Note: All questions are compulsory. Marks are indicated against each question in square brackets.

Q1. What is the physical significance of Ψ^2? What are the properties of a wave function Ψ? Write down the statement of Born rule and define probability density.

[3]

Q2. Write down the condition for an operator to be a Hermitian in a quantum state Ψ. Proof whether position x and momentum p are Hermitian or not. What is the value of the commutation [x,p]?

[3]

Q3. Can the magnitude of a wave function ($\Psi^*(x,t)\Psi(x,t)$) be a negative number? Explain. Can we measure both the position and momentum of a quantum particle with complete precision?

[3]

Q4. Write down the Schrodinger wave equation for a particle in an infinite square well potential,

$V(x) = -V_0;\ 0 \leq x \leq a$

$= 0\quad$; elsewhere

a being the width of the potential along x-direction. What will be the eigenvalues of the particle? Give a practical example of such potential well.

[3]

Q5. Write down the Hamiltonian for a quantum harmonics oscillator in ladder operator form (show the steps starting from the Schrodinger equation of a quantum harmonic oscillator). Define the number operator.

[3]