SUBJECT- CHEMISTRY
CLASS - B.Sc(Hons) PART-III
PAPER - V
TOPIC - POSTULATES OF QUANTUM MECHANICS

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Quantum mechanics deals with the wave nature of electron in which Complete description of an electron is obtained as a mathematical function known as wave function It has following main postulates -

1 The State of a quantum mechanical System is described by a state function or wave function ψ. It is a function of co-ordinates of particles of the System and of time for one dimensional System, The quantity $[\psi^2_{x,t}]dx$ gives the probability that a measurement of particle's position at a time t will find it between x & x+dx. It has all informations known about the System ψ is a Solution of 2nd order differential Schrodinger wave equation.

2. There is infinite number of Solutions of This equation. The following limitations must be imposed to get meaningful or acceptable Solutions That are physically possible must have four properties, we call them well behaved Solutions to the wave functions

(a) The wave function must be finite and Continuous.
(b) The Solution must be single valued.
(c) The Solution must be normalised i.e the probability of finding the electron over all space from plus infinity to minus infinity must be equal o one.

$$\int_{-\infty}^{+\infty} \psi^2 d\tau = 1$$

3. ψ Can be expressed as a linear Sum of Series of orthonormal functions, each of which is also a well behaved function i.e

$$\psi = \Sigma_i a_i \phi_i$$

4. Every physically observable quantity like linear momentum. angular momentum, energy etc. is associated with a Hermitian operator such that the physical property of the observable can be described by the mathematical property of the operator. In other words, to every physical quantity (dynamic variable), there is a linear operator in quantum mechanics e.g.

$$\text{Momentum } (P_x) = -i\hbar \frac{\partial}{\partial x}$$

5. The precise value of physical quantity e.g energy angular momentum etc. for which the operator is $\hat{A}$ can be expressed as

$$\hat{A}\psi = E\psi \quad \text{i.e} \quad E\psi = H\psi$$

where terms have usual meanings.

6. The average or expectation value ($\bar{M}$) of a physical quantity (M) of a system, whose state function is ψ is given by

$$\bar{M} = \int_{-\infty}^{+\infty} \psi^* \hat{M} \psi \, d\tau$$

This formula holds only when the wave function is normalised Otherwise the following formula is used -

$$\bar{M} = \frac{\int \psi^* \hat{M} \psi \, d\tau}{\int \psi^* \psi \, d\tau}$$

where $\hat{M}$ is the operator for M. The bar over indicates the average value. It is also shown as $\langle M \rangle$

7. ψ being the well behaved solution, therefore, It can never be applied to a large body.

8. Two wave functions ϕ_A & ϕ_B of the same system must be orthogonal to each other i.e the product of two wave functions integrated over all space must be equal to zero i.e

$$\int_{-\infty}^{+\infty} \phi_A \phi_B \, d\tau = 0$$