M.Sc. (Physics) (CBCS Pattern) Semester-II

PSCPHYT05 - Core Paper-V - Quantum Mechanics-I

P. Pages : 2 **GUG/S/25/11220**

Time : Three Hours * 1 2 8 9 * Max. Marks : 80

Either:

1. a) What is wave packet? How it represents analytically and diagrammatically prove that velocity of a particle and velocity of corresponding wave pocket are same. **8**

b) What are characteristic features of stationary states. **8**

OR

e) State postulates of operator formalism of quantum mechanics. **8**

f) State and prove Ehrenfest's theorem. Explain its importance. **8**

Either:

2. a) Derive matrices for representing state vectors and operators, in an orthonormal basis. **8**

b) State and prove Schwarz inequality. Show it leads to general uncertainty principle. **8**

OR

e) Define Hermitian Operator. **8**
Show that-
i) Eigen value of Hermitian operator are real.
ii) Eigen function belonging to different eigenvalue are orthogonal.

f) How will you express eigen value equation in matrix representation. **8**

Either:

3. a) Solve the eigen value equation of L^2. **8**

b) Derive the general solution for one dimensional Linear harmonic oscillator. **8**

OR

e) Discuss the parity of wave function. What is parity operator? What are its eigen values. **8**

f) A particle of mass 'm' is moving in a potential well: **8**

$V(x) = V_O$ for $x < -a$

$= O$ for $-a < x < a$

$= V_O$ for $x > a$

when energy of a particle is $E < V_O$; then show that there exists at least one bound state.

Either:

4. a) Find the eigen values of J^2 and J_z. **8**

b) Derive C.G. coefficients for $j_1 = ½, j_2 = 1$. **8**

OR

e) Show that- **8**

i) $[J_+, J_-] = 2\hbar Jz$.

ii) $\left[J_x^2, J_y^2\right] = \left[J_y^2, J_z^2\right] = \left[J_z^2, J_x^2\right]$

f) Solve the following- **8**

i) $\left[L_x^2, L_y\right]$ ii) $\left[L_y, L_z^2\right]$

5. Attempt all the followings-

a) Explain the quantum mechanical concept of 'expectation values? **4**

b) Discuss the Dirac's Bra-Ket Notations. **4**

c) Show that the component of angular momentum operator does not commutes among themselves. **4**

d) Prove that- **4**

i) $\left[\sigma_x, \sigma_y\right] = 2i\sigma_z$

ii) $\sigma_x, \sigma_y, \sigma_z = i$

****