

25P206

(Pages: 2)

Name:

Reg.No:

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2026

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19PPHY2C05 - QUANTUM MECHANICS – I

(Physics)

(2019 Admission onwards)

Time : 3 Hours

Maximum : 30 Weightage

Section A

Answer *all* questions. Each question carries 1 weightage.

1. In a Stern Gerlach experiment, why does the beam of silver atoms split under the influence of the magnetic field?
2. Discuss how eigen kets are used as base kets.
3. Does the translation operator commute with position operator? Why?
4. Discuss how the infinitesimal time-evolution operator can be represented in terms of Hamiltonian.
5. What is meant by stationary state?
6. What is the time-energy uncertainty relation?
7. Write the commutator relations of ladder operators.
8. Write and explain the Hamiltonian for an isotropic harmonic oscillator.

(8 × 1 = 8 Weightage)

Section B

Answer any *two* questions. Each question carries 5 weightage.

9. Discuss the concept of measurements in quantum mechanics. Define expectation value of an operator and its dependence on eigenvalues.
10. What is a Gaussian wave packet? Obtain the expectation values of x , x^2 , p , p^2 from it. Also obtain the uncertainty relation.
11. Obtain an expression for Ehrenfest's theorem.
12. Derive the wavefunction of a quantum particle approaching a finite one-dimensional potential barrier.

(2 × 5 = 10 Weightage)

Section C

Answer any **four** questions. Each question carries 3 weightage.

13. Using $[X, P] = i\hbar$, find (a) $[X^2, P]$ (b) $[X, P^2]$ (c) $[X^2, P^2]$.
14. Obtain an expression for the expectation value of S_x for a spin half system using the concept of infinitesimal rotation.
15. Calculate the commutator between the x and y components of the orbital angular momentum operator.
16. Consider a system with total angular momentum $j = 1$. Evaluate the angular momentum operators j_x , j_y , and j_z .
17. What is meant by central potential? What are the relevant commutation relations and their physical meaning for operators for a particle placed in a central potential?
18. Discuss the connection between rotation in space and conservation of angular momentum.
19. Discuss spin of a quantum particle and statistics it obeys.

(4 × 3 = 12 Weightage)
