UNIT 2

PART A

1. What is Convective heat transfer?
2. Sketch formation of boundary layer and show laminar, transition & turbulent flow.
3. Write down differential equation for Continuity of fluid flow.
4. State Newton\'s law of cooling.
5. Differentiate between Natural & Forced convection.
6. State Buckingham\'s π theorem.
7. What is meant by Dimensional analysis?
8. Sketch boundary layer development in a circular pipe.
9. What is Reynolds analogy?
10. Define the Bulk temperature.
11. Define velocity boundary layer thickness.
12. Define thermal boundary layer thickness.
13. Distinguish between laminar and turbulent flow.
14. What is meant by critical Reynolds number?
15. Define skin friction coefficient.
16. Give examples for free convection.
17. Define Grashoff number.
18. Define momentum thickness
19. Define Displacement thickness.
20. List the dimensionless numbers.
21. What are the uses of dimensional analysis?

PART - B

22. Air at 200 kPa and 200°C is heated as it flows through a tube with a diameter of 25 mm at a velocity of 10 m./sec. The wall temperature is maintained constant and is 20°C above the air temperature all along the length of tube. Calculate:

(i) The rate of heat transfer per unit length of the tube.

(ii) increase in the bulk temperature of air over a 3 m length of the tube. (16)

23. (i) Write down the momentum equation for a steady, two dimensional flow of an incompressible, constant property Newtonian fluid in the rectangular coordinate system and mention the physical significance of each term. (6)

(ii) A large vertical plate 5 m high is maintained at 100°C and exposed to air at 30°C Calculate the convection heat transfer coefficient. (10)

24. (i) Sketch the boundary layer development of a flow over a flat plate and explain the significance of the boundary layer. (6)

(ii) Atmospheric air at 275 K and a free stream velocity of 20 m/s flows over a flat plate 1.5 m long that is maintained at a uniform temperature of 325 K. Calculate the average heat transfer coefficient over the region where the boundary layer is laminar, the average he at transfer coefficient over the entire length of the plate and the total heat transfer rate from the plate to the air over the length 1.5 m and width 1 m. Assume transition occurs at Recr=2xl05 (10)

25. (i) What is Reynold\'s analogy? Describe the relation between fluid friction and heat transfer?

(4)

(ii) Air at 25°C flows over 1 m x 3 m (3 m long) horizontal plate maintained at 200°C at 10 m/s. Calculate the average heat transfer coefficients for both laminar and turbulent regions. Take Re (critical) = 3.5 x 105 (12)

26. (i) Define Reynold’s, Nusselt and Prandtl numbers. (6)

(ii) A steam pipe 10 cm outside diameter runs horizontally in a room at 23°C. Take the outside surface temperature of pipe as 165°C. Determine the heat loss per unit length of the pipe.

(10)

27. (i) Explain for fluid flow along a flat plate:

(a) Velocity distribution in hydrodynamic boundary layer

(b) Temperature distribution in thermal boundary layer

(c) Variation of local heat transfer co-efficient along the flow. (8)

(ii) The water is heated in a tank by dipping a plate of 20 cm X 40 cm in size. The temperature of the plate surface is maintained at 100°C. Assuming the temperature of the surrounding water is at 30° C, Find the heat loss from the plate 20 cm side is in vertical plane. (8)

28 Air at 400 K and 1 atm pressure flows at a speed of 1.5 m/s over a flat plate of 2 m long. The plate is maintained at a uniform temperature of 300 K. If the plate has a width of 0.5 m, estimate the heat transfer coefficient and the rate of heat transfer from the air stream to the plate. Also estimate the drag force acting on the plate. (16)

29 Cylindrical cans of 150 mm length and 65 mm diameter are to be cooled from an initial temperature of 20°C by placing them in a cooler containing air at a temperature of 1°C and a pressure of 1 bar. Determine the cooling rates when the cans are kept in horizontal and vertical positions. (16)

30 A circular disc heater 0.2m in diameter is exposed to ambient air at 25°C. One surface of the disc is insulated at 130°C. Calculate the amount of heat transferred from the disc when it is.

(i) Horizontal with hot surface facing up. (5)

(ii) Horizontal with hot surface facing down. (5)

(iii) Vertical (6)

31 (i) Distinguish between free and forced convection giving examples. (4)

(ii) A steam pipe 10 cm OD runs horizontally in a room at 23° C. Take outside temperature of pipe as 165 ° C. Determine the heat loss per unit length of the pipe. Pipe surface temperature reduces to 80° C with 1.5 cm insulation. What is the reduction in heat loss? (12)