R

11463/NH

BS/2111

QUANTUM MECHANICS–III

Semester–III

Time Allowed : 3 Hours]   [Maximum Marks : 30

Note : The candidates are required to attempt **two** questions each from Sections A and B carrying 5 marks each and the entire Section C consisting of 5 short answer type questions carrying 2 marks each.

SECTION—A

1. Define the group velocity and particle velocity for a wave packet. Derive relation between them.   5

2. State and Prove Ehrenfest theorem.   5

3. Derive Time Independent Schrodinger equation starting from time dependent Schrodinger equation.   5

4. Define the Commutator. Show that position and linear momentum operators do not commutate. 5

SECTION—B

5. Differentiate between classical and quantum mechanical explanation for reflection and transmission through a potential barrier. Hence explain what is tunneling?   5

6. Obtain expression for energy levels and normalized wave functions for a particle in an infinite square potential well.   5

7. What is harmonic oscillator? Derive an expression for the energy of one dimensional harmonic oscillator.   5

8. Starting from Schrodinger equation for hydrogen atom in spherical polar coordinates obtain three independent equations in separate variables.   5

SECTION—C

9. Attempt any **five** questions of the following :

$$5 \times 2 = 10$$

(i) Define the term expectation value of any observable.

(ii) What is Born's Interpretation of wave function?

(iii) Normalize the wave function $\psi(x) = Ae^{ikx}$ over the region $-a \leq x \leq a$.

(iv) Show that if two Hermition operators commute, then their product is also a Hermition Operator.

(v) How does uncertainty principle prove the absence of electrons in atomic nuclei?

(vi) An electron and proton have same wavelength. Which of them will have more energy?

(vii) Define an operator and derive expression for energy operator.