(b) Stefan's Law and Wien's Displacement Law

Stefan's Law

The integral of the spectral radiancy $R(\nu,T)$ over all frequency ν is the total energy emitted per unit time per unit area from a black body at temperature T. It is called the radiancy $R(T)=\int_0^\infty R(T,\nu)d\nu$ or intensity I of radiated electromagnetic wave .

According to Stefan's law intensity I of radiated electromagnetic wave is proportional to fourth power of absolute temperature (T).

$I=\sigma T^4$ where σ is known as Stefan's Boltzmann constant.

The value of $\sigma=\dfrac{2\pi^5k^4}{15c^2h^3}$ where k is Boltzmann constant, c is speed of light and h is Plank's constant. The value of $\sigma=5.67\times10^{-8}W/m^2-{}^0K^4$

From the Stefan's law, one can calculate the Power P of radiated electromagnetic wave. So power is given by $P=\sigma AT^4$ where A is surface area of black body from which electromagnetic wave radiated.

Wien's Displacement Law

The plot between energy density of blackbody radiation and frequency shows that maximum frequency $(\nu_{\max})$ is shifted towards right as temperature increases. Wien's displacement law stated that maximum frequency $(\nu_{\max})$ is directly proportional to absolute temperature . $\nu_{\max}=\dfrac{c}{\lambda_{\max}}=\dfrac{4.9663}{h}kT$