Q1. The wall in a furnace consists of 125mm thick refractory bricks and 125mm thick insulating firebricks separated by an air gap. A 12mm thick plaster covers the outer wall. The inner surface of the wall is at 1100^0C and the ambient temperature is 25^0C. The heat transfer coefficient on the outside wall to the air is 17 W/m^{2}K, and the resistance to heat flow of the air gap is 0.16 K/W. The thermal conductivities of refractory brick, insulating firebrick and plaster are 1.6, 0.3 and 0.14 W/mK, respectively. Find out, (a) the rate of heat loss per unit area of the wall surface, (b) the interface temperatures throughout the wall, and (c) the temperature at the outside surface of the wall.

Q2. A plastic pipe (k = 0.5 W/mK) carries a fluid such that the convective heat transfer coefficient is 300 W/m^{2}K. The average fluid temperature is 100^0C. The pipe has an inner diameter of 3 cm and an outer diameter of 4 cm. If the heat transfer rate through the pipe per unit length is 500 W/m, calculate the outside surface temperature of the pipe and the overall heat transfer coefficient based on the outside area.

Q3. A brick (k = 1.2 W/mK) wall 0.15 m thick separates hot combustion gases of a furnace from the outside ambient air which is at 25^0C. The outer surface temperature of the brick wall is found to be 100^0C. if the natural convection heat transfer coefficient on the outside surface of the brick wall is 20 W/m^{2}K and its emissivity is 0.8, calculate the inner surface temperature of the brick wall.

Q4. A refrigerated container in the form of a cube with 2 m sides and 5 mm thick aluminium walls is insulated with a 10 cm layer of cork (k = 0.043 W/mK). During the steady state operation, the temperatures on the inner and the outer surfaces of the container are measured to -5^0C and 20^0C respectively. Determine the cooling load on the refrigerator. Give k for aluminium = 204 W/mK.

Q5. The walls of a sparsely furnished single-room cabin consist of two layers of pine-wood (k = 0.10 W/mK), each 2 cm thick, sandwiching 5 cm fibreglass (k = 0.038 W/mK) insulation. The cabin interior is maintained at 20^0C when the ambient air temperature is 2^0C. if the interior and exterior convective heat transfer coefficients are 3 and 6 W/m^{2}K respectively, and the exterior surface is coated with a white acrylic paint (ε = 0.9), estimate the heat flux through the wall.