

**BS-2110**

**5223/NH**

Title of the Paper: **Quantum Mechanics-I**  
**SEM-III**

**Paper: C**

Time allowed: 3 hrs

Maximum Marks: 30

*Note: Candidates are required to attempt five questions in all, selecting two questions each from Section A & B and the compulsory question of Section C. All the questions of Section A & B carry 5 marks each whereas Section C carries 10 marks.*

**Section-A**

1. Derive the Schrödinger equation for a free particle in one dimension.
2. What is Hermitian operator? What do you mean by hermicity?
3. What do you understand by Uncertainty principle in quantum mechanics. Explain that it does not allow the presence of electrons in atomic nucleus.
4. State and prove Ehrenfest theorem.

**Section-B**

5. Consider a particle incident on a potential step of height  $V_0$  with energy  $E > V_0$ . Calculate coefficient of reflection and transmission.
6. Explain the physical significance of various quantum numbers involved in quantum theory of hydrogen atom.
7. Derive an expression for the energy of harmonic oscillator. What do you understand by zero energy?
8. Solve the radial part of the Schrödinger wave equation for hydrogen atom.

**Section-C**

**9. Attempt any five parts:**

- (i) Explain space quantization
- (ii) Can a photon have rest mass? Explain.
- (iii) What do you understand by normalization of wave function?
- (iv) What is the ground state energy of an electron that is confined to an one dimensional box of length  $1.5 \text{ \AA}$ .
- (v) Give two differences between classical and quantum mechanics.
- (vi) What do you understand by eigenvalues and eigen function.
- (vii) What is a degenerate state? Explain.