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task5

Summary) every object or person emits energy through radiation. In real world this

radiation happens in all directions and the distribution of this emitted radiation is definitely not uniform. Radiation Intensity (I) is an imaginary quantity which frames radiation in a specific direction. In order to calculate the radiation intensity in practice, we should approximate the surfaces to be diffuse so that we conclude on constant emissivity.

Surfaces which emit radiation, receive and absorb it as well. Receiving radiation also doesn't happen in a uniform direction thus we need to introduce another phenomenon called Irradiation (G) to describe incident radiation on a surface for further calculations.

other important fact to know is that surfaces emit radiation as well as reflecting it in a certain amount. Radiosity (J) is another key player which sums both reflected and emitted irradiation.

As we know, black body is an idealized body which absorbs and emits all the irradiation and does not reflect any of it. This means that the amounts of radiosity and irradiation are equal. This scenario happens in another way in other (grey & diffuse) surfaces. Emissivity (ε) is a number between 0 and 1 (1 for black body) which defines the ratio of the Emitted radiation by a certain surface. At a given temperature to the radiation emitted by a black body at the same temperature.

In semitransparent and opaque surfaces we can define other ratios which we need while determining the heat exchange between surfaces:

1- Absorptivity : Ratio of absorbed radiation to irradiation at a certain Temperature which is between 0 and 1.

2- Reflectivity : Ratio of reflected radiation to irradiation at a certain temperature which is between 0 and 1.

2- Transmissivity : Ratio of transmitted radiation to irradiation at a certain Temperature which is between 0 and 1.

. Since opaque surfaces do not transmit light then their transmissivity is equal to zero.

According to Kirchhoff's law, emissivity of a surface at certain temperature, direction and wavelength is equal to it's absorptivity. What we can conclude from this statement is that in most surfaces

Another element which affects the head exchange rate between different surfaces is called View Factor. It represents the proportion of radiation leaving one surface and being received by another one. In concave surfaces we can also define internal view factor since part of radiation is received by itself.

In order to measure the heat exchange rate between surfaces we can divide them into two categories:

1- Black Surfaces: In this case the net heat exchange from one surface to another is equal to (radiation leaving the surface 1 that is received by surface 2) - (radiation leaving the surface 2 that is received by surface 1) which means:

According to reciprocity relation:

And as we mentioned in previous assignment:

2- Diffuse Grey Surfaces: In this case the first thing to do is to calculate the from a single surface and then to apply it on the whole situation. Transferred heat from the first surface (i) is equal to (radiation leaving the surface i on a certain unit area) - (radiation incident on surface i on a certain unit area)

question2) Find the radiation heat transfer between to parallel surfaces of i and j where the area is 1 m2,$\mathcal{E}1 = 0.1$,$\mathcal{E}2 = 0.1$, $T1 = 800$ K and $T2 = 500$ K

In parallel surfaces the situation is a little bit different. We have to calculate the summation of all radiation resentences which are $R1, R1{\longrightarrow}2$ and $R2$. The formula will be as following for parallel heat exchange:

$$- \dot{Q}_{12} = \frac{E_{b1} - E_{b2}}{R_1 + R_{12} + R_2} = \frac{\sigma \times (T_1^4 - T_2^4)}{\frac{1 - \varepsilon_i}{A_1 \times \varepsilon_1} + \frac{1}{A_2 \times F_{12}} + \frac{1 - \varepsilon_i}{A_2 \times \varepsilon_2}}$$

In parallel surfaces $A_1 = A_2 = A$ and $F_{1 \rightarrow 2} = 1$, then:

$$- \dot{Q}_{12} = \frac{A \times \sigma \times (T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} \implies \dot{Q}_{12} = \frac{1 \times 5.67 \times 10^{-8} \times (800^4 - 500^4)}{\frac{1}{0.1} + \frac{1}{0.1} - 1}$$

$$\implies \dot{Q}_{12} = \boxed{1035.81 \text{ w}}$$

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In the example which we solved in the class we had the following figures: $\varepsilon 1 = 0.2$, $\varepsilon 2 = 0.7$ and the final answer was around 3625 Watts. We can see that how significant emissivity ratios of both surfaces can affect the radiation heat transfer between two parallel surfaces.