week 5

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

Emissivity: The ability to measure the relative strength of an object's surface in the form of heat radiation.
The ratio of the radiation emitted by the surface at a given temperature to the radiation emitted by a blackbody at the same temperature. The emissivity of blackbody is 1 ,and the emissivity of other objects is between 0 and 1.

In general, The darker the material with the rougher the surface, and the closer the emissivity is to 1. The higher the reflectivity of the material, the lower its emissivity.The emissivity of a real surface varies with the temperature of the surface as well as the wavelength and the direction of the emitted radiation.

Absorptivity: Absorption rate is the ratio of the thermal radiation energy absorbed by an object to the object and the total radiant energy projected onto the object, so it is called the absorption rate of the object, which is the total absorption rate of all wavelengths.
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 inherent property of the object itself, independent of the external environment.

Reflectivity: reflected radiation by an object divided by total radiation on the surface.the reflectivity of object is also between 0 and 1.

The view factor: A reflection factor is a portion of the energy emitted (radiated or reflected) from an isothermal, opaque, diffusely reflective surface that is emitted directly to another plane (absorbed or

reflected by it).

Heat Exchange (between two Black Surfaces): The heat exchange between two black surfaces refers to the process in which one black surface emits radiation to another black surface and is completely absorbed, while the other black surface also emits radiation and is also completely absorbed by the first black surface. Can be expressed by a formula:

$$A_1 * E_{b1} * F_{1\to2} - A_2 * E_{b2} * F_{2\to1}$$

(A represents the area of the black surface, Eb represents the amount of radiation emitted per unit area per unit time, F represents the view factor), and applying the reciprocity relation:

$$A_1 * F_{1\to2} = A_2 * F_{2\to1}$$

$$\therefore \dot{Q}_{1\to2} = A_1 * F_{12} * \sigma(T_1^4 - T_2^4)$$

Heat Exchange (between the two Gray Surface): The heat exchange between the two gray surfaces only absorbs and reflects a portion of the radiation (unlike the black surface). For example, when the gray surface i emits radiation to another gray surface j, the radiation that leaves the entire surface i and strikes the surface j subtracts the radiation that leaves the entire surface j and strikes the surface i. The formula that can be used is:

$$A_i * J_i * F_{i\to j} - A_j * J_j * F_{j\to i}$$

$$A_1 * F_{1\to 2} = A_2 * F_{2\to 1}$$

(A represents the area of the black surface, J represents the amount of radiation emitted per unit area per unit time, F represents the field of view factor), and the reciprocity relationship is applied:

Radiative resistances: The radiative resistance is a value used to measure the loss resistance energy, and the loss energy is converted into heat radiation; the energy lost by the radiative resistance is converted into radio waves.

QUESTION 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?

$\Sigma 1=0.2$, $\Sigma 2=0.7$

$Q1\text{-}2 = A*5.67*10^{-8}* (800^4-500^4)/(1/0.2+1/0.7-1)=3625.4$ AW

$\Sigma 1=0.2$, $\Sigma 2=0.2$

$Q1\text{-}2 = A*5.67*10^{-8}* (800^4-500^4)/(1/0.1+1/0.1-1)=1035.8$ AW

Conclusion: if Emissivity of object decrease ,the radiation will also decrease