

Code: 9A03505

R09

III B. Tech I Semester (R09) Supplementary Examinations, May 2012

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours

Max Marks: 70

Answer any FIVE questions
All questions carry equal marks

- 1 (a) Define heat flux and thermal diffusivity and explain its importance in conduction mode of heat transfer.
(b) A plane wall 80 mm thick ($K=0.15$ W/mK) is insulated on one side while the other is exposed to environment at 90°C . If the convective heat transfer coefficient between the wall and the environment is 560 W/m² K, determine the temperature at the surface of the wall will be subjected.
- 2 Determine the rate of heat flow through a spherical boiler wall which is 2 m in diameter and 2 m thick steel ($k = 58$ W/m K). The outside surface of boiler wall is covered with asbestos ($k = 0.116$ W/m K) 5 mm thick. The temperature of outer surface and that of fluid inside are 50°C and 300°C respectively. Take inner film resistance as 0.0023 K/W.
- 3 (a) Sheets of brass and steel, each of thickness 1 cm, are placed in contact. The outer surface of brass is kept at 100°C and the outer surface of steel is kept at 0°C . What is the temperature of the common interface? The thermal conductivities of brass and steel are in the ratio of 2:1.
(b) How long will it take to form a thickness of 4cm of ice on the surface of a lake when the air temperature is -6°C ? K of ice = 1.675 W/m K and its density = 920 kg/m³. Take the latent heat of fusion of ice as 335 kJ/kg.
- 4 Starting with the two dimensional Navier Stokes equation, listing all assumptions, and performing an order of magnitude analysis, show that for flow over a flat plate, the pressure is a function of x alone. (Please proceed systematically for full credit. Brute force application of known result will yield zero credit).
- 5 (a) Estimate the heat transfer from a 40 W incandescent bulb at 127°C to 27°C quiescent air. Approximate the bulb as a 50 mm diameter sphere. What percentage of the power is lost by free convection?
(b) What is the boundary layer thickness? What do you mean by laminar and turbulent boundary layers? What is laminar sub layer?
- 6 (a) Explain the flow regimes in two phase flow through a tube. What is the difference between slug flow regime and annular flow regime?
(b) Saturated steam at atmospheric pressure condenses on a horizontal copper tube of 25 mm inner diameter and 29 mm outer diameter through which water flows at the rate of 30 kg/min entering at 32°C and leave at 72°C . Calculate: (a) the condensing heat transfer coefficient, (b) the inside heat transfer coefficient and (c) the length of the tube.
- 7 (a) Define heat exchanger effectiveness and explain its significance.
(b) In a counter flow double pipe heat exchanger water is heated from 40°C to 80°C with oil entering at 105°C and leaving at 70°C . Taking the overall heat transfer coefficient as 300 W/m²k and the water flow rate as 0.1 Kg/s. Calculate the heat exchanger area .
- 8 Explain the following laws relevant to radiation heat transfer:
(i) Kirchhoff's law. (ii) Wien's displacement law. (iii) Planck's law. (iv) Lambert Law.
