WEEK 5 :

Task 1 :

- Emissivity, absorptivity and reflectivity :

All objects are characterized by an absorption coefficient α, a reflection coefficient ρ, and a transmission coefficient τ, which respectively express the proportion of energy absorbed, reflected and transmitted. These three coefficients have values that vary between 0
and 1 and their sum is always equal to 1, according to the principle of the conservation of energy.
special cases:
A totally opaque body does not transmit radiation, which is partly absorbed and partly reflected.

$$\tau = 0 \quad \Rightarrow \quad \alpha + \rho = 1$$

A perfectly transparent body does not reflect radiation, but absorbs and transmits part of it.

$$\rho = 0 \quad \Rightarrow \quad \alpha + \tau = 1$$

- The heat exchange betweeen two black surfaces :

In order to study a set of several surfaces exchange energy with one another.
radiation, consider two surfaces first. The surface S1 sends a total flow Φ1 = M1S1
but only the flow Φ12 touches the surface S1. The ratio between the total flow emitted by S1 and the flow that actually strikes S2
is called view factor between S1 and S2. By definition, this number is between 0 and 1.:
F12 =Φ12/M1S1
This factor is a function of the shape of the surfaces S1 and S2, of their distance from the angle they make between them, etc.
calculates either by an analytical formula or, what is faster, by use of charts. Equivalently, one can
to define F21 = which will be such that: Φ12 = F12.S1
Reciprocally: it can be shown that the flow Φ12 sent by S1 to S2 is equal to the flow stream Φ21 sent by S2 to S1. => F12.S1 = F21.S2

- The heat exchange between the two gray surface :

This type of surface, in addition to the radiative flux emitted, reflects a part of the incident radiative flux (which it receives).
radiosity J, is consisting of the emitted flux and the reflected flux, the flux that "leaves the surface".

The emissivity ε is relative to the radiation emitted while the reflection coefficient ρ depends on the incident radiation.

The introduction of radiosity magnitude is of great interest for gray surfaces where its coefficients have values "independent" of the nature of the emitted and incident radiation.

$$\alpha + \rho + \tau = 1 \Rightarrow \rho = 1 - \alpha = 1 - \varepsilon \qquad \sigma = 5{,}7210^{8}\, wm^{-2}.K^{-4}$$

The radiative flux exchanged by a surface is equal to the difference between that emitted and that absorbed.

$$\Phi_i = (\varepsilon_i M_i^0 - \alpha_i E_i)S_i = \varepsilon_i S_i (M_i^0 - E_i) = \frac{\varepsilon_i S_i}{1-\varepsilon_i}(M_i^0 - J_i) = S_i(J_i - E_i)$$

- <u>Radiative resistance :</u>

the value to measure the energie released and converted to radiation

<u>Task 2</u> <u>:</u>

<u>ε 1=0,2 , ε 2= 0,7</u>

Rtotal = 1/ε 1+ 1/ε 2 -1 =1/0,2 + 1/0,7 -1
Rtotal=5,43

Q12 = Aσ $(T^4{}_{1} - T^4{}_{2})$/5,43 = A*5,67*10^{-8}*(800^4-500^4/5,43)
Rtotal =3625,37A W

<u>if ε 1= ε 2= 0,1</u>
R'total = 1/0,1 +1/0,1 -1
R'total = 19

Q'12 = Aσ $(T^4{}_{1} - T^4{}_{2})$/19 = A*5,67*10^{-8}*(800^4-500^4/19)
Q'12 = 1035,82 AW