physical properties of sphere material are $\delta = 400$ kg/m^3, C_p = 1600 J/kg-K, k = 17 W/m-K. Calculate :

(a) The time required for the sphere to reach 415 K

(b) Time constant

(c) Insten taneous heat flux at outer surface of the sphere at the end of cooling

(d) The energy lost by sphere during the whole process of cooling. **20**

5. Air at 27ºC and at atmospheric pressure flows over a flat plate at a speed of 2 m/s. If the plate is maintained at 93ºC, the length of the plate is 2 m and width 1m. Calculate :

(a) The thickness of hydrodynamic and thermal boundary layer at a distance of 1 m from the leading edge.

(b) Average skin friction coefficient

(c) Heat transfer from the plate. **20**

No. of Printed Pages : 06 **Roll No. .....**

633

B. Tech. EXAMINATION, May 2017

(Sixth Semester)

(Old Scheme) (Re-appear Only)

(ME)

ME-306

HEAT TRANSFER

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

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt any *Five* questions. All questions carry equal marks. The use of properties tables, charts and graphical plot related to this course is permitted.

1. (a) What is the difference between thermodynamics and heat transfer ?

(b) Discuss the mechanism of thermal conduction in gases and solids.

(c) Two infinite black plates at 800ºC and 300ºC exchange heat by radiation. Calculate the heat transfer per unit area.

(d) Air at 20ºC blows over a hot plate (50 cm × 75 cm) maintained at 250ºC. The convective heat transfer coefficient is 25 w/m^2-K. Calculate the heat transfer.

(e) What is the physical significance of thermal diffusivity ? **5×4=20**

2. (a) Derive general three-dimensional heat conduction equation in Cartesian coordinates.

(b) Derive expression for temperature distribution under one-dimensional steady state heat conduction for the composite wall. **12,8**

3. (a) A long hollow cylinder has inner and outer radii as 5 cm and 15 cm, respectively. It generates heat at the rate of 1 kW/m^3. If the maximum temperature occurs at radius 10 cm and the temperature of the outer surface is 50ºC, find :

(i) Temperature at the inner surface

(ii) Maximum temperature in the cylinder.

Take k = 50 W/mk. **12**

(b) A longitudinal copper fin (k = 380 W/m-K) 6 cm long and 5 mm diameter is exposed to air stream at 20ºC. Take h = 20 M/m^2-K, base temperature of the fin = 150ºC. Calculate the heat transferred and fin efficiency. **8**

4. A sphere 30 mm in diameter initially at 800 K is quenched in a large bath having a constant temperature of 320 K with a heat transfer coefficient of 75 W/m^2-K. The thermo-

6. (a) Two large parallel planes with emissivities 0.4(T = 500 K) and 0.8 (T = 700 K) exchange heat. Find the net heat radiated by them and percentage reduction in heat transfer when polished aluminium radiation shield (ε = 0.4) is placed between them. **12**

(b) A disc of 10 cm diameter at 700 K is situated 2 m below the centre of the another disc of 2 m in diameter which is maintained at 500 K. Find the heat lost by the smaller disc and given to bigger disc. ε_1 (for smaller disc) = 0.8, ε_2 (for bigger disc) = 0.6. **8**

7. (a) Derive expression of effectiveness by NTU method for the parallel flow heat exchanger. **10**

(b) The flow rates of hot and cold water streams running through a parallel flow heat exchanger are 0.2 kg/s and 0.5 kg/s, respectively. The inlet temperatures of hot

and cold sides are 75ºC and 20ºC, respectively. The exit temperature of hot water is 45ºC. Take heat transfer coefficient on both sides = 650 W/m^2 K. Calculate the area of heat exchanger. **10**

8. (a) Explain the film boiling. Why is it avoided in practice ? What is boiling crises ? **5**

(b) Using Nusselt's theory of laminar film condensation show that $\delta\alpha\ x^{1/4}$ for a flat vertical surface. Where x is the distance from the leading edge of the film and δ is the film thickness. **15**