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B. E. 6th Semester (Mech. Engg.) Examination, May–2011

HEAT AND MASS TRANSFER

Paper–ME-306-C

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

Note : *Attempt five questions by selecting atleast two from each part.*

Part–A

1. Explain the various modes of heat transfer and deal with basic formula of :
   (a) Conduction
   (b) Convection
   (c) Radiation. 20

2. A steel pipe having 10 cm bore and 12 cm outside diameter carries hot water at 80 °C when the surrounding temperature is 15°C. The thermal conductivity of pipe material is 54 W/mK and inner and outer heat transfer co-efficients are 1KW / m^2K and 9W/m^2K resp. Calculate the heat loss per meter length of pipe and surface temperatures. Also calculate the heat loss and the surface temperature when the pipe is covered with a 4 cm thick insulation having thermal conductivity of 0.048 W/mK with outer surface heat transfer co-efficient reduced to 7 W/m^2K. 20

3. (a) Derive an expression for temperature distribution and heat transfer through an infinitely long fin. 10

(b) Two long rods of the same diameter, one made of brass (K=85W/m°C) and other made of copper (K=375W/m°C) have one of their ends inserted in the furnace. Both of the rods are exposed to the same environment. At a distance 105mm away from the furnace end, the temperature of the brass is 120°C. At what distance from the furnace end the same temperature would be reached in the copper rod. 10

4. An aluminium pipe carries steam at 110 °C. The pipe (K=185W/m°C) has an inner dia. of 100mm and outer dia. of 120mm. The pipe is located in a room where ambient air temp. is 30°C and convective heat transfer coefficient between the pipe and air is 15W/m^{2}C. Determine the heat transfer rate per unit length of pipe.

Also to reduce the heat loss from the pipe if it is covered with a 50mm thick layer of insulation (K=0.20 W/m°C). Determine the heat transfer rate per unit length from

the insulated pipe. Assume that the convective heat resistance of steam is negligible. 20

Part–B

5. (a) Using Buckinghm's pi-theorem find general relation for forced convection i.e. 12

Nu = [C {(Re)×m}.{(Pr)×n}], where C,m,n are some constants.

(b) State Nusselt theory of laminar film condensation. 8

6. (a) What is the Stefan's-Boltzmann law ? Explain the concept of monchromatic emmisive power, total emmissive power and intensity of radiation. 8

(b) The radiation shape factor of the circular surface of a thin hollow cylinder of 10cm diameter and 10cm length is 0.1716. What is the shape factor of the curved surface of the cylinder with respect to itself ? 12

7. (i) In counter flow double pipe heat exchanger water is heated from 25°C to 65°C by an oil with a specific heat of 1.45 kJ/Kg K and mass flow rate of 1.9 Kg/sec. The oil is cooled from 230°C

to 160°C. If the overall heat transfer coefficient is 420W/m^{2}K, calculate the following :

(a) The rate of heat transfer

(b) The mass flow rate of water

(c) Surface area of heat exchanger. 15

(ii) Define and classify heat exchangers. 5

8. Write short notes on :

(a) Boiling Regimes

(b) Convective mass transfer. 2+10=20