Savinetti Simone_WEEK 5 Assignment

Radiative Heat Transfer

Emissivity:

The ability of a surface to emit radiant energy compared to that of a black body at the same temperature and with the same area.
It is one of the important basic factors that affect the surface temperature.
The specific emissivity varies with the dielectric constant, surface roughness, temperature, wavelength and observation direction, and its value is between 0 and 1.
It can be considered as the function of surface object type (roughness), temperature, (with the measured radiant energy) wavelength, and change with the measured radiant energy wavelength, observation Angle and other conditions.

Absorptivity:

Physics a measure of the ability of a material to absorb radiation, equal to the internal absorptance of a homogeneous layer of the material under conditions in which the path of the radiation has unit length and the boundaries of the layer have no influence, expressed by the symbol epsilon.
For a medium with selective absorption in the visible light region, it represents the sensitivity of a certain color reaction. For the same color reaction, the sensitivity is related to the measured concentration.
Molar absorption coefficient depends by the properties of the substance to be measured, the solvent and the wavelength of light.

Reflectivity:

Physics a measure of the ability of a surface to reflect radiation, equal to the reflectance of a layer of material sufficiently thick for the reflectance not to depend on the thickness.
The reflectivity of different objects is also different, which mainly depends on the nature of the object itself (surface condition), as well as the wavelength of incident electromagnetic wave and incident Angle.

View Factor:

The view factor is the degree to which heat carried by radiation can be passed between two surfaces. The view factor is the fraction of radiation leaving one surface which is intercepted by a second surface. The intensity of the emitted radiation depends on the view factor of the surface relative to the sky. The view factor is the degree to which heat carried by radiation can be passed between two surfaces. It does not depend on the surface properties.

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:

$$A1Eb1F1\text{-}2\text{-}\ A2Eb2F2\text{-}1$$

A = the area of the black surface, **Eb** = the amount of radiation emitted per unit area per unit time, **F =** the view factor

and applying the reciprocity relation: A1F1-2= A2F2-1, so $\dot{Q}_{1\to2} = A_1 \times F_{12} \times \sigma\,(T_1^4 - T_2^4)$.

Heat Exchange (between the two Gray 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:

$$A_iJ_iF_{i\text{-}j}\text{-}\ A_jJ_jF_{j\text{-}i},$$

A = the area of the grey surface, **J** = the amount of radiation emitted per unit area per unit time, **F =** the view factor

and applying the reciprocity relation: A1F1-2= A2F2-1, so $\dot{Q}_{\mathrm{i}\to\mathrm{j}} = A_{\mathrm{i}} \times F_{\mathrm{i}-\mathrm{j}} \times \left(\mathrm{J_i} - \mathrm{J_j}\right)$.

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.

A.

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$\frac{\boldsymbol{W}}{\mathbb{m}^2\cdot\boldsymbol{K4}}$.

B.

$\dot{Q}_{1\to2} = \frac{A_1\sigma\left(T_1^4 - T_2^4\right)}{\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}-1}$ = $\frac{1.5*\mathbf{5.67}*10^{-8}*\left(298^4 - 308^4\right)}{\frac{1}{0.1}+\frac{1}{0.1}-1}$ = -4.92W

$F_{12} = \frac{1}{\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}-1}$ = $\frac{1}{\frac{1}{0.1}+\frac{1}{0.1}-1}$ = 0.0526

As the value of emissivity increases, the view factor will increase more.