

KATWA COLLEGE

DEPARTMENT OF PHYSICS

INTERNAL ASSESSMENT EXAMINATION - 2024

B.Sc. (H), SEMESTER: - V, PAPER: CC-IX

(QUANTUM MECHANICS AND APPLICATIONS)

F.M: 10

TIME: 1 HOUR

❖ Answer any five of the following questions:

1. Find the eigenvalues and eigenfunctions of the operator $-i \frac{d}{dx}$.
2. If a system has two eigenstates Ψ_1 and Ψ_2 with eigen values E_1 and E_2 respectively. Under what condition a linear combination $(c_1\Psi_1 + c_2\Psi_2)$ is also an eigen function of this system.
3. Consider an asymmetric one-dimensional infinite potential well of width a . Suppose a particle of mass m is confined within this well and the state of this quantum system at $t = 0$ is given by $\psi(x, 0) = \frac{1}{\sqrt{6}} \psi_1(x) + \frac{i}{\sqrt{2}} \psi_2(x) + \frac{1}{\sqrt{3}} \psi_3(x)$. How will such a state evolve with time? Find average value of energy $\langle E \rangle$.
4. Find the constant A that makes $e^{-\alpha x^2}$ an eigenfunction of the operator $\left(\frac{d^2}{dx^2} - Ax^2\right)$. What is the corresponding eigenvalue?
5. Evaluate $[x, \sin p]$.
6. Show that the first excited state of a quantum system with a particle of mass m trapped in three-dimensional rigid cubic box with sides L is always threefold degenerate.
7. Find out the energy eigenfunctions in all regions of the ground state of a particle bound in the one-dimensional symmetric finite potential well of width a and height V_0 .
8. Show that if \hat{A} and \hat{B} are Hermitian then $i[\hat{A}, \hat{B}]$ is also Hermitian.