B. Sc. III
Group-B

De-Broglie wave Equation

According to de-broglie hypothesis both light and matter have dual character as wave as particle.

When electron is taken as wave, it must be associated with wavelength frequency etc.

If 'ν' is the frequency of this wave and 'E' is its energy then according to plank's equation

$$E = h\nu \quad \text{---- (i)}$$

If electron is taken as particle, then its energy E is given by Einstein equation

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

Where m = Mass of particle
c = Velocity of light

∴ on comparing equation (i) and equation (ii)

$$h\nu = mc^2$$

$$\therefore mc = \frac{h\nu}{c}$$

but $\frac{\nu}{c} = \frac{1}{\lambda}$

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

or $$p = \frac{h}{\lambda} \quad \text{--- (iii)}$$

where $p = mc$ is momentum

λ = wavelength

h = Planck constant

Equation (iii) is known as de broglie equation

Significance of de-broglie equation:

Although the de-broglie equation is applicable to all material object but it has significance only in case of microscopic particles. This is because the wave length produced by a bigger particle come out to be too small to be observed.

Only particles like electrons, atoms, etc give an observable value of λ according to de-broglie equation

$$\left(\lambda = \frac{h}{mc}\right).$$