الجمهورية الجزائرية الديمقراطية الشعبية
Ministry of Higher Education and Scientific Research
وزارة التعليم العالي و البحث العلمي

Mohamed Boudiaf- M'Sila University
Faculty of Technology
Department of Electrical Engineering

جامعة محمد بوضياف-المسيلة
كلية التكنولوجيا
قسم الهندسة الكهربائية:

Tutorial 04

Exercise 1:

Calculate the time required for a small 16°C cast aluminum plate to be heated to 510°C using blast furnace gases at 1204°C.
We give: $C = V/S$ = 15 cm, h = 85 W/m^2K, λ = 210 W/m.K, ρ_{al}= 2700 Kg/m^3 and C_{al}= 940 J/Kg.K.

Exercise 2:

To warm the baby's milk, the mother pours it into a small glass wall with a diameter of 6 cm. The height of the milk in the glass is 7 cm. She then places the glass in a large pot filled with hot water (60°C). The milk is constantly stirred, ensuring that its temperature remains constant at all times. Determine how long it would take for the milk to warm up from 3°C to 38°C if the heat transfer coefficient between water and glass is 120 W/m^2. C. Assume that the properties of milk are the same as those of water.

- Why can milk be treated as a small thermal environment under these conditions?

Data: The thermal conductivity, density and specific heat of water are :
λ =0.607 W/m.°C, ρ = 998 kg/m^3 and Cp = 4.182 kJ/kg.°C.

Exercise 3:

In a cylinder of 4 cm diameter, air flows at an average speed of 26.5 m/s.
Calculate the heat transfer coefficient *h* **knowing that**:
ρ = 1,2 kg/m^3 **,** Cp = 0,24 kcal/kg.°C , η = 1,9 10^{-5} Pa.s **,** $\lambda = 6{,}2 \cdot 10^{-6}$ kcal/m.s.°C, $Nu = 0{,}023 \cdot Re^{0,8} \cdot Pr^{0,4}$

Exercise 4:

A full copper bar of **1cm** in diameter and a length of **10cm** is cooled by sweeping it by a current of Helium, previously cooled to 77K and which strikes it perpendicularly with an average flow rate of 54m/s. The wall temperature of the copper rod is then set at 80K.
We deduce the heat release (in W/g) which occurs in the copper bar.. The characteristics of helium at the temperature considered:
- **ρ= 0,65kg/m^3** **λ = 0,06 W/ (m.K)**
- **μ=8,5.10^{-6} kg/(m.s)** **Cp = 5300 J / (kg.K)**

1. Calculate the Reynolds number and the Nusselt number.
2. Calculate the coefficient of convection h and the convective heat flux.
3. Calculate the copper mass and heat in W/g.