Code: 9A03505

R9

B.Tech III Year I Semester (R09) Supplementary Examinations, May 2013

HEAT TRANSFER

(Mechanical Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Distinguish between conduction, convection and radiation modes of heat transfer.

(b) A solar pane, 1 m × 1.25 m receives solar radiation 1500 W, Calculate surface temperature of the pane if the ambient temperature is 25^0C and the convective heat transfer coefficient of the air film over the surface of pane is 12.5 W/m^2.K.

2 (a) Define thermally conductivity and how it can be measured. What is the difference between thermal conductivity and thermal conductance?

(b) A 0.8 m high and 1.5 m wide double pane window consists of two 4 mm thick layers of glass (78 W/m.K) separated by a 10 mm wide stagnant air space (0.026 W/mK). Determine the rate of heat transfer through this window and the temperature of the inner surface, when the room is maintained at 20^0C. Take the convection heat transfer coefficients on the side and the outside surfaces of the window as 10 and 40 W/m^2 K respectively.

3 (a) What is lumped mass model? Derive the equation for the temperature of a lumped body for the specified transient condition.

(b) A thick bronze plate (α = 0.86 x 10^{-5} m^2/s and K = 26 W/m.K) is initially at a uniform temperature of 250^0C. Suddenly the surface is exposed to a coolant at 25^0C. Assuming h = 150 W/m^2.K, determine the temperature at 5 cm from the surface after 10 min of exposure.

4 (a) Using dimensional analysis, obtain the general form of equation for natural convection heat transfer.

(b) A rectangular plate is 120 cm long in the direction of flow and 200 cm wide. The plate is maintained at 80^0C when placed in nitrogen that has a velocity of 2.5 m/s and a temperature of 0^0C. Determine: (i) the average friction coefficient, (ii) the viscous drag exerted on the plate, (iii) the average heat transfer coefficient and (iv) the total heat transfer rate from the plate.

5 (a) What is Reynold's analogy? Describe the relation between fluid friction and heat transfer.

(b) Water at 60^0C enters a tube of 2.54 cm diameter at a mean velocity of 2 cm/s. Calculate the exit water temperature if the tube is 3.0 m long and wall temperature is constant at 80^0C.

6 (a) Draw the boiling curve for the water and explain the salient features.

(b) Saturated steam, at 120^0C condenses on a 2 cm OD vertical tube which is 20 cm long. The tube wall is maintained at a temperature of 119^0C. Calculate the average heat transfer coefficient and the thickness of the condensate film at the base of the tube. Assume Nusselt solution is valid.

7 In an industry, 0.6 kg/sec of oil, (Cp = 2.5 kJ/kg K) is to be cooled in a counter flow heat exchanger from 110^0C to 35^0C by the use of water entering at 20^0C. The overall heat transfer coefficient is expected to be 1500 W/m^2K. Presume that the exit temperature of water is not to exceed 80^0C. Using NTU method, calculate:
(i) Water flow rate. (ii) Surface area required. (iii) Effectiveness of exchanger.

8 (a) Define view factor and discuss its importance.

(b) If the intensity of radiation emitted by a surface covered with lamp back (α = 0.96) in the normal direction is 1.85 × 10^3 W/m^2. Sr. Calculate the temperature of the surface if it follows Lambert's cosine Law.

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