Weekly Submission 5

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?

From <https://github.com/bnajafi/TES_2019-2020_weeklySubmissions/tree/master/Week%205>

PART 1

Emissivity is the ratio of a) radiation emitted by the surface, at a given temperature, to b) the radiation emitted by a blackbody, at the same temperature. Emissivity measures how closely the surface approximates that of a blackbody. However, unlike that of a blackbody, the emissivity of a real surface will vary with the temperature of the surface, the direction of the radiation, and the wavelength of the radiation. Emissivity is subcategorized as spectral emissivity, which is the emissivity of a surface at a specific wavelength, and as directional emissivity, which is emissivity in a specific direction.

Absorptivity is a surface's ability to absorb light, at a given wavelength. However, unlike that of a blackbody, a real surface cannot absorb all incident light, resulting in incomplete absorption, which means the light is either then transmitted through or reflected by the surface.

Reflexivity is the amount of radiant energy reflected by the surface of an object compared to the total radiant energy. Reflexivity helps to evaluate the nature of the surface of the object.

View Factor (also known as shape factor, configuration factor, or angle factor) most importantly begins our discussion of radiation between two surfaces, as it quantifies the radiation leaving one surface, and intercepted by another. While it does not depend on surface properties, it is geometrical in nature.

Heat exchange between two black surface occurs when one black surface emits radiation that is completely absorbed by another black surface, and again the second black surface emits radiation that is completely absorbed by the first black surface. To calculate the net radiation we can use the reciprocity relation!

Heat exchange between two grey surfaces- To begin, surfaces are considered grey if their properties are independent of wavelength. However, similar to black surfaces, the heat exchange between two grey surfaces does consist of the radiation emitted from one surface and absorbed by another, and vice versa. However, unlike black surfaces, the radiation is not completely absorbed by either of the two surfaces. Again we can use the reciprocity relation to calculate the net radiation between the two grey surfaces!

Radiative Resistance measures the loss of resistance energy, which is converted into heat radiation. The loss of energy by radiative resistance is converted into radio waves.

PART 2

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$\frac{\boldsymbol{W}}{\boldsymbol{m^2 \cdot K^4}}$.

$\dot{Q}_{1\to2} = \frac{A_1\sigma\left(T_1^4 - T_2^4\right)}{\frac{1}{\epsilon_1}+\frac{1}{\epsilon_2}-1}$ = $\frac{1.5*\mathbf{5.67}*10^{-8}*\left(308^4-298^4\right)}{\frac{1}{0.1}+\frac{1}{0.1}-1}$ = 4.9821W

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

F_{12} = 0.01

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

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