5 Attempt any **TWO** parts : **10x2=20**

a) A long cylindrical heater 25 mm in diameter is maintained at 660 °C and has surface resistivity of 0.8. The heater is located in a large room whose walls are at 27 °C. How much will the radiant transfer from the heater be reduced if it is surrounded by a 300 mm diameter radiation shield of aluminum having an emissivity of 0.2? What is the temperature of the shield?

b) Define the properties :
I. emissivity
II. absorptivity
III. reflectivity
IV. transmissivity

c) Consider two concentric cylinders having diameters 10 cm and 20 cm and a length of 20 cm. Designating the open ends of the cylinders as surfaces 3 and 4, estimate the shape factor, F_{3-4}.

Printed Pages : 4

EME 504

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 140504

Roll No.

B. Tech.

(SEM. V) (ODD SEM.) THEORY EXAMINATION, 2014-15

HEAT & MASS TRANSFER

Time : **3** Hours] [Total Marks : **100**

1 Attempt any **FOUR** parts : **5x4=20**

a) Under what conditions is the effectiveness – NTU method definitely preferred over the LMTD method in heat exchanger analysis?

b) Discuss briefly the Fick's law of diffusion

c) Draw the boiling curve and identify the different boiling regimes. Also, explain the characteristics of each regime.

d) Dry saturated steam at a pressure of 2.45 bar condenses on the surface of a vertical tube of height 1 m. The tube surface temperature is kept at 117 °C. Estimate the thickness of the condensate film

e) A wire of 1.2 mm diameter and 200 mm length is submerged horizontally in water at 7 bar. The wire carries a current of 135 A with an applied voltage of 2.18 V. If the surface of the wire is maintained at 200°C, calculate the heat flux.

f) Discuss the general arrangement of parallel flow, counter flow and cross flow heat exchangers.

2 Attempt any **TWO** parts : **10x2=20**

a) What are the mechanisms of heat transfer? How are they distinguished from each other?

b) Starting with an energy balance on a spherical shell volume element, derive the one-dimensional transient heat conduction equation for a sphere with constant thermal conductivity and no heat generation. (FIG 1)

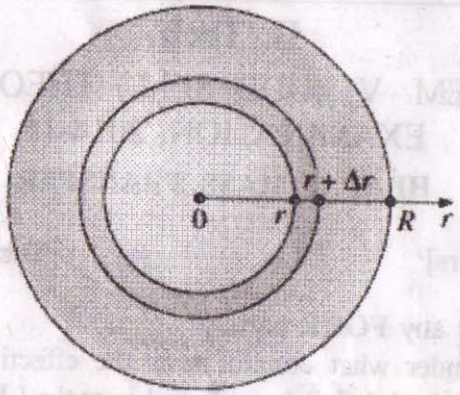

FIG 1

c) Consider a 0.8 m high and 1.5 m wide double pane window consisting of two 4 mm thick layers of glass (k = 0.78 W/m°C) separated by a 10 mm wide stagnant air space (k = 0.026 W/m°C). Determine the steady rate of heat transfer through this double pane window and the temperature of its inner surface for a day during which the room is maintained at 20°C while the temperature of the outdoors is -10°C. Take the convection heat transfer coefficients on the inner and outer surfaces of the window to be h_1 = 10 W/m^2 °C and h_2 = 40 W/m^2 °C, which includes the effects of radiation.

3 Attempt any **TWO** parts : **10x2=20**

a) Aluminum fins 1.5 cm wide and 1.0 mm thick are placed on a 2.5 cm diameter tube to dissipate the heat. The tube surface temperature is 170°C, and the ambient fluid temperature is 25°C. Calculate the heat loss per fin for h = 130 W/m^2°C for aluminum.

b) Consider heat transfer between two identical hot solid bodies and the air surrounding them. The first solid is being cooled by a fan while the second one is allowed to cool naturally. For which solid is the lumped system analysis more likely to be applicable? Why?

c) I. What is the reason for the widespread use of fins on surfaces?

II. Two pin fins are identical, except that the diameter of one of them is twice the diameter of the other. For which fin will the (a) fin effectiveness and (b) fin efficiency be higher? Explain.

4 Attempt any **TWO** parts : **10x2=20**

a) Air is flowing over a flat plate 5 m long and 2.5 m wide with a velocity of 4 m/s at 15°C. If ρ =1.208 kg/m^3 and ν = 1.47 x 10^{-5} m^2/s, calculate the length of plate over which the boundary layer is laminar and thickness of the boundary layer (laminar), shear stress at the location where boundary layer ceases to be laminar and the total drag force on the both sides on that portion of the plate where boundary layer is laminar.

b) A horizontal pipe 1 ft (0.3048 m) in diameter is maintained at a temperature of 250°C in a room where the ambient air is at 15°C. Calculate the free convection heat loss per meter of length.

c) Describe the relation between fluid friction and heat transfer? How is the average friction and heat transfer coefficients determined in flow over a flat plate?