Register Number

SATHYABAMA UNIVERSITY

(Established under section 3 of UGC Act,1956)

Course & Branch :B.E - AERO
Title of the Paper :Heat Transfer — Max. Marks :80
Sub. Code :526603-26603 — Time : 3 Hours
Date :09/11/2009 — Session :AN

PART - A (10 x 2 = 20)

Answer ALL the Questions

1. State the Fourier's law of heat conduction.

2. What are extended surfaces?

3. Explain the concept of free convection heat transfer mechanism.

4. Define Prandtl and Stanton numbers and give their importance in convection heat transfer.

5. Distinguish between black body and gray body.

6. What are radiation shields?

7. Give the classification of heat exchanger.

8. Define NTU in heat exchanger.

9. What is ablative heat transfer?

10. Define the thermal efficiency of a gas turbine.

PART – B (5 x 12 = 60)

Answer All the Questions

11. (a) Derive an expression for one dimensional Radial heat conduction through hollow cylindrical system.

(b) A plane wall 10cm think generates heat at the rate of 4 x $10^4 W/m^3$ when an electric current is passed through it. The convective heat transfer co-efficient between each face of the wall and the ambient air is $50Wm^2K$. Determine.

(i) The surface temperature.

(ii) The maximum temperature in the wall.

Assume the ambient air temperature to be 20°C and the thermal conductivity of the wall material to be 15W/mK.

(or)

12. (a) Discuss heat transfer using lumped parameter analysis.

(b) A stainless ball diameter $2cm(d_o)(\rho = 7865 kg/m^3, Cp = 0.46 KJ/kg°C \, and \, K = 61 W/m°C)$ is uniformly heated to a temperature $T_i = 800°C$. It is to be hardened by suddenly dropping it onto an oil bath at $T_a = 50°C$. If the quenching occurs when the ball reaches 100°C(T) and the heat transfer co-efficient (h) for the oil and sphere is $300w/m^2°C$ (T) and the heat transfer co-efficient (h) for the oil and sphere is $300W/m^2$ °C, how long should the ball be kept in the oil bath?

13. (a) Sketch temperature and velocity profiles in free convection on a vertical wall.

(b) Air at atmospheric pressure is contained between two horizontal panels separated by a distance of 25.4mm. The temperature of the lower panel is 60°C and the upper panel is at 15.6°c. Calculate the free convection heat transfer per m^2 of the panel surface. At 37.8°C air will have f =

$1.121 kg/m^3$, $K = 29.2 \times 10^{-2} W/mK$, $Pr = 0.7$, $\gamma = 0.171 \times 10^{-4} m^2/s$, $\beta = 3.22 \times 10^{-3} K^{-1}$.

(or)

14. (a) In a long annulus (3.125 cm ID and 5cm O.D), the air is heated by maintaining the temperature of the outer surface of inner tube at 50°C. The air enters at 16°C and leaves at 32°C and its flow rate is 30m/s. Estimate the heat transfer co-efficient between the air and the inner tube. Air properties 24°C. (8)

$$\rho = 1.614 kg/m^3, \gamma = 15.9 X 10^{-6} m^2/s, C_p = 1.007 kJ/kg\,K, \mathrm{Pr} = 0.707, K = 0.023 W/mK.$$

(a) Describe the relation between fluid friction and heat transfer. (4)

15. (a) Describe the radiation heat exchange between two large parallel gray planes.

(b) Emissiveties of two large parallel plates maintained at 800°C and 300°C are 0.3 and 0.5 respectively. Find the net radiant heat exchange per m^2 for these plates.

(or)

16. (a) State Stefan-Boltzmann law. (2)

(b) Explain Radiation shape factor. (4)

(c) Two circular discs of diameter 20cm each are placed 2m apart. Calculate the radiant heat exchange for these plates if these plates are maintained at 800°C and 300°C respectively and their corresponding emissivities are 0.3 and 0.5. (6)

17. (a) Explain the concept of mean temperature difference.

(b) In a double pipe counter flow heat exchanger, 10,000kg/hr of an oil having a specific heat of 2095 J/kg°C is cooled from 80°C to 50°C by 8000kg/hr of water entering at 25°C. Determine the heat exchange area for an overall heat transfer co-efficient of $300 W/m^2K$. Take C_p for water as 4180 J/kg K.

(or)

18. (a) Define the effectiveness of a heat exchanger. (4)

    (b) Explain the stepwise procedure to determine the area required for a heat exchanger by NTU method. (8)

19. Explain the heat transfer problems in gas turbine combustion chamber.

(or)

20. Explain the aerodynamic heating.