters at 180°C, and cooling water enters at 25^0,C.Mass flow rates of oil and water are 2.5*kg/s* and l.2kg/s respectively. Area for heat transfer =16 m^2. Data for oil and water are C_p *oil* =1900 *J/kg* K, C_p water=4184 J/kg K, U=285 W/m^2 K. Calculate outlet temperatures of oil and water for counter and parallel flow Heat Exchanger.

9. A hemispherical furnace of radius lm has a roof temperature of T_1= 800K and emissivity 0.8. The flat circular floor of furnace has a temperature of T_2=600K and emissivity 0.5. Calculate the net radiant heat exchange between the roof and floor. Also calculate net radiant heat exchange when both surfaces assumed to be black.