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

DSC-1 - 02MSCPH1 - Paper-I - Fundamentals of Quantum Mechanics

P. Pages : 2 **GUG/S/25/15415**

Time : Three Hours * 3 0 6 4 * Max. Marks : 80

Either :

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

b) Derive the expression for time independent Schrodinger's equation. Explain its application. **8**

OR

e) Explain the concept of normalized and orthogonal wave functions with suitable example. **8**

f) Derive time dependent Schrodinger's equation. Is this equation relativistically invariant? Explain. **8**

Either :

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

b) How will you express eigen value equation in matrix representation? **8**

OR

e) Derive Schrodinger & Heisenberg equation of a motion. **8**

f) Define Dirac bra-ket notations. What is the relation between wave function and ket notation? **8**

Either :

3. a) Find the eigen values of J^2 and J_x. **8**

b) Explain the addition of two independent angular momenta J_1 and J_2. What is Clebsch Gordon coefficients. **8**

OR

e) Explain representation of angular momenta. Derive matrices for J_x, J_y, J_+ and J_- for J = 1. **8**

f) What are the Pauli spin matrices? **8**

Show that

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

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

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

Either :

4. 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) Solve the Schrodinger equation for 1D harmonic oscillator and find its energy. **8**

5. Attempt all the followings.

a) What is momentum eigen function? How will you normalize the momentum eigen function using Dirac-delta normalization method? **4**

b) Prove the eigen value of A & A' are same. **4**

c) Construct Green function for a free particle. **4**

d) Explain Hermitian operators and its properties. **4**

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