Sr.No.14101

Exam Code: 209002
Subject Code : 4885

M.Sc. Physics - 2nd Semester

(2721)

Paper : Phy-451 Quantum Mechanics-I

Time allowed: 2 hrs. **Max. Marks: 100**

Note: There are EIGHT questions of equal marks. Candidates are required to attempt any FOUR questions.

Section A

Q 1 (a) Explain Stern Gerlach experiment in detail. How did this experiment help demonstrate that the spatial orientation of angular momentum is quantized? (17)

(b) Prove that in a vector space F, the scalar product is antilinear with respect to the first vector. (8)

Q2 (a) Draw a comparison of a two level quantum system with polarization states of light. ($7\frac{1}{2}$)

(b) Define and discuss with one example for each of the following: ($3\frac{1}{2} \times 5 = 17\frac{1}{2}$)

- Complex linear vector space
- ket space
- bra space
- inner product
- operators and their properties

Section B

Q3 (a) Differentiate between Schrodinger and Heisenberg picture.

(b) Discuss about the different approaches to handle unitary operators, state kets and observables in Schrodinger and Heisenberg picture. ($12\frac{1}{2} \times 2 = 25$)

Q4 (a) State and prove Ehrenfest theorem. (15)

(b) Find the relation between operators in Schrodinger and Heisenberg picture. (10)

Contd....P/2

Section C

Q5 (a) Find $< n|x|k >$ for a one-dimensional harmonic oscillator.

(b) What ratio of E/V_o is necessary for scattering from a one dimensional step potential so that the transimission probability of the system is 50%. $(12\frac{1}{2} \times 2 = 25)$

Q6 (a) Find the eigen values and eigen vectors for a Potential step.

(b) Differentiate between bound and scattering states for a finite potential well. $(12\frac{1}{2} \times 2 = 25)$

Section D

Q7 (a) Find Eigen vectors and eigen functions for J^2 and J_z.

(b) What are Spherical Harmonics? Where are they used? $(12\frac{1}{2} \times 2 = 25)$

Q8 (a) Consider a quantum particle in spherically symmetric potential. Solve the Schrodinger equation for it. (12)

(b) Find $[Z, P_Z]$. $(6\frac{1}{2})$

(c) Using the commutation relations between **R** and **P**, find the commutation relation $[L_x, L_y]$. $(6\frac{1}{2})$

****