TDC-I
Paper-II

Atomic Structure

max. Planck's Quantum Theory (1900)

This theory is regarding the quantization of radiant Energy or the particle nature of an Electromagnetic wave

The main assumptions of this theory are as followed.

(I) Hot body radiates energy discontinuously in the form of bundle of packets of Energy

(II) Each packet of energy is designated as a "quantum" or a photon

(III) The Energy of a photon is is directly proportional to the frequency of radiation.

$$E_{photon} \propto \nu$$

$$\boxed{E_{photon} = h\nu} = \frac{hc}{\lambda}$$

where h = planck's constant
$= 6.625 \times 10^{-34}$ J·sec.

(IV) The radiation from hot body is either a single photon or its integral multiples.

$$\boxed{E = n h\nu}$$ where $n = 1, 2, 3, \cdots$

de-Broglie Relationship/Equation

A French Physicist de-Broglie established That the Electrons and like particles have properties of both matter and waves nature. He Examined the Consequence of Combining two Energy Equation of Planck's & Einstein.

For an Electron moving in an Orbit, The Energy expression using Planck's Theory

$$E = h\nu = \frac{hc}{\lambda} \quad \text{---(I)}$$

Also, Energy of Electron of mass 'm' moving with speed c, the Energy relation according to Einstein Equation is

$$E = mc^2 \quad \text{---(II)}$$

for Same Electron, two Energy values must be identical. Hence

$$mc^2 = \frac{hc}{\lambda}$$

$$mc = \frac{h}{\lambda}$$

momentum $= \boxed{p = \frac{h}{\lambda}}$ ---This is required de-Broglie Relation.

$$\lambda = \frac{h}{p}$$

It is applicable to matter wave