* Write notes on Kirchoff's law of radiation.

* State Kirchoff's law of radiation and establish it. Illustrate your answer with suitable examples.

Kirchoff's law of radiation states that at any temperature the ratio of emmissive power of a body to it's absorptive power is constant and equal to the emmissive power of a perfectly black body. In symbols this law is expressed by

$$\frac{e_\lambda}{a_\lambda} = E_\lambda \quad \cdots\cdots \quad (i)$$

Where E_λ = emmissive power of perfectly black body

e_λ = emmissive power of the emitting body

a_λ = absorptive power of the body

To establish this law, let us consider figure 1. In this the emmitting and absorbing body B has been shown placed at the centre of spherical black body chamber C. If, the black body chamber is filled

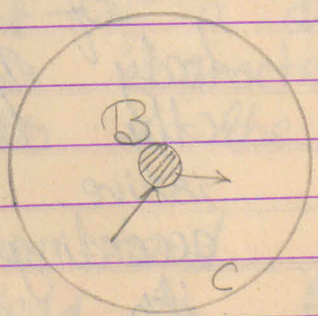

Figure 1

with diffuse radiation of wavelength range λ and $d\lambda$. Then we take

e_λ = emmissive power of B

a_λ = absorptive power of B.

If dQ = energy of radiation incident on B, then the amount of energy absorbed by it is given by $a_\lambda \cdot dQ$. The emmited energy within wavelength range maintioned is given by $e_\lambda \cdot d\lambda$.

Since chamber C is perfect black body, Prevoust theory of exchange is valid for B. According to Prevoust theory of exchange we have

energy emmitted = energy absorbed

writing the symbols

$$e_\lambda \cdot d\lambda = a_\lambda \cdot dQ \quad \cdots\cdots (ii)$$

This gives

$$\frac{e_\lambda}{a_\lambda} = \frac{dQ}{d\lambda} \quad \cdots\cdots (iii)$$

If, now we imagine body B to be a perfectly black body of emmissive power E_λ, then according to definition it's absorptive power

$$A_\lambda = 1 \quad \cdots\cdots (iv)$$

For this system of chamber C and perfectly black body B. like equation (ii) we have the result

$$E_\lambda \cdot d\lambda = A_\lambda \cdot dQ \quad \ldots\ldots (v)$$

or, $E_\lambda \cdot d\lambda = dQ \quad \ldots\ldots (vi)$ [from eqn (iv)]

This gives

$$E_\lambda = \frac{dQ}{d\lambda} \quad \ldots\ldots (vii)$$

Now, the results of equation (iii) and (vii) are equal and we have

$$\frac{e_\lambda}{a_\lambda} = E_\lambda \quad \ldots\ldots (viii)/(i)$$

This is Kirchoff's law of radiation.

Importance of Kirchoff's law of radiation

Kirchoff's law of radiation gave rise to two important branches of physics, namely spectroscopy and astrophysics. The basic law for origin of spectrum is "every different type of atom, when ~~sighted~~ excited properly, emits light of a definite wave-length which is characteristic of the atom." This is the origin of spectroscopy.

$h\nu = W_2 - W_1$ Bohr's theory

On the other hand, for astrophysics this ~~lead~~ led to the study of the sun and stars.

Kirchoff's law of radiation is supported by following examples:

i) Two pieces of china ~~cley~~ clay, one white and other coloured or with coloured patten are heated to nearly 1000°C and thrown in dark. It is observed that the coloured piece glows more brilliantly than the white one., Reason is that white body absorbes less and emits less.

ii) An iron ball with platinum-black dot is heated in a ~~furnes~~ furnace to about 1000°C and thrown in dark. Platinum black dot glows more brilliantly and retains brilliance even after rest of the ball becomes dark.

iii) A piece of green glass and another piece of red glass plate are heated to high temperature so as to glow. Both are thrown in dark room. The red piece of glass appears green while the green piece appears red, Reason is that red and green are complemetery colours.