Heat transfer

Supervised Practical Work
Thermal radiation

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EXERCISE 1: Estimation of the solar constant

The sun is supposed to behave very nearly like a blackbody at approximately 5777K. In this exercise the solar radiation attenuation by the atmosphere will be neglected. The sun radius and the average distance between Earth and sun are respectively $R_s = 6.96 \times 10^8\, m$ and $d_{ES} = 1.496 \times 10^{11}\, m$.

1. At what wavelength has the sun its maximum spectral emissive power.
2. Calculate the total emissive power of the sun.
3. Determine the solid angle with which the sun is seen from Earth.
4. Determine the total solar heat flux incident in the earth per unit surface of area directed at the sun (i.e., normal to the sun rays).

EXERCISE 2: Radiation in a hemisphere

Let us consider a cavity shown in figure 1, which consists of a hemispher and two plane surfaces A_3 and A_1 . All these surface are considered as black. Let us supposed that the temperature of A_1 is T_1 and that the temperature of A_2 and A_3 are equal to T_2. The diameter of the hemisphere is noted D. The diameter of the disk A_1 is $D/2$.

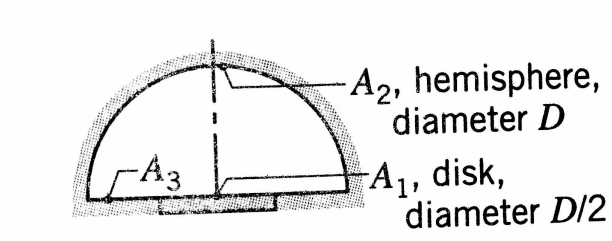

Figure 1: Hemispherical cavity

1. Express the various view factors of the problem.
2. Calculate the heat exchange from A_2 to A_1.
3. Calculate the heat exchange from A_3 to A_1;
4. Calculate the heat exchange from A_1 to A_2.
5. Express the total energy rate exchange between A_1 to A_2.
6. Make the numerical application for $D = 1\,\text{m}$, $T_1 = 20\,℃$ and $T_2 = 1000\,℃$.

EXERCISE 3: Estimation of the view factors between parallel coaxial disks

Let us consider two parallel and coaxial disks represented in figure 2. The radius of the upper disk is R_1 and the surface of the second disk dS_2 is supposed to be very small. The temperature the upper disk and the small disk are respectively T_1 and T_2. The distance between the center of the two disks is h.

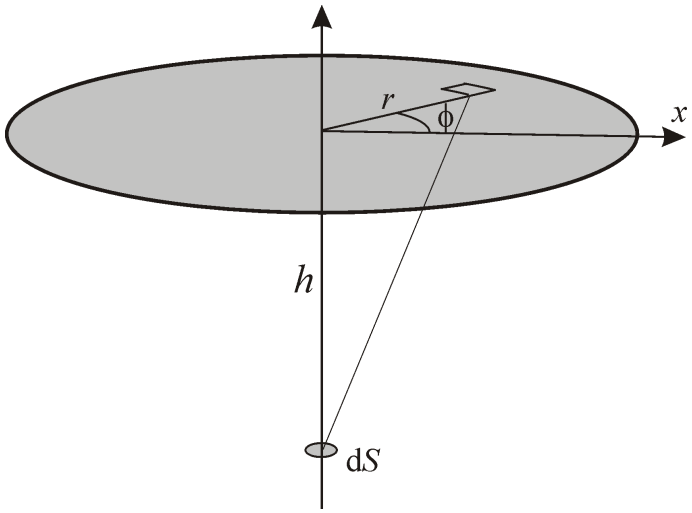

Figure 2: view factor between two parallel and coaxial disks

1. Calculate the view factor between the disk 2 and the upper disk 1.
2. Express the heat flux radiated by the upper disk to the small disk.

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