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قسم :الهندسة الكهربائية

Tutorial 01

Exercise 1:

One side of a 3 cm thick copper plate is maintained at 400°C and the other side at 100°C.

1. How much heat is transferred per unit area through the plate?

Data : copper thermal conductivity is 370 W/m^2°C.

Exercise 2:

Air at 20°C blows on a 50 x 75 cm hot plate maintained at 250°C. The heat transfer coefficient by convection is 25 W/m^2 °C.

1. Calculate the heat transfer transmitted by convection.

Exercise 3:

Two infinite black plates at 800°C and 300°C exchange heat by radiation.

1. Calculate the heat transfer per unit area.

Exercise 4:

An electrical resistor is connected to a battery, as shown in the diagram. After a brief transient fluctuation, the resistance takes an almost uniform equilibrium temperature of 95°C, while the battery and connection cables remain at an ambient temperature of 25°C. The thermal and electrical resistance of the connection cables is negligible. If the electrical energy dissipates uniformly in the cylindrical resistance of diameter D = 60 mm and length Lr = 25 mm.

1) What is the heat flux generated per unit of volume g_{vol} in W/m^3
2) What is the coefficient of convection that it should have to evacuate all the heat if the radiation resistance is neglected?

Data: $V_1 = 24V$, $I = 6A$, $Lr = 25mm$, $Dr = 60mm$, $Tw = 95\ °C$, $T\infty = 95\ °C$

Exercise 5:

It is necessary to calculate the heat flux lost by a man in an environment where the temperature of the walls is $T_p = 27^oC$ and the environment is $T_\infty = 20^oC$ if the human being has a surface temperature of $T_h = 32^oC$ and a coefficient of heat transfer by convection between man and the environment and the emissivity of $h_h = 3W/m^2\ ^oC$, $\varepsilon = 0,9$ respectively, it is known that a normal human being has a body surface area of $S_h = 1,5\ m^2$ neglecting the thermal resistance of clothing. Also calculate the energy lost in t= 24 hours.

Exercise 6:

A plate of 0.3 m in length, 0.1 m in width and 12 mm in thickness is made of stainless steel (λ =16 W/m.K), the upper surface is exposed to a flow of air at a temperature of 20°C. In an experiment, the plate is heated by an electric heater (also 0.3 m x 0.1 m) positioned on the underside of the plate and the temperature of the plate adjacent to the radiator is maintained at 100°C. A voltmeter and ammeter are connected to the radiator and they display respectively 200 V and 0.25 A. Assuming that the plate is perfectly insulated from all sides except the top surface, what is the coefficient of heat transfer by convection?