1. What are the two m ecu i.i ms o~ heat conduction in solids?
2. Wh at is t hi p urpose of attaching fins to a surface? What are the different typ ı s of fin profiles?
3. In what medium is the lumped system analysis is more likely to be applicable? An aluminum or wood? Why?
4. List the parameters that influence the heat transfer coefficient.
5. Physically, what does the Grashof number represent and how does it differ from Reynolds number?
6. How does boiling differ from evaporation?
7. What are the different types of fouling in heat exchangers?
8. What is total hemispherical emissivity?
9. What are radiation shields?
10. What is the physical meaning of Lewis number?

11. (a) (i) Explain Newton's law of cooling and Stefan-Boltzmann's law of thermal radiation. (4)

(ii) A composite wall consists of 2.5 cm thick Copper plate, a 3.2 cm layer of asbestos insulation and a 5 cm layer fibre plate. Thermal conductivities of the materials are respectively 355, 0.110 and 0.0489 W/m.K. The temperature difference across the composite wall is 560°C (560°C on one side and 0°C on the other side. Find the heat flow through the wall per unit area and the interface temperature between asbestos and fibre plate.

Or

(b) The cylinder of a 2-stroke SI engine is constructed of alumin im alloy (k = 186 W/m.K). The height and outside diameter of he cylnaer are respectively 15 cm and 5 cm. Under steady op 'rating . onditions, the outer surface of the cylinder is at 500 K and is exposed to the ambient air at 300 K, with a convection heat transfer coefficient of 50 $W/m^2.K$ Equally spaced annular fins are attached with the cylinder to increase the heat transfer. There are five such fins with uniform thickness, t = 6 nm a.d length, L = 20 mm. Calculate the increase in heat transfer due to the addition of fins.

12. (a) (i) Explain the development of velocity boundary layer for flow over a flat plate. (4)

Engine oil at 60°C flows with a velocity of 2 m/s over a 5 m long flat plate whose temperature is 20°C. Determine the drag force exerted by oil on the plate and the rate of heat transfer for aplate width of 1 m.
(12)

Or

(b) (i) Define bulk temperature and thermal entry length for tube flows. (4)

(ii) A metallic cylinder of 12.7 mm diameter and 94 mm length is heated internally by an electric heater and its surface is cooled by air. The free stream air velocity and temperatures are respectively 10 m/s and 26.2°C. Under steady operating conditions, heat dissipated by the cylinder is 39.1 W and its avenge surface temperature is 128.4°C. Determine the

convection heat transfer coefficient from the above experiment. Also find the convection heat transfer coefficient from an appropriate correlation and compare both.

13. (a) (i) Discuss critical heat flux and Leidenfrost point. (4)

(ii) A 10 by 10 array of horizontal tubes of 1.27 cm diameter is exposed to pure steam at atmospheric pressure. If the tube wall temperature is 98°C, estimate the mass of steam condensed assuming a tube length of 1.5 m. (12)

Or

(b) (i) List the assumptions made in the analysis of heat exchangers. (4)

(ii) In a cross flow heat exchanger, air is heated by water. Air enters the exchanger at 15°C and a mass flow rate of 2 kg/s while water enters at 90°C and a mass flow rate of 0.25 kg/s. The overall heat transfer coefficient is 250 $W/m^2.K$. If the changer has a heat transfer area of 8.4 m^2, find the exit temp -r utes of both the fluids and the total heat transfer rate. (12)

14. (a) (i) What is a black body? Find the, , - e g * emitted by a black body at 700°C. (4)

(ii) A furnace is approximated as an equilateral triangular duct of sufficient length so that end effects can be neglected. The hot wall of the furnace is maintained at 900 K and has an emissivity of 0.8. The cold wall is at 400 K and has the same emissivity. Find the net radiation heat flux leaving the wall. Third wall of the furnace may be assumed as a reradiating surface. (12)

Or

(b) (i) Considering radiation in gases, obtain the exponential-decay formula. (6)

(ii) Consider two concentric cylinders having diameters 10 cm and 20 cm and a length of 20 cm. Designating the open ends of the cylinders as surfaces 3 and 4, estimate the shape factor, F_{3-4}. (10)

15. (a) (i) How does mass transfer differ from bulk fluid motion? State Fick's law of diffusion. (4)

(ii) An open pan of 20 cm diameter and 8 cm depth contains water at 25°C and is exposed to dry atmospheric air. Assuming the rate of diffusion of water as 8.54 x $l0^{-4}$ kg/h, find the diffusion coefficient. (12)

Or

Discuss briefly the following :

(i) Analogy between heat and mass transfer

(ii) Mass convection.