2.2-POSTULATES OF QUANTUM MECHANICS

Classical mechanics-Energy is **continuous**

Quantum Mechanics- Energy is **discontinuous, quantized (fixed).**

1. POSTULATES OF QUANTUM MECHANICS

(i) Postulate-1 (*Wave functions*)

Every system can be described by a well behaved wave function, Ψ

- *Properties of **well-behaved** wave functions* – continuous, single valued, disappear at extreme limit, normalized and orthogonal.
- Condition for normalization : $\int \psi_i^* \psi_i \, d\tau = 1$
- Condition for orthogonality : $\int \psi_i^* \psi_j \, d\tau = 0$

(ii) Postulate-2 (*Operators*)

- Each observable has a characteristic operator.
- *Concept of operators* – mathematical symbol.

Linear operators: (Examples: Differential and integral operators)

Non-linear operators :(*Examples*: logarithmic; Square root)

Commutative (Commuting operators)(ABψ = BAψ): Position and momentum operators do not commute(*Uncertainty principle*)

3D Laplacian operator, $\nabla^2 = \frac{d^2}{dx^2} + \frac{d^2}{dy^2} + \frac{d^2}{dz^2}$

Hence, 1D Laplacian operator is $\frac{d^2}{dx^2}$ or $\frac{d^2}{dy^2}$ or $\frac{d^2}{dz^2}$

A 2D Laplacian operator in x and y is $\nabla^2 = \frac{d^2}{dx^2} + \frac{d^2}{dy^2}$

Direction of operation-operating from left to right.

- *Total energy* operator(Hamiltonian operator), H : $(-h^2 / 8\pi^2 m)\nabla^2 + V$

(iii) Postulate-3 (*Schrodinger Equation*)

All systems satisfy an equation of the form $H\Psi = E\Psi$ called *Schrodinger Equation*

(iv) Postulate-4 (*Eigen equation*)

The observable of a system is given by the *Eigen equation:* $A\psi = a\psi$; Where , A *is Eigen operator,* ψ *is Eigen function. and a* is Eigen *value.*

NB: Schrodinger Equation is a special form of the Eigen equation, $A\psi = a\psi$

NB: (i) ae^{ax} will be an Eigen function for $\frac{d^n}{dx^n}$

(ii) "Asinax & Acosax" will be Eigen functions for $\frac{d^2}{dx^2}$

(iii) "Asinax & Acosax" will not be Eigen functions for $\frac{d^n}{dx^n}$ if n is odd

(v) Postulate-5 (*Average value or Expectation value*)

The average or expectation value is given by the integral

$$\langle E \rangle = \frac{\int \psi^* H \psi \, d\tau}{\int \psi^* \psi \, d\tau}$$

Where ψ^* is the complex conjugate of ψ