B.E. 6th Semester (Mech. Engg.) Examination,

December–2011

HEAT TRANSFER

Paper–ME–306–E

Time allowed : 3 hours] *[Maximum marks : 100*

Note : *(i) Attempt any **five** questions. All questions carry equal marks.*

(ii) Use of steam tables, charts, Graphical plots is permitted.

(iii) Assume missing data if, any.

1. (a) What is heat transfer ? Explain the various modes of heat flow in detail. 10

(b) Explain the combined heat transfer system and law of energy conservation in detail. 10

2. Derive the General Heat conduction equation in Cartesian coordinates and cyclindrical co-ordinates. 20

3. (a) What is Fin effectiveness ? 5

(b) A cyclinder 5 cm in diameter and 1 m long is provided with 10 longitudinal straight fins of material having thermal conductivity 120 W/m-deg. The fins are 0.75 mm thick and protrude 12.5 mm from the cyclinder surface. The system is placed in an atmosphere at 40°C and the heat transfer coefficient from the cyclinder and fins to be ambient air is 20 W/m^2-deg. If the surface temperature of the cyclinder is 150°C, calculate the rate of heat transfer and the temperature at the ends of fins, considering the fin to be of finite length. 15

4. During the heat treatment, cylindrical pieces of 25 mm diameter, 30 mm height and at 30°C are placed in a furance at 750°C with convection coefficient 80 W/m^2-deg the surface. Find out the time required to heat the pieces to 600°C. What will be the shortfall in temperature if the pieces are taken from the furnace after 280 seconds ? Assume the following property values :

(i) Density : 7850 kg/m^3, Specific Heat : 480 J/kg K, Conductivity : 40 W/m-deg.

5. The temperature profile at a particular location on the surface of plate is prescribed by the identities :

(i) $$\frac{t_S - t}{t_S - t_\infty} = \sin\left(\frac{\pi Y}{0.015}\right)$$

(ii) $$\frac{t_S - t}{t_S - t_\infty} = \frac{1}{2}\left(\frac{Y}{0.0075}\right)^3 + \frac{3}{2}\left(\frac{Y}{0.0075}\right)$$

If the thermal conductivity of air is stated to be 0.03 W/m-deg. Find out the value of convective heat transfer co-efficient in each case. 20

6. Air at 1 atm. and 20°C flows across a flat plate maintained at 100°C. The plate measures 20 cm long × 10 cm wide and when the flow is along the 20 cm side, the flow Reynolds number is 40,000. Make calculations for the heat transfer from the plate to the air ? How this heat flow will be affected if the flow velocity is doubled and the pressure is increased to 4 atm ? 20

7. (a) What are different types of heat exchangers ? Explain in detail. 10

   (b) Explain the logarithmic mean temp. Difference and number of transfer units in heat exchanger. 10

8. Write short notes on the following :

   (i) Boiling regimes

   (ii) Nucleate and film boiling. 10