Jhargram Raj College
Internal Assessment 2022
5th SEM Physics (Honours)
Paper – C-11
Full Marks: 10

Answer any five Questions

1. Which one of the following is not physical wave function and why?

   (i) $3\cos\pi x$ (ii) $4-|x|$ (iii) $A\,exp(-x^2)$ (iv) $A\,exp(-\alpha|x|)$

2. Consider a one-dimensional particle which is confined within the region 0≤x≤a and whose wave function is $\psi(x,t)=sin(\frac{\pi x}{a})\,exp(-i\omega t)$. Find the potential V(x) and calculate the probability of finding the particle in the interval a/4≤x≤3a/4.

3. Find the state $\psi(x)$ for which $\hat{A}\psi(x)=0$ and normalize it.

   Where $\hat{A}=i(\hat{x}^2+1)\frac{d}{dx}+i\hat{x}$

4. Consider the operator $\hat{Q}=i\frac{d}{d\phi}$, where ϕ is the usual polar coordinate in two dimensions. Is $\hat{Q}$ hermitian? Find its eigen function and eigen values.

5. Show that the eigen vectors corresponding to distinct eigen values of a Hermitian operator are mutually orthogonal.

6. Show that the expectation value of momentum(P) is real.

7. A particle of mass m, which moves freely inside an infinite potential well of length a, is initially in the state $\psi(x,0)=\sqrt{\frac{3}{5a}}sin(\frac{3\pi x}{a})+\frac{1}{\sqrt{5a}}sin(\frac{5\pi x}{a})$.

   Find $\psi(x,t)$ at any later time t.

8. Prove that $\left[\widehat{H},\widehat{P_x^2}\right]=2i\hbar\frac{\partial V}{\partial x}\widehat{P_x}+\hbar^2\frac{\partial^2 V}{\partial x^2}$