Assignment Week 5.

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1)

Radiation Heat transfer

Radiation is the act of transmitting or emitting energy in liquids, solid or gases. The radio of that emitted radiation is called ***emissivity*** and it is measure comparing of how close is a surface to a blackbody, under the same conditions of temperature. Considering that a blackbody is an ideal body that absorb and emits radiation perfectly, its value is considered to be equal to 1. With this is mine we can state that the emissivity values are between 0 and 1.

$$0 \leq \varepsilon \leq 1$$

In addition, the emissivity of a surface varies according to its temperature, the wavelength and the direction of the emitted radiation. According to this, if the properties of a surface are independent from the direction, the surface is consider to be ***diffuse***. At the same time, if the properties are independent from the wavelength the surfaces are consider as ***gray***.

Every object emits radiation and at the same time they receive the radiation emitted or reflected by other surfaces; this is called ***incident radiation***. The entire amount of incident radiation in a body is going to be reflective, absorbed by the body or transmitted through it. Those three phenomenons are called ***absorptivity***, ***reflectivity*** and ***transmissivity*** and their summation meant to be equal to 1. In the case of opaque surfaces only takes place absorptivity and reflectivity.

Kirchhoff's Law

Kirchhoff stated that the emissivity of a surface (at an specific wavelength, direction and temperature is always equal to the absorptivity under the same conditions of wavelength, direction and temperature.

$$\varepsilon(T) = \alpha\ (T)$$

View factor

The view factor (also called shape, angle or configuration factor) is the geometrical quantity of radiation leaving a surface and reaching another. The view factor depends on the surface and it involves a reciprocity law that state that the amount of radiation leaving the surface 1 is equal to the amount of radiation leaving the surface 2.

$$A_1 \times F_{12} = A_2 \times F_{21}$$

Heat exchange between two black surfaces

It refers to the heat exchange between two blackbodies. In this case, all the amount of emitted radiation of the first body is going to be absorbed by the second and vice versa. This heat exchange depends on the area of the bodies, the amount of radiation emitted and the view factor, applying always the reciprocity law. Reflectivity doesn't have to be consider because black bodies does not reflect radiation. The mathematical expression is:

$$\dot{Q}\ 1 \to 2 = A_1 \times F_{12} \times \sigma\ (T_1^4 - T_2^4)$$

Heat exchange between two grey surfaces.

It refers to the heat exchange between one grey body (i) and a second grey body (j). In this case, the grey bodies only absorbed and reflect one portion of the radiation. In this heat transfer situation it must also be apply the reciprocity law. The mathematical expression is:

$$\dot{Q}\ i \to j = A_1 \times F_{i\text{-}j} \times (J_i - J_j)$$

Radiative resistances.

The radiative resistance is the amount of loss resistance energy. That lost energy is converted into heat radiation, and the lost of the radiative resistance is converted into radio waves.

2) Heat exchange between the surface 1 and surface 2.

A1= 1,50 m2 T1= 298 K $\sigma = 5.67 \times 10^{-8} \frac{W}{m^2 \cdot K4}$.

F12= 0,01 T2= 308 K $\varepsilon 1 = \varepsilon 2 = 0{,}10$

$$\dot{Q}\ 1 \to 2 = \frac{A_1 \times \sigma\ (T_1^4 - T_2^4)}{1/\varepsilon 1 + 1/\varepsilon 2 - 1}$$

$$= \frac{1{,}50m2 \times 5{,}67.10^{-8}\ W/m^2 \times (298^4\ K - 308^4 K)}{1/0{,}10 + 1/0{,}10 - 1}$$

$$= \frac{8{,}505.10^{-8}\ W.m^2 \times (7{,}8.10^9 K - 8{,}9.10^9 K)}{0{,}1 + 0{,}1 - 1}$$

$$= \frac{8{,}505.10^{-8}\ W.m^2 \times -1{,}10.10^9}{-0{,}8} K$$

$$= \frac{-93{,}55}{-0{,}8} W.m^2 .K$$

$$=116{,}94\ W.m^2.K$$

The net heat exchanged between the surface 1 and surface 2 is 116,94 $W.m^2.K$

Conclusion: As long as the function value of T2 increases, the net heat exchanged between surface 1 and surface 2 will keep on increasing.

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