Total No. of Questions : 6]

SEAT No. :

P3677

[Total No. of Pages : 2

Engg.-7
T.E. (Mechanical) (Semester - I)
HEAT TRANSFER (In Sem.)
(2012 Pattern)

Time : 1 Hour] *[Maximum Marks : 30*

Instructions to the candidates:

1) ***Solve Q.1 or Q.2, Q.3 or Q.4 and Q.5 or Q.6.***
2) ***Draw neat diagram wherever necessary.***
3) ***Use of scientific calculator is allowed.***
4) ***Assume suitable data wherever necessary.***
5) ***Figures to the right indicate full marks.***

Q1) a) A steam pipe 10 cm inner diameter and 11 cm outer diameter is covered with an insulating material (k = 1 W/mK). The steam temperature and the ambient temperatures are 200 °C and 20 °C respectively. If the convective heat transfer coefficient between the insulation surface and the air is 8 W/m^2K, find the critical radius of insulation. For this value of critical radius, calculate the heat loss per metre of pipe and the outer surface temperature. Neglect the resistance of pipe material. **[8]**

b) Explain significance of thermal diffusivity. **[2]**

OR

Q2) a) A chemical reactor vessel of spherical shape of outside radius of 0.5 m has to loose heat at the rate of 650 W in order to maintain the temperature of the chemical. The surface temperature of the vessel is 125 °C. The surrounding is at 113 °C. If the heat loss is by both convection and radiation, determine the value of convective heat transfer coefficient required. **[4]**

b) Derive an expression for critical radius of insulation for a sphere using standard notations. **[6]**

P.T.O.

Q3) In a thick infinite slab of thickness 20 cm, the temperature of fluid on one side is 30 °C and on other side is 20 °C. The heat transfer coefficient on the hot side is 20 W/m^2K and on cold side is 40 W/m^2K, the conductivity of material is 20 W/mK. The heat generated in the slab is at the uniform rate of 5 kW/m^3. **[10]**

a) Derive an expression for temperature distribution in the slab.

b) Find the maximum temperature in the slab and its location.

OR

Q4) a) Explain the significance of Biot Number. **[2]**

b) During a heat treatment process, alloy steel spherical balls of 12 mm diameter are initially heated to 800 °C in a furnace. Subsequently these are cooled to 100 °C by keeping them immersed in oil bath at 35 °C with convection coefficient 20 W/m^2 °C. Determine the time required for cooling process. Proceed to calculate the value of convection coefficient it is desired to complete the cooling process in a period of 10 min. The thermophysical properties of steel balls are

ρ = 7750 kg/m^3, Cp = 520 J/kgK and k = 50 W/m °C. **[8]**

Q5) a) Write a note on Convection boundary condition. **[4]**

b) In an experiment to determine the thermal conductivity of a very long solid rod 2.5 cm diameter, its base is placed in a furnace with a large portion of it projecting into the room air at 22 °C. After steady state conditions prevail, the temperatures at two points. 10 cm apart, are found to be 110 °C and 85 °C respectively. The convective heat transfer coefficient between the rod surface and the surrounding air is 28.4 W/m^2K. Determine the thermal conductivity of the rod material. **[6]**

OR

Q6) a) Differentiate between Fin Efficiency and Fin Effectiveness. **[4]**

b) 10 rectangular fins of brass (k = 120 W/mK) are welded horizontally to a plane vertical surface of a tank, 1m wide and 1m high. The fins are 2 mm thick and 20 cm long. They are uniformly spaced on the vertical surface of a tank, which is maintained at 200 °C. If the unit is exposed to ambient air at 20 °C with h = 20 W/m^2K, find heat transfer from the total system (finned area + unfinned area). Assume insulated tip condition for fin analysis. **[6]**

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