WEEK ASSIGNMENT 5

QUESTIONS:

1 In your 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 between two black surfaces, the heat exchange between the two grey surface and finally the definition of radiative resistances.

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?

ANSWERS:

1.

Radiation is method of heat transfer just like conduction and convection, but radiation does not require the presence of material medium to take place. Radiation transfer is occurred in solid, liquid and gases.
In general radiation is emission of energy in form of waves through space. Electromagnetic waves travel at the speed of light.

Emissivity *is the ratio of the radiation emitted by the given temperature to the radiation which is emitted from the black body at the same temperature.*

Absorptivity and reflectivity: Absorptivity (α) is ability of the material to reflect thermal radiation(ρ), while reflectivity is ability to reflect the thermal radiation.

View factor is fraction of radiation which is leaving the surface 1 and strikes to other surface. And it never depends on the surface properties.

Heat exchange between the two black surfaces- is radiation leaving from surface 1 to surface 2 which is rejected by radiation leaving from surface 2 to surface 1.

Heat exchange between two grey surfaces- two grey surfaces will absorb and reflect a certain fraction of radiation.

Radiative resistance- energy spent by loss resistance and converted to heat radiation and energy lost by radiation resistance is converted to electromagnetic waves.

2.

When the ϵ_1=0.2 and ϵ_2=0.7;

$$R_{total} = \frac{1}{0.2} + \frac{1}{0.7} - 1 = 5.43$$

$$\dot{Q}_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = A * 5.67 * 10^{-8} * \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1} = A * 3624.68\ W$$

When the ϵ_1=ϵ_2=0.1;

$$R'_{total} = \frac{1}{0.1} + \frac{1}{0.1} - 1 = 19$$

$$\dot{Q}'_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon'_1} + \frac{1}{\epsilon'_2} - 1} = A * 5.67 * 10^{-8} * \frac{800^4 - 500^4}{\frac{1}{0.1} + \frac{1}{0.1} - 1} = A * 1035.72\ W$$

Lower the emissivity, lower the heat transfer.