M.Sc. DEGREE EXAMINATION,NOVEMBER 2019
I Year I Semester
Quantum Mechanics-I

Time : 3 Hours **Max.marks :75**

Section A $(10 \times 2 = 20)$ Marks

Answer any **TEN** questions

1. What are orthonormal wave functions?
2. The average period that elapses between the excitation of an atom and the time it radiates energy is 10^{-8} sec. Calculate the uncertainty in the energy of the emitted photon in this process.
3. Define probability current density
4. What are Ladder operators?
5. Write the orbital angular momentum components of an electron.
6. What are central forces?
7. Define Hilbert space
8. What is transformation matrix?
9. Differentiate between degenerate and non-degenerate levels
10. What is the validity of WKB approximation?
11. What you mean by particle exchange operator?
12. Define spin angular momentum of an electron.

Section B $(5 \times 5 = 25)$ Marks

Answer any **FIVE** questions

13. Explain the basic postulates of quantum mechanics.
14. Normalize (i) ψ_1(x) = A_1 e $^{-\alpha x}$ (ii) ψ_2(x) = A_2 x e $^{-\alpha x}$
15. Obtain the energy levels of an one dimensional square well potential.
16. Obtain the Schrodinger equation in momentum representation.
17. Explain the unitary transformation associated with translations and rotations.
18. Describe the simple harmonic oscillator problem using WKB approximation
19. Explain the Pauli spin matrices for electron.

Section C $(3 \times 10 = 30)$ Marks

Answer any **THREE** questions

20. State and prove Ehrenfest's theorem.
21. Separate the wave function of hydrogen atom and obtain the solution of radial equation and give its eigen values.
22. Obtain the equation of motion using Heisenberg and interaction pictures.
23. Discuss vibrational method and use it to obtain the ground state energy of helium atom
24. Explain Clebsch Gordan coefficients and calculate the Clebsch Gordan coefficients for $J_1 = 1$ and $J_2 = 1/2$

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