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.

radiative heat transfer

When an object emits radiant energy outward, it constantly absorbs the radiant energy of other surrounding objects and converts it into heat. The heat transfer between objects that emit radiant energy and absorb radiant energy is called radiant heat transfer. If radiant heat transfer is between two objects with different temperatures, the result of heat transfer is that the high temperature object transfers heat to the low temperature object. If the temperatures of the two objects are the same, the radiant heat transfer between the objects is equal to zero, but the object is equal to zero. The process of radiation and absorption is still in progress. The process of transferring heat between cold and hot objects by means of electromagnetic radiation is a non-contact heat transfer, which can also be carried out in a vacuum.

Emissivity

The emissivity is the ratio of the radiation emissivity of an object to the absolute value of absolute blackbody radiation at the same temperature and at the same wavelength. It characterizes the proximity of the thermal radiation of an actual object to the thermal radiation of a black body. The specific emissivity varies with dielectric temperature, surface roughness, temperature, wavelength, and material viewing direction, and values between 0 and 1.

Absorptivity

Absorption rate is the ratio of the thermal radiant energy absorbed by an object to an object and the total radiant energy projected onto the object, ie the absorption rate of the object. The absorption rate of the surface of the object is related to the nature of the object, the surface condition and the temperature. It is an intrinsic property of the object itself, independent of the external environment.

Reflectivity

The percentage of radiant energy reflected by an object to the total radiant energy is called the reflectivity. Different objects also have different reflectivities. This depends mainly on the nature of the object itself and the wavelength and angle of the incident electromagnetic wave. The reflectance range is always less than or equal to 1, and you can use reflectivity to determine the properties of an object.

View Factor

The field of view factor is independent of surface i, the geometric amount corresponding to the fraction of radiation leaving surface i, independent of surface characteristics, and is also referred to as form factor, component factor and angle factor.

Heat Exchange (between two Black Surfaces)

The heat exchange between two black surfaces refers to the process in which one black surface is completely absorbed by emitting radiation to the other black surface. Relational expression: A1F1-2 = A2F2-1 Therefore, $\dot{Q}$_(1→2)= A_1×F_12×σ(T_1 ^ 4-T_2 ^ 4).

Heat Exchange (between the two Gray Surface)

Unlike black surface, the heat exchange between two gray surfaces absorbs and reflects only a portion of the radiation. A gray surface i emits radiation to another gray surface j, radiation leaving the entire surface i that strikes surface j subtracts radiation leaving the entire surface j that strikes surface i. Can be expressed by a formula: AiJiFi-j- AjJjFj-i, (A represents the area of the black surface, J represents the amount of radiation emitted per unit area per unit time, F represents the view factor), and applying the reciprocity relation: A1F1-2= A2F2-1, so $\dot{Q}_{\mathrm{i}\to\mathrm{j}} = A_{\mathrm{i}} \times F_{\mathrm{i-j}} \times \left(\mathrm{J_i} - \mathrm{J_j}\right)$.

Radiative Resistances

Radiation resistance is a value used to measure the loss-reducing energy, and the loss energy is converted into heat radiation, and the energy that is resistant to radiation loss is converted into radio waves.

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?

Question:
Find the net heat exchange between the surface 1 and 2 where A1 = 1.5 m2, F12 =

0.01, T1 = 298 K, T2 = 308 K, $\boldsymbol{\epsilon_1}$=0.1, $\boldsymbol{\epsilon_2}$=0.1, $\boldsymbol{\sigma}$=5.67*10-8$\frac{\boldsymbol{W}}{\text{m}^2\cdot\boldsymbol{K4}}$.

Solution:

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

$$\mathrm{F}_{2\to1} = \frac{1}{\frac{1}{\in_1}+\frac{1}{\in_2}-1} = \frac{1}{\frac{1}{0.1}+\frac{1}{0.1}-1} = 0.0526$$

$$\mathrm{F}_{12} = 0.01$$

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

$$\dot{Q}_{2\to1} = -\dot{Q}_{1\to2} = 0.9466W$$

Conclusion:

It can be seen from the results that as the emissivity value increases, the field of view factor will increase more significantly, and the value of radiant heat transfer will also increase significantly.