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Degree - III, Papar - V Group - C

Name Giridhar Kumar.

Topic:- The Postulates of Quantum Mechanics

There are six postulates of Quantum Mechanics:-

* Postulate (1) :- The state of a quantum Mechanical system is completely Specified by the function $\psi(r,t)$ that depends on the coordinates of the particle, r and the time, t. This function is called the wavefunction or state function and has the property that $\psi^*(r,t)\,\psi(r,t)\,dt$ is the probability that the particle lies in the volume element $d\tau$ located at r and time t.

$$\int_{-\infty}^{+\infty} \psi^*(r,t)\,\psi(r,t)\,d\tau = 1$$

This is the normalisation condition of postulate 1.

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Postulate (2) :- To every observable in classical mechanics there corresponds a linear, Hermitian operator in quantum mechanics.

Some Examples of Hermition Operators are :-

Observable	Classical Symbol	Quantum operator	Operation
position	r	$\hat{r}$	multiply by r.
momentum	p	$\hat{p}$	$-i\hbar\left(\hat{i}\frac{\partial}{\partial x}+\hat{j}\frac{\partial}{\partial x}+\hat{k}\frac{\partial}{\partial x}\right)$
Kinetic energy	T	$\hat{T}$	$\frac{-\hbar^2}{2m}\left(\frac{\partial^2}{\partial x^2}+\frac{\partial^2}{\partial y^2}+\frac{\partial^2}{\partial z^2}\right)$

Postulate (3) :- In any measurement of the observable associated with operator $\hat{A}$. the only values that will ever be observed are the eigenvalues, a, that satisfy the eigenvalue equation.

$$\hat{A}\psi = a\psi$$

This is the postulate that the value of dynamical variables are quantized in quantum mechanics. . . . . .

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Although measurement will always yield a value, the initial state does not have to be an eigenstate of $\hat{A}$. An arbitrary state can be expanded in the complete set of eigenvectors of $\hat{A}$, $\hat{A}\psi_i = a_i\psi_i$, as

$$\psi = \sum_i^n c_i \psi_i$$

where n may go to infinity.

Postulate (4) :- If a system is in a state described by the normalised wavefunction, ψ, then the average value of the observable corresponding to $\hat{A}$ is given by

$$\boxed{\langle \hat{A} \rangle = \int_{-\infty}^{+\infty} \psi^* \hat{A} \psi \, d\tau}$$

Postulate (5) :- The wave function or state function of a system evolves in time according to the time-dependent Schrödinger

$$\boxed{\hat{H}\psi(r,t) = i\hbar \frac{\partial \psi}{\partial t}}$$

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Postulate (6) :- The ~~total~~ wavefunction must be antisymmetric with respect to the interchange of all coordinates of one fermion with those of another. Electronic spin must be included in this set of coordinates

Note :- The Pauli exclusion principle is a direct result of this antisymmetry postulate

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Q. Write all the postulate of Quantum mechanics.