B.E. (Mechanical Engineering) Sixth Semester

1058

Exam Code: 0942
Sub. Code: 7061

MEC-604: Heat Transfer

Time allowed: 3 Hours

Max. Marks: 50

NOTE: Attempt <u>five</u> questions in all, including Question No. I which is compulsory and selecting two questions from each Unit. Make suitable assumptions, wherever necessary.

x-x-x

I. Solve the following:-

a) What is a boundary condition? How many boundary conditions do we need to specify for a two-dimensional heat transfer problem?

b) What is heat generation? Give some examples.

c) Consider heat conduction through a wall of thickness L and area A. Under what conditions will the temperature distributions in the wall be a straight line?

d) What is the physical significance of the Nusselt number? How is it denned?

e) What is the difference between evaporation and boiling? (5x2)

UNIT – I

II. A 6-m-long 2-kW electrical resistance wire is made of 0.2-cm-diameter stainless steel (k = 15.1 W/m . °C). The resistance wire operates in an environment at 30°C with a heat transfer coefficient of 140 W/m 2 . °C at the outer surface. Determine the surface temperature of the wire. (10)

III. Heat is to be conducted along a circuit board that has a copper layer on one side. The circuit board is 15 cm long and 15 cm wide, and the thicknesses of the copper and epoxy layers are 0.1 mm and 1.2 mm, respectively. Disregarding heat transfer from side surfaces, determine the percentages of heat conduction along the copper (k = 386 W/m . °C) and epoxy (k = 0.26 W/m . °C) layers. Also determine the effective thermal conductivity of the board. (10)

IV. A hot surface at 100°C is to be cooled by attaching 3-cm-long, 0.25-cm-diameter aluminum pin fins (k =237 W/m . °C) to it, with a center-to-center distance of 0.6 cm. The temperature of the surrounding medium is 30°C, and the heat transfer coefficient on the surfaces is 35 W/m^2 . °C. Determine the rate of heat transfer from the surface for a 1-m section of the plate. Also determine the overall effectiveness of the fins. (10)

P.T.O.

UNIT – II

V. The top surface of the passenger car of a train moving at a velocity of 70 km/h is 2.8 m wide and 8 m long. The top surface is absorbing solar radiation at a rate of 200 W/m 2, and the temperature of the ambient air is 30°C. Assuming the roof of the car to be perfectly insulated and the radiation heat exchange with the surroundings to be small relative to convection, determine the equilibrium temperature of the top surface of the car. (10)

VI. Saturated steam at 30°C condenses on the outside of a 4-cm-outer-diameter, 2-m-long vertical tube. The temperature of the tube is maintained at 20°C by the cooling water. Determine (a) the rate of heat transfer from the steam to the cooling water, (b) the rate of condensation of steam, and (c) the approximate thickness of the liquid film at the bottom of the tube. (10)

VII. A furnace is of cylindrical shape with R = H = 2 m. The base, top, and side surfaces of the furnace are all black and are maintained at uniform temperatures of 500, 700, and 1200 K, respectively. Determine the net rate of radiation heat transfer to or from the top surface during steady operation. (10)

x-x-x