PVP 12

Code: ME5T5

III B.Tech - I Semester – Regular Examinations - November 2014

HEAT TRANSFER
(MECHANICAL ENGINEERING)

Duration: 3 hours Marks: 5x14=70

Answer any FIVE questions. All questions carry equal marks

1. a) Explain the different modes of heat transfer. 4 M

   b) Derive the general heat conduction equation in Cartesian coordinates. 10 M

2. a) Differentiate between conductivity and conductance. 2 M

   b) Compare the temperature distributions in pin fin having a diameter of 20 mm and length 100 and exposed to heat transfer coefficient of 25 W/m^2K for three different materials: Copper (Thermal Conductivity = 385 W/m K), stainless steel (Thermal Conductivity = 17 W/m K) and glass (Thermal Conductivity = 0.8 W/m K). Also compare the relative heat flows and fin efficiencies with respect to copper fin. 12 M

3. A 20 mm diameter stainless steel ball (Density = 7865 kg/m^3, Specific Heat = 0.46 kJ/Kg K and Thermal Conductivity = 6 W/m K) is uniformly heated to 800 ^{0}C. It is to be hardened by suddenly dropping it into an oil bath at 50^{0}C. If the quenching occurs when the ball reaches 100 ^{0}C and the heat transfer coefficient between oil and the sphere is 300 W/m^2K, how long should the ball is to be kept in the oil bath? If 100 balls are to be quenched per min, determine the rate of heat removal from the oil bath per min, needed to maintain its temperature at 40 ^{0}C. 14 M

4. a) Using dimensional analysis, establish the relation between Nusselt, Prandtl and Grashof numbers. 7 M

b) Explain for fluid flow over a flat plate 7 M

i) Velocity distribution in hydrodynamic boundary layer

5. a) Sketch temperature and velocity profiles in free convection on a vertical wall. 6 M

b) A vertical plate of 0.3 m height and 0.1 m width maintained at a uniform temperature of 80 ^{0}C is exposed to ambient air at 25 ^{0}C. Calculate the heat lost from the plate. 8 M

6. a) Distinguish between filmwise and dropwise condensation. Which of these gives a higher heat transfer coefficient? Why? 7 M

b) A vertical tube, 40 mm diameter and 1m long is used for condensing dry saturated steam at atmospheric pressure. The tube surface temperature is 60 ^{0}C. Determine the condensation heat transfer coefficient and the mass flow rate of condensate. 7 M

7. a) What are fouling factors? Explain their effect in heat exchanger design. 6 M

b) In a crossflow heat exchange the overall heat transfer coefficient and area are 100 W/m^2 K and 40 m^2, respectively. Hot gases at 250 ^{0}C enter the exchanger with a flow rate of 1.5 kg/s whereas water flowing at 1kg/s enters at 35 ^{0}C. Using the NTU method, calculate the water and gas outlet temperatures. 8 M

8. a) Explain how good emitters can be treated as good absorbers. 3 M

b) State and explain Lambert's Cosine Law. 3 M

c) A small area A_1 is located on the axis of a parallel plane circular disc A_2. The disc makes an angle of 2^0 with the area A_1 as vertex height of the cone thus formed being h. Find F_{12}. 8 M