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Ministry of Higher Education and Scientific Research
وزارة التعليم العالي و البحث العلمي

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Module: Heat transfer

جامعة محمد بوضياف-المسيلة
كلية التكنولوجيا
قسم :الهندسة الكهربائية

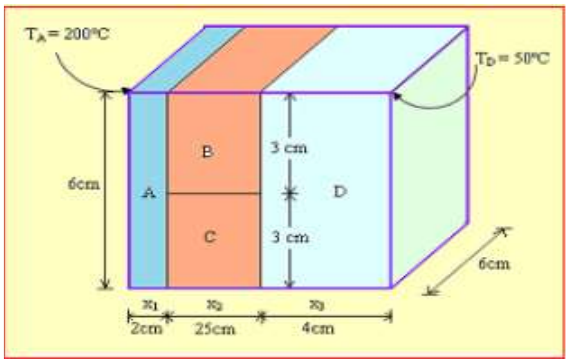
Tutorial 03

Exercise 1:

A composite wall section with the dimensions shown in the figure below. The uniform temperatures of 200 °C and 50 °C in the left and right surfaces respectively. If the thermal conductivity of wall materials is:

λ_A =70 W/mK ; λ_B =60 W/mK ;
λ_C = 40W/mK; λ_D = 20 W/mK.

Data: $S_A = S_D = 36*10^{-4}$ m^2
$S_B = S_C = 18*10^{-4}$ m^2



1) Give the equivalent electrical diagram and calculate the equivalent thermal resistance.
2) Determine the heat transfer flow through this section of the wall and the temperatures at the contact surfaces.

Exercise 2:

The water flows through a cast steel pipe (λ = 50 W/mK) with an outside diameter of 104 mm and a wall thickness of 2 mm.

1) Calculate the heat flow lost per unit length, in case of an uninsulated pipe when water temperature is 15 °C, outside air temperature is -10 °C, the water-side heat transfer coefficient is 30 kW/m^{2}K and the external heat transfer coefficient is 20 W/m^{2}K.

2) Calculate the heat flux lost when the pipe is covered with insulation having an outside diameter of 300 mm and a thermal conductivity of λ = 0.05 W/mK.

Exercise 3:

Water at 80°C is pumped through 100 m of stainless steel pipes, λ = 16 W/m.K of 47 mm inner and 50 mm outer radii respectively. The coefficient of heat transfer due to water is 2000 $W/m^2.K$. The surface of the pipe loses heat by convection in air at 20°C and the heat transfer coefficient is 200 $W/m^2.K$.

1) Calculate the heat flow through the pipe.

2) Also calculate the heat flow through the pipe when an insulation layer, λ = 0.1 W/m.K and a radial thickness of 50 mm is wound around the pipe.

Exercise 4:

A stainless steel tube (λ =19W/mC) with 3cm of inner diameter and 5cm of outer diameter is insulated by an asbestos layer (λ =0.2 W/mC) of 2.5cm thickness (see figure below). Knowing that the tube inner wall is maintained at 578 °C and the insulation outer wall at 92°C.

1) Calculate the heat flow lost per meter of length.

2) Give the equivalent electrical diagram

3) What is the importance of using the analogy between Thermal and electrical quantities?