IA – TEST – ODD SEMESTER – 2023-2024 SESSION

Dr. Priyanka Verma

Subject – Quantum Mechanics (Physics (H))-V Sem)

Max Marks 25

1. Explain a Hermitian operator with example. **2**

2. What is a wave packet. Discuss about the spread of a Gaussian Wave Packet for a free particle in 1D. **5**

3. A free particle of mass *m* is described by the wave-function $\psi(x) = A\exp(i\mu x)$ **where *A* and** μ **are constants. Determine the probability current density for this particle.** **4**

4. Derive time dependent Schrodinger wave equation in 1D. **4**

5. Find the Fourier transform for $\phi(k) = \begin{cases} A(a-|k|), & |k| \le a, \\ 0, & |k| > a \end{cases}$

Where a **is a positive parameter and *A* is a normalization factor to be found. Calculate the uncertainties** Δx and Δp **and check whether they satisfy the uncertainty principle.** **6**

6. Calculate the commutator $\left[\hat{L}_x, \hat{p}_x\right]$ **2**

7. Consider the state $\psi = \sqrt{\frac{1}{10}}\phi_1 + \sqrt{\frac{3}{5}}\phi_2 + \sqrt{\frac{3}{10}}\phi_3$ **where** ϕ_n **are orthonormal eigenstates of an operator** $\hat{A}$**.**

Find the expectation value of the operator $\hat{A}$ **in the state** ϕ**, if it satisfies the eigenvalue eqn** $\hat{A}\phi_n = (2n^2+1)\phi_n$**.** **2**

Date of Test : 13-10-2023

Time : 9 AM – 11 AM

Signature :