

BB283

M. Sc. EXAMINATION, 2021

(Second Semester)

(B Scheme) (Re-appear)

(PHYSICS)

PHY506B

QUANTUM MECHANICS-I

Time : 2½ Hours]

[Maximum Marks : 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Four* questions in all. All questions carry equal marks.

1. Explain the problem of leakage of a particle through a rectangular potential barrier of finite width and find out the transmission coefficient.
2. (a) Calculate the expectation value of p and p^2 for the wave function $\psi(x) = \sqrt{\frac{2}{L}} \sin \frac{\pi x}{L}$ in the region $0 < x < L$ and $\psi(x) = 0$ outside this region.
(b) Discuss the time dependent and time independent form of Schrödinger equation.
3. (a) Find commutation relation $[H, p]$.
(b) Consider two states $|\psi_1\rangle = |\phi_1\rangle + 4i|\phi_2\rangle + 5|\phi_3\rangle$ and $|\psi_2\rangle = b|\phi_1\rangle + 4|\phi_2\rangle - 3i|\phi_3\rangle$, where $|\phi_1\rangle, |\phi_2\rangle$ and $|\phi_3\rangle$ are orthonormal kets and where b is a constant. Find the value of b so that $|\psi_1\rangle$ and $|\psi_2\rangle$ are orthogonal.

4. (a) What is Interaction picture for describing the dynamical behavior of a system ?
(b) Find the commutation relation $[L^2, L_x]$.
5. (a) Find out the solution of theta dependent Schrödinger wave equation.
(b) Find the commutation relation $[J_x, J_y]$.
6. (a) Define orbital angular momentum in spherical polar coordinates.
(b) Derive Eigen values of J^2 and J_z .
7. Outline the perturbation theory for non-degenerate levels and apply it to explain first order Stark effect in Hydrogen.
8. Describe in detail the Variation method and apply it to Hydrogen atom.