(a) Basic Definition of Black Body Radiation

Thermal Radiation: If Heat is given to any substance, the particle at atomic level can generate motion known as thermal motion. If any charged particle within the matter has thermal Motion then they generate **electromagnetic radiation** known as thermal radiation. All matter with temperature greater than absolute zero emits thermal radiation.

Consider, for example, heating iron rod to higher and higher temperatures in fire the rod assumes a dull red color then a bright red color and at very high temperature intense blue- white color. The **intensity** of a beam of **electromagnetic radiation** is the **energy** it delivers per second per unit area.

Black Body Radiation: The spectrum of the thermal radiation emitted by a hot body depends somewhat upon the composition of body .How ever experiments show that there is one class of hot body that emits thermal spectra of universal character.

A **black body** is an idealized physical body that absorbs all incident electromagnetic radiation, regardless of frequency or angle of incidence. A black body in thermal equilibrium (that is, at a constant temperature) emits electromagnetic radiation called black body radiation. When an object is heated, it radiates electromagnetic energy as result of thermal agitation of electrons in its surface.

The spectral distribution of black body radiation is specified by quantity $R \equiv R(\nu, T)$ called spectral radiancy which is defined so that $R(\nu, T)d\nu$ is equal to the energy emitted per unit time in the interval ν to $\nu + d\nu$ from unit area of surface at absolute equilibrium temperature T. The Spectral Radiancy also known as density.

Intensity of radiation depends on frequency and absolute temperature (T) .

The total intensity I over the entire spectrum is given by $I = \int_0^\infty R(\nu, T)d\nu$.

An object in thermal equilibrium with its surrounding radiates as much energy it absorbers. A black body is perfect absorber as well perfect emitter of radiation.

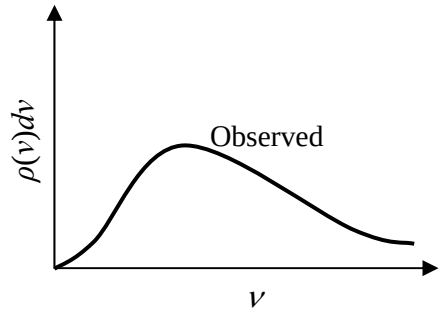

Figure 1: Intensity versus frequency at temperature (T)

Observation of spectral energy density (Radiancy or Intensity) of black body radiation at different temperature as function of frequency ν.

(1) At the equilibrium the radiation emitted has a well defined **continuous** energy distribution.

(2) To each frequency there corresponds as energy density which depends neither on chemical composition of object nor on shape, but only temperature of black body.

(3) The curve shows pronounced Maximum at a given frequency, which increase with temperature, i.e. the peak of the radiation spectrum occurs at a frequency that is proportional to temperature.

In figure the radiation incident upon the hole from the outside enters the cavity and is reflected back and forth by the walls of the cavity, eventually being absorbed on these walls. If the area of the hole is very small compared to the area of inner surface of the cavity, a negligible amount of the incident radiation will be reflected back through the hole. Essentially all the radiation upon the hole is absorbed; therefore the hole must have the properties of the surface of blackbody. Most blackbodies used in laboratory experiment are constructed along these lines.

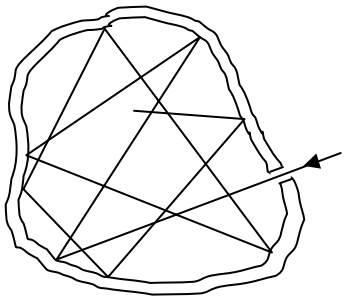

Figure 2: Perfect Black Body