

QP CODE: 25050525



Reg No :

Name :

MSc DEGREE (CSS) EXAMINATION, DECEMBER 2025

First Semester

M Sc PHYSICS (MATERIAL SCIENCE)

Core Courses - PH020102 - BASIC QUANTUM MECHANICS

2019 Admission Onwards

A9AD6E62

Time: 3 Hours

Weightage: 30

Part A (Short Answer Questions)

*Answer any **eight** questions.*

Weight 1 each.

1. What is the postulate of positive definite metric?
2. What do you mean by an orthonormal set of vectors?
3. Prove that trace of operator X , $\text{tr}(X)$ is independent of any representation.
4. What do you mean by finite translation operator? Write down the equation.
5. When an observable is said to be a constant of motion?
6. What are unitary operators?
7. Show that the eigen values of Pauli's spin matrices are ± 1 .
8. Explain the first order wave function correction in a non degenerate stationary perturbation theory.
9. What is the first order energy correction in hydrogen molecule ion.
10. Give the connection formula for WKB approximation.

(8×1=8 weightage)

Part B (Short Essay/Problems)

*Answer any **six** questions.*

Weight 2 each.

11. Briefly explain Stern-Gerlach experiment.
12. Derive the transformation function which relates position and Momentum representations. Explain how the wave functions in position and Momentum representation are related.
13. Derive Schrodinger equation for time evolution operator and discuss the possible solutions.





14. Explain how the state kets and operators of schrodinger and Heisenberg pictures are related. Also comment on the concept of transition amplitude.
15. Show that rotation about same axis commute.
16. Obtain the Clebsch Gordon coefficients for a system having $j_1 = j_2 = \frac{3}{2}$
17. Describe the quadratic stark effect.
18. Discuss the Zeeman effect.

(6×2=12 weightage)

Part C (Essay Type Questions)

Answer any **two** questions.

Weight 5 each.

19. Obtain the momentum space wave function for Gaussian wave packet. Also prove that Gaussian wave packet is a minimum uncertainty wave packet.
20. Using creation- annihilation operators, obtain the energy eigen values and energy eigenkets of simple harmonic oscillator.
21. Briefly explain the matrix representation of angular momentum operators. Obtain the matrices of J^2 , J_x , J_y and J_z for $j = \frac{1}{2}$
22. Explain the transmission coefficient of a particle in a potential barrier using WKB approximation.

(2×5=10 weightage)

