B.TECH.DEGREE EXAMINATION

Sixth Semester

Branch: Aeronautical Engineering

Heat Transfer (AN 010 604)

Time: 3 hours   Maximum: 100 marks

Part A

Answer all questions

Each question carries three marks

1. Write a short note on conductive heat transfer.
2. A hot plate 1mx1.5m is maintained at 300^0c.Air at 20^0c blows over the plate. If the convective heat transfer coefficient is $20 w/m^{2\circ}C$. Calculate the rate of heat transfer.
3. Write a short note on solar radiation.
4. Briefly explain heat exchangers and their classification.
5. Explain aerodynamic heating.

(3x5 = 15 Marks)

Part B

Answer all questions

Each question carries five marks

6. Using lumped system analysis, determine the time required for a solid steel ball of radius R=2.5cm, k=54 $w/m^{2\circ}C$, ρ=7833Kg/m^3 and c = 0.465 kJ/Kg˚C to cool from 850˚C to 250˚C if it is exposed to an air stream at 50˚C having a heat transfer coefficient h=100 $w/m^{2\circ}C$.
7. Write a short note on convective heat transfer. What are the different types of it?
8. Briefly explain about radiation shields.
9. Engine oil at a mean temperature Ti=100˚C flow inside a D=3cm ID, thin walled copper tube with a heat transfer coefficient hi=20 $w/m^{2\circ}C$. The outer surface of the tube dissipates heat by free convection into atmospheric air at temperature T_∞=20˚C with a heat transfer coefficient h_0=8 $w/m^{2\circ}C$. Calculate the overall heat transfer coefficient and heat loss per meter length of the tube.
10. Briefly explain the heat transfer problems in aerospace engineering.

(5x5= 25 Marks)

Part C

Answer all questions

Each question carries 12 marks

11. (i) Define critical thickness. Derive an equation for critical thickness of insulation for cylinders.

    (ii) Calculate the critical radius of asbestos [k=0.172 w/mK] surrounding a pipe and exposed to room air at 300K with h=2.8 Wm/K. Calculate the heat loss from a 475K, 60mm diameter pip

    When covered with the critical radius of insulation and without insulation.

OR

12. (i) Derive an equation for heat flow through a "rectangular fin"

    (ii) Find out the amount of heat transferred through an iron fin of length 50mm, width 100mm and thickness 5mm. Assume k=210 kJ/mh˚C and h=42 kJ/m^2h˚C for the material of the fin and the temperature at the base of the fin as 80˚C. Also determine the temperature at tip of the fin, is the atmospheric temperature is 20˚C.

13. Derive momentum and energy equations for laminar free convection heat transfer on a Vertical flat plate.

OR

14. 0.05kg/s of hot air flows through an insulated sheet metal duct of 150mm diameter. The air enters the duct at a temperature of 150˚C and after a distance of 5m gets cooled to a temperature of 80˚C. If the heat transfer coefficient between the outer surface of the duct and cold ambient air at 5˚C is 6 W/ m^2˚C, calculate a) the heat loss from the duct over its 5m length b) the heat flux and the duct surface temperature at a length of 5m.
15. Explain radiation properties of surfaces.

OR

16. Discuss the exchange of heat between non black bodies in the following two cases
    (i) Infinite parallel planes
    (ii) Infinite long concentric cylinders.
17. Derive an expression for logarithmic mean temperature difference for counter-flow heat exchanger.

OR

18. 16.5 kg/s of the product at 650 ˚C (Cp=3.55 kJ/Kg˚C), chemical plant are to be used to heat 20.5 kg/s of the incoming fluid from 100˚C (Cp=4.2 KJ/Kg˚C). If the overall heat transfer coefficient is 0.95kw/m^2 ˚C and the installed heat transfer surface is 44m^2, calculate the fluid outlet temperature of the counter-flow and parallel flow arrangements.
19. Discuss the problems and remedies associated with heat transfer in gas turbine combustion chambers and rocket thrust chambers.

OR

20. Describe the theory of ablative cooling process.

(12x5 = 60 marks)