(3) If an experiment is performed which is capable of determining whether one or another alternative is actually taken, the probability of the event is the sum of the probabilities for each alternative, $P = P_1 + P_2$.

## 2.3 PHYSICAL INTERPRETATION OF WAVE FUNCTION '$\Psi$'

If $\Psi$ is the amplitude of matter wave at any point in the space, then $\Psi^2$ is the particle density. But when this is multiplied by the charge of the particle. This gives the charge density. According to Born, $\Psi\Psi^* = |\Psi|^2$ ($\Psi^*$ is the conjugate of $\Psi$) gives the probability of finding a particle in the state $\Psi$, *i.e.* $|\Psi|^2$ is the probability density. Thus the probability of finding a particle in volume $d\tau = dx\,dy\,dz$ is $|\Psi|^2\,dx\,dy\,dz$ and $\iiint_v |\Psi|^2\,dx\,dy\,dz = 1$. $\Psi$ satisfying the above requirement is said to be **normalised**.

### 2.3.1. Orthogonal Wave Function

If the two wave functions $\Psi_m$ and $\Psi_n$ are such that $\int \Psi_m^* \Psi_n \, d\tau = 0$ or $\int \Psi_n^* \Psi_m \, d\tau = 0$ for $m \neq n$

Then the wave function $\Psi_m$ and $\Psi_n$ are said to be orthogonal and the equations represent orthogonality conditions.

However, the wave functions which satisfy the normality condition and orthogonality condition are called ortho normal functions

$$\int \Psi_m^* \Psi_n \, d\tau = \delta_{mn}$$

Hence $\delta_{mn}$ is called the Kronecker delta function

$$\delta_{mn} = 0 \quad \text{if} \quad m \neq n$$
$$= 1 \quad \text{if} \quad m = n$$

### 2.3.2. Properties of Wave Function

A wavefunction is normalizable. It however must satisfy the following conditions also:

**(a) $\Psi$ must be finite Everywhere:** If $\Psi$ is infinite for a particular point, it would mean infinitely large probability of finding particle at that point which would go against the uncertain principle. Thus $\Psi$ must have finite values at any point.

**(b) $\Psi$ must be Single Valued:** If $\Psi$ has more than one value at any point, then it would me more than one value of probability of finding the particle at the point which is not allowed.

**(c) $\Psi$ must be Continuous and must have a Continuous Derivative everywhere :** know from Schrodinger equations that $\frac{d^2\Psi}{dx^2}$ must be finite every where. This is possible only w $\frac{d\Psi}{dx}$ has no discontinuously at the boundary where potential changes. Thus if $\frac{d\Psi}{dx}$ is continu hen $\Psi$ is also continuous across a boundary.