Nov - Dec - 2011

[4063] – 212

T.E. (Mechanical) (Semester – I) Examination, 2011
HEAT TRANSFER
(2008 Pattern) (New)

Time : 3 Hours | Total Marks : 100

SECTION – I

1. a) Write a short note on :
   i) Variable thermal conductivity
   ii) Isotropic and anisotropic material
   iii) Insulating materials. **9**

   b) A surface having an area of 1.5 m^2 and maintained at 300°C exchanges heat by radiation with another surface at 40°C. The value of factor due to the geometric location and emissivity is 0.52. Determine :
   i) Heat lost by radiation
   ii) The value of thermal resistance, and
   iii) The value of equivalent convection coefficient. **7**

   OR

2. a) Write three dimensional heat conduction equations in cylindrical and spherical coordinates and reduce it to one dimensional form. **8**

   b) The variation of thermal conductivity of a wall material is given by $k = ko\,(1+\alpha t+\beta t^2)$.
   If the thickness of the wall is L and its two surfaces are maintained at temperature T1 and T2, find an expression for the steady state one-dimensional heat flow through the wall. **8**

3. a) Derive an expression for temperature distribution in plane wall under steady state, state heat conduction with heat generation for asymmetrical boundary condition. **8**

   b) Heat is conducted through a tapered circular rod of 200 mm length. The ends A and B having diameters 50 mm and 25 mm are maintained at 27°C and 227°C respectively. k(rod material) = 40 W/m°C. Find :
   i) Heat conducted through the rod
   ii) The temperature at the mid-point of the rod. Assume one dimensional steady state conduction. **8**

   OR

P.T.O.

4. a) Derive an expression for critical radius of insulation for sphere. **6**

   b) A plane wall is 1 m thick and it has one surface (x = 0) insulated while the other surface (x = L) is maintained at a constant temperature of 350°C. The thermal conductivity of the wall is 25 W/m K and a uniform heat generation per unit volume of 500 W/m^3 exists throughout the wall. Determine the maximum temperature in the wall and the location of the plane where it occurs. **10**

5. a) Derive an expression for instantaneous heat flow rate and total heat transfer under unsteady state heat conduction. **10**

   b) A heating unit is made in the form of a vertical tube fitted with rectangular section steel fins. The tube height is 1.2 m and its outer diameter is 60 mm. The fins are 50 mm in height and their thickness is 3 mm. The total number of fins used is 20. The temperature of the base of the fin is 80°C and surrounding temperature is 18°C. The HTC on the fin surface and tube surface to the surrounding air is 9.3 W/m2K. K(fin material) = 55.7 W/m°C. Calculate the rate of heat transfer from the tube with and w/o fin. **8**

OR

6. a) Derive the formula for rate of heat transfer, efficiency and effectiveness for a short fin. **10**

   b) An egg with mean diameter of 40 mm and initially at 20°C is placed in a boiling water pan for 4 minutes and found to be boiled to the consumer's taste. For how long should a similar egg for same consumer be boiled when taken from a refrigerator at 5°C. Take the following properties for egg :

   k = 10 W/mK, ρ = 1200 kg/m^3, c = 2 kJ/kgK and h = 100 W /m^2K. Use lump theory. **8**