M.Sc.F.Y. (Physics)(with Credits)-Regular-Semester 2012 Sem II

0140 - Paper-I : Quantum Mechanics-I

P. Pages : 2 **GUG/S/18/5788**

Time : Three Hours * 1 8 0 8 * Max. Marks : 80

EITHER

1. a) Derive time independent Schrodinger equation. Is this equation relativistically invariant? Explain. **8**

b) Explain the physical interpretation of wave function & show that the wave function Ψ leads to continuity equation. **8**

OR

e) What is the importance of normalized wave function? How will you normalized a function $\Psi = a \exp \frac{i}{\hbar}(p, x)$ using Dirac Delta normalization. **6**

f) i) Derive Schrodinger equation in momentum representation. **6**

ii) Explain the quantum mechanical concept of expectation value. **4**

EITHER

2. a) State and explain uncertainty principle using operator < A >. **8**

b) State and prove Schwarz inequality. **8**

OR

e) How will you express wave function and eigen value in matrix mechanics. **8**

f) Outline Dirac's bra and Ket notation. **6**

g) Show that, in unitary transformation, the Hermitian nature of an operator are preserved. **2**

EITHER

3. a) Explain the role of L^2 operator in central force problem. **8**

b) Obtain expression for L^2 operator in spherical polar co-ordinates. **8**

OR

e) Obtain solution of Schrodinger equation for square well potential by operator method. **8**

f) Find the solution of radial equation for Hydrogen atom. **8**

EITHER

4. a) State the commutation relation obeyed by the components of angular momentum and express them in vector notation. **8**

b) What are Clebsch-Gordan coefficient? Explain their significance. **8**

OR

e) Consider J_1 and J_2 are two independent angular momenta, explain how they add together to obtain an angular momenta for the system. **10**

f) What are Pauli matrices? **6**
Show that

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

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

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

5. All questions are compulsory.

a) Give the inadequacy of classical mechanics. **4**

b) State fundamental commutative bracket. **4**

c) Explain step function & step barrier potential by boundary condition. **4**

d) **4**

i) Derive matrix for J_2 for $j = \frac{3}{2}$

ii) Prove that $\left[J_x, J_-\right] = \hbar J$

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