



K25P 2020

Reg. No. :

Name :

**II Semester M.Sc. Degree (C.B.S.S. – Supplementary) Examination, April 2025
(2021 and 2022 Admissions)**

PHYSICS

PHY 2C06 : Quantum Mechanics – I

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer both the questions (Either **a** or **b**).

1. a) Discuss the first order time independent perturbation theory of non-degenerate stationary state. Obtain the corrected eigen functions and eigen value.

OR

- b) Derive the general uncertainty principle. Deduce the three basic uncertainty relations for canonically conjugate operators.

2. a) What is an operator ? Distinguish between Hermitian and Skew-Hermitian Operators. Show that the commutator of two Hermitian operators is anti-Hermitian.

OR

- b) Explain how spacetime symmetries lead to conservation laws taking linear momentum as an example. **(2×12=24)**

SECTION – B

Answer **any four** questions (**1** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**)

3. a) Define commutator of $\hat{A}$ and $\hat{H}$.

- b) Write the basic postulates of quantum mechanics.

- c) Distinguish between Schrodinger and Heisenberg pictures in quantum mechanics.

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4. a) Define Hilbert space.
b) Explain the properties of ket and bra space.
c) Prove that the expectation value of a Hermitian operator is real and that of an anti-Hermitian operator is imaginary.
5. a) What is a parity operator ?
b) Show that an observable is a constant of motion if the corresponding operator commutes with the Hamiltonian.
c) Show that rotational invariance of the Hamiltonian leads to the conservation of angular momentum.
6. a) What are Pauli matrices ?
b) Calculate $[L_x, L_y]$
c) Derive matrices of J^2 and J_z operators for upto $j = 1$.
7. a) What is expectation value of an observable ?
b) Explain general uncertainty principle.
c) Prove that zero-point energy of a harmonic oscillator is a consequence of uncertainty principle.
8. a) Define a commutator.
b) When do we say that an operator is Hermitian or anti-Hermitian.
c) Prove that two eigen vectors of a Hermitian operator belonging to different eigen values are orthogonal. (4×9=36)
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