1. State Fourier's 'ıw of conduction.

2. Define Coefficient of Thermal conductivity.

3. What is the ratio of the hydrodynamic boundary layer to thermal boundary layer in the case of laminar flow over a plate?

4. Explain why the temperature boundary layer grows much more rapidly than the velocity boundary in liquid metals.

5. Define log-mean temperature difference.

6. What are the parameters affecting the fouling?

7. What is a radiation shield?
8. Define emissivity.

9. State Fick's law of diffusion.

10. Give examples of mass transfer.

PART B - (5 x 16 = 80 marks)

11. (a) A hollow cylinder of 5cm ID and 10 cm OD, has an inner surface temperature of 200°C and an outer surface temperature of 100°C. If the thermal conductivity of the cylinder material is 70 W/mK. Determine the heat flow through the cylinder per unit length.

O
r

(b) The wall of an oven consists of 3 layers of brick. Inside one is built of 20 cm of fire bricks surrounded by 10 cm of insulating brick and outside layer is binding bricks of 12 cm thick. The oven operates at 900°C, such that the outside surface of the oven is maintained at 60°C. Calculate

(i) The heat loss per m^2 in surface.

(ii) The interfacial temperature.

Given the thermal conductivity of fire brick, insulting brick and binding are 1.2, 0.26 and 0.68 respectively in W/moC

12 (a) A steam pipe 20 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 meter length of the pipe.

O
r

(b) A sphere of diameter 25 mm at 200°C IS immersed III aIr at 40°C. CalcuJ'-tv the c.onvective heat loss.

13. (a) 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. Find the thickness of the condensate film and the local heat transfer coefficient at a distance of 0.2 m from the upper end of the tube.

Or

(b) It is desired to use a shell and tube heat exchanger to heat 68 kg/min of water from 35°C to 75°C by using oil having a specific heat of 1.9 kJ/ kgK.The oil enters at a temperature of 110°C and flows at the rate of 170 kg/min. The water makes shell pass and the oil makes two tube passes. Calculate the area required for the heat exchangers assuming the overall heat transfer coefficient to be 300 W/m^2K and specific heat of water to be 4.18 kJ/kgK. .

14. (a) A 40 mm diameter spherical container used for storing liquid nitrogen under atmospheric conditions(boiling point = 90 K) is insulated by enclosing it concentrically within another sphere of O. 75m diameter. The intervening annular space between the spheres is completely evacuated and the material for both spheres has surface emissivity of 0.4. Make calculation for the radiant heat flow of the temperature if the outer container is 400 K.

Or

(b) What will be the reduction in heat loss if a steel screen having an emissivity value of **0.6** on both sides is placed between the brick and steel setting? Also calculate the desired emissivity of the screen if radiation heat loss is 200 W/m^2.

15.(a) Determine the diffusion co-efficient of carbon tetrachloride into air if it evaporates at a rate of 0.012 gm/hr from a tube of 2 cm diameter and length 45 cm. It evaporates at a temperature of O°C into dry air at a pressure of 760 mm of Hg. The vapour pressure of carbon tetrachloride at O°C is 33 mm of Hg.

Or

(b) In a gas mixture consisting ofH2 and 02, H2 moves with velocity of 1 m/s and its mole fraction is 0.2. Calculate

(i) The mass and molar average velocities.

(ii) The mass and molar fluxes across a plane which is

(1) Stationary

(2) Moving with mass-; verage velocity

(3) Moving with molar average velocity.