2005-PUNJAB TECHNICAL UNIVERSITY

B.TECH V SEMESTER DEGREE EXAMINATION

HEAT TRANSFER

(MECHANICAL ENGINEERING)

TIME-3HOUR
MARK-60

Note: Section A Is Compulsory. Attempt Any Four Questions From Section B And Any Two From Section C.

SECTION A MARKS 2 EACH

1.(a) Define thermal conductance and thermal resistance.

(b) Why thermal conductivity of metals is higher than that of a fluid?

(c) What is thermal diffusivity?

(d) Describe efficiency and effectiveness of fin.

(e) Define forced and free convection. Give one example of each.

(f) Explain significance of Biot number.

(g) Discuss in brief physical mechanism of boiling.

(h) What do you mean by burnout point?

(i) What is characteristic length?

(j) Give a concept of black body.

SECTION B MARKS 5 EACH

2. Air at 90 oC flows in a Copper tube (k=0.384 W/mK) of 4 cm inner diameter and with 0.6 cm thick walls which are heated from the outside by water at 125 oC. A scale of 0.3 cm thick is deposited on the outer surface of the tube whose thermal conductivity is 1.75 W/mK. The air and water side unit surface conductance are 221 and 3605 W/m2K respectively. Find:

(a) The overall water to air transmittance
(b) Water to air heat exchange
(c) Temperature drop across the scale deposit.

3. A fin 0.5 cm thick and 40 mm long has its base on a plane plate which is maintained at 110 oC. The ambient air temperature is 20 oC. The conductivity of the fin material is 80W/mK and the heat transfer coefficient h= 150 W/m2K. Determine:

(a) Temperature at the middle of the fin.
(b) Temperature at the end of the fin.
(c) Total heat dissipated by the fin.

4. Derive the expression for effectiveness by NTU method in counter flow heat exchanger.

5. Derive an expression for the shape factor of a cylindrical cavity of diameter D and depth H with respect to itself. Also calculate the set radiative heat coming out from the cavity if H=250 mm and D= 150 mm, temperature of inside surface of the cavity is 600 K and emissivity of the cavity surface is 0.75.

6. Air flows through the annulus gap of two concentric cylinders, the diameters of which are 5 cm and 15 cm respectively. Their absorptivities are 0.7 and 0.8 respectively. They are maintained at a temperature of 200 oC and

600 oC. At a certain part temperature of flowing air is 400 oC. Compare the rate of radiant heat transfer per m2 to the inner surface with the rate of convective heat transfer at that very point if the heat transfer coefficient is 41 W/m2K. Assume that no radiant heat is absorbed by the air.

SECTION C MARKS 10 EACH

7. A 66 kV transmission line carrying a current of 900 ampere is 18 mm diameter. The electrical resistance of Copper conductor is 0.076 ohm/km and thermal conductivity of copper is 380 W/mK.. The surrounding temperature is 35 oC. The combined convection and radiation coefficient for heat transfer from the wire surface to the surroundings is 14 W/m2K. Calculate the following:

(a) the surface temperature f the transmission line
(b) the heat generation per unit volume
(c) the maximum temperature in the line.

8. In order to cool the lubricating oil for a large industrial gas turbine a counter flow concentric tube heat exchanger is used. The flow rate of cooling water through the inner tube (D1 =2 mm) is 0.21 kg/s while the flow rate of oil through the outer annulus (D2 =2 mm) is 0.21 kg/sec while the flow rate of oil through the outer annulus (Do = 45mm) is 0.11 kg/s. The inlet and outlet temperature of water is 100 oC and 60 oC respectively. The water enters at 30 oC to the exchanger. Calculate the length of the tube. Take the following properties at bulk mean temperature.
Engine oil at 80 oC; Cp???????J/kg??
?= 3.25 x 10 -2 N-s/m2.
k= 0.138 W/mK
Water at 35 oC
Cp=4.174 kJ/kg,
?= 725 x 10 -6 N-s/m2
k= 0.625 W/mK, Pr =4.85.

9. (a) Discuss the factors affecting the nucleate boiling.

(b) Explain Nussett and Grasshof numbers.