Week5

Task 1 In you own words (which means in your own words) write a summary of the topics about radiative heat transfer we went through including the definitions of emissivity, absorptivity and reflectivity, the view factor, the heat exchange betweeen two black surfaces,the heat exchange between the two gray surface and finally the definition of radiative resistances

Task 2 Solve the last example you solved in the class (radiative heat exchange between two parallel plates) awhile considering the two emissivities to be 0.1, what can you conclude from the result?

Answer1：

radiative heat transfer

Radiative heat transfer is a basic way of heat transfer, which can be transmitted through electromagnetic wave in vacuum without other media. When an object emits radiation, it also receives radiation from other objects around it. This process of heat transfer between objects is called radiation heat transfer.

the definitions of emissivity, absorptivity and reflectivity

Emissivity(ε) is the ratio of radiation per unit area of the surface of an object to the radiation flux of the black body at the same temperature. Black body's emissivity=1.
Absorptivity （α） is the ratio of the heat radiation energy projected and absorbed onto the object to the total heat radiation energy projected onto the object.
Reflectivity(p) is the amount of radiant energy reflected by an object as a percentage of the total radiant energy.
Transmissivity(τ) is the ratio of the amount of radiation that passes through the refraction and absorption to the incident amount.
$\alpha+p+\tau=1$ or $\alpha+p=1$

the view factor

The view factor is a geometrical quantity that describe the fraction of the radiation

leaving one surface I and intercepted by another surface.

the heat exchange betweeen two black surfaces,

Thermal radiation from one black body will be completely absorbed by the other, and the black body that absorbs radiation will emit the same radiation at the same time, and will be completely absorbed by the previous black body.

In formula:$A_1F_{1\to2} = A_2F_{2\to1}$

the heat exchange between the two gray surface

Only part of the thermal radiation emitted from one grey body is absorbed by the other grey body, and the grey body that absorbs the radiation also emits some of the radiation, and only part of it is absorbed by the previous grey body.

In formula:$\dot{Q}_{i\to j} = A_1F_{i\to j}(J_i - J_j)$

definition of radiative resistances

Radiative resistance is a value to measure the energy depleted by loss resistance which is converted to heat radiation; the energy lost by radiation resistance is converted to radio waves.

In formula:$R_1 = \frac{1-\varepsilon_i}{A_i\varepsilon_i}$

Answer2：

Solution:

$$\dot{Q}_{2\to1} = \frac{A_1\sigma(T_1{}^4 - T_2{}^4)}{\frac{1}{\in_1}+\frac{1}{\in_2}-1} = \frac{1.5*5.67*10^{-8}*(308^4 - 298^4)}{\frac{1}{0.1}+\frac{1}{0.1}-1} = 4.9823W$$

$$F_{2\to1} = \frac{1}{\frac{1}{\in_1}+\frac{1}{\in_2}-1} = \frac{1}{\frac{1}{0.1}+\frac{1}{0.1}-1} = 0.0526$$

$$F_{12} = 0.01$$

$$\dot{Q}_{1\to2} = A_1 * F_{12} * \sigma(T_1{}^4 - T_2{}^4) = 1.5*0.01*5.67*10^{-8}*(298^4 - 308^4) = -0.9466W$$

$$\dot{Q}_{2\to 1} = -\dot{Q}_{1\to 2} = 0.9466W$$

Conclusion:

When the emissivity value increases, the field of view factor will increase, and the value of radiant heat transfer will also increase significantly.