[Total No. of Questions - 9] [Total No. of Printed Pages - 3]

Dec.-22-0186

ME-503 (Heat Transfer, ME, AE)

B.Tech. 5th (CBCS)

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

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : 1. This question paper contains five sections: Section A. B, C, D, and E.

2. Attempt five questions in all. Attempt one question from each Section A, B, C & D. Attempt all subparts of Section E.

3. Supplement your answer with suitable sketches wherever required.

4. Assume the data suitably, if required.

SECTION - A

1. Derive three-dimensional general conduction equation in Cartesian coordinates involving internal heat generation and unsteady state conditions. (10)

2. A heavy-wall tube of Monel, 2.5-cm ID and 5-cm OD, is covered with a 2.5-cm layer of glass wool. The inside tube temperature is 300°C, and the temperature at the outside of the insulation is 40°C. How much heat is lost per foot of length? Take k =11 Btu/h • ft • °F for Monel. (10)

SECTION - B

3. A solid body at some initial temperature T_0 is suddenly placed in a room where the air temperature is T_∞ and the walls of the room are very large. The heat-transfer coefficient for the convection heat loss is h, and the surface of the solid may be assumed black. Assuming that the temperature in the solid is

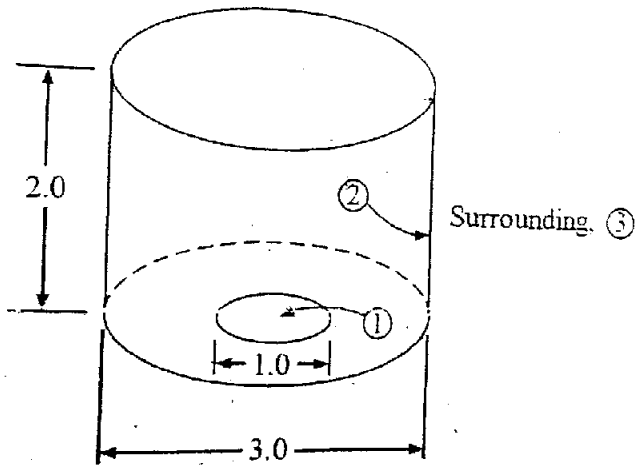
uniform at any instant, write the differential equation for the variation in temperature with time, considering both radiation and convection. (10)

4. Water flows in a duct having a cross section 5×10 mm with a mean bulk temperature of 20°C. If the duct wall temperature is constant at 60°C and fully developed laminar flow is experienced, calculate the heat transfer per unit length. (10)

SECTION - C

5. Two concentric cylinders have diameters of 10 and 25 cm and a length of 7 cm. Calculate the shape factor between the open ends. (10)

6. Determine the shape factors F13, F23, F22, F21, F12 for the disk surrounded by a short cylinder as shown in Figure. (10)



SECTION - D

7. Derive the formula for LMTD assuming that the heat exchanger is a counterflow double-pipe arrangement. (10)

[P.T.O.]

8. A counterflow double-pipe heat exchanger operates with hot water flowing inside the inner pipe and a polymer fluid flowing in the annular space between the two pipes. The water-flow rate is 2.0 kg/s and it enters at a temperature of 90°C. The polymer enters at a temperature of 10°C and leaves at a temperature of 50°C while the water leaves the exchanger at a temperature of 60°C. Calculate the value of the overall heat-transfer coefficient expressed in $W/m^2°C$, if the area for the heat exchanger is 20 m^2. (10)

SECTION - E

9. Short answer type compulsory questions:

   (i) Once finite-difference equations are obtained for a conduction problem, what methods are available to affect a solution? What are the advantages and disadvantages of each method, and when would each technique be applied?

   (ii) Define the conduction shape factor.

   (iii) Define the bulk temperature. How is it used?

   (iv) What is the form of equation used to calculate heat transfer for flow over cylinders and bluff bodies?

   (v) What is the physical significance of Stefan-Boltzmann law?

   (vi) Why do surfaces absorb differently for solar or earthbound radiation?

   (vii) Compare pros and cons of the atmospheric greenhouse effect.

   (viii) What is meant by a non-black body?

   (ix) What is physical significance of fouling factor?

   (x) What advantage does the effectiveness-NTU method have over the LMTD method? (10×2=20)