The Wave Nature of electron :

Since the electron is found to behave in the same manner as a wave it is of importance to describe its motion by a wave equation. Ordinarily the mathematical treatment of wave motion involves a second order differential equation. for instance, the transmission of a disturbance along a stretched string can be expressed by the equation

$$\frac{d^2\phi}{dx^2} = \frac{1}{c^2}\frac{\partial^2\phi}{dt^2}$$

where 'c' is the velocity of wave. The wave function ϕ is seen to be the displacement of the string as a functional of variable x, at any time t and is therefore an amplitude function. An equation of this form is found to be applicable to virtually all forms of wave motion from the vibration of a string to the transmission of electromagnetic radiation. In three dimensional Cartesian space the wave equation becomes

$$\frac{\partial^2\phi}{dx^2} + \frac{\partial^2\phi}{dy^2} + \frac{\partial^2\phi}{dz^2} = \frac{1}{c^2}\frac{\partial\phi}{dt^2}.$$

or, simply

$$\nabla^2\phi = \frac{1}{c^2}\frac{\partial^2\phi}{dt^2}$$

∇^2 is the Laplacian operator which is Cartesian coordinate is given by

$$\nabla^2 = \frac{\partial_2}{dx^2} + \frac{\partial_2}{dy^2} + \frac{\partial_2}{dz^2}.$$

A typical example of such wave function ϕ, is the familiar sine function

$$\phi = A \sin\frac{2\pi}{\lambda}(x - ct)$$

This, of course could just as easily be a cosine function or any other function that is still a solution to the differential equation of wave motion. This is a type of wave motion with which we are familiar. However its extension to matter waves