F.Y.M.Sc.(Physics) Second Semester Old 0140 - Quantum Mechanics-I Paper - I

P. Pages : 2 Time : Three Hours			Hours Hours GUG/W/18/2	GUG/W/18/2238 Max. Marks : 80			
 1.	Either:-						
	a)	Sta	te and prove Ehrenfest's theorem. Explain its importance.	8			
	b)	De: der	fine normalization condition? Derive the equation of continuity for probability current asity. What is the value of probability current density when the function is real.	8			
			OR				
	e)	Sta	te postulates of operator formalism of quantum mechanics.	8			
	f)	Der Exj	rive time dependent Schrodinger's equation. Is this equation relativistically invariant? plain.	8			
2.	Eith	Either:-					
	a)	State and prove Schwarz inequality. Show how it leads to general uncertainty principle.					
	b)	What is meant by unitary transformation? Derive equation of transformation from one orthonormal basis to another.					
			OR				
	e)	Wh i) ii)	hat are Hermitian operator? Show that Eigen values of Hermitian operator is real. Eigen function belonging to non-degenerate value are orthonormal.	8			
	f)	i)	If X and P _X are the coordinate and momentum operators, prove that $\begin{bmatrix} X, P_X^n \end{bmatrix} = ni\hbar P_X^{n-1}$.	8			
		ii)	Show that scalar product is invariant under unitary transformation.				
3.	Either:-						
	a)	Obtain expression for L^2 operator in spherical polar coordinates.					
	b)	Wh har	hat is parity operator? Define even and odd parity. Show that the parity of spherical monics $Y_{\ell,m}(\theta,\phi)$ is $(-1)^{\ell}$	8			
			OR				

8

f) A particle of mass 'm' is moving in a potential well: $V(x) = V_0$ for x < -a

$$= 0 \quad \text{for } -a < x < a$$

 $= V_{O}$ for x > a

When energy of a particle is $E < V_0$; then show that there exists at least one bound state.

4. Either:-

- a) Find the eigen values of J^2 and Jz
- b) Obtain Clebich Gordan co-efficient when two angular momenta jl = 1 and $j2 = \frac{1}{2}$

OR

- e) Find the eigen function of J^2 and Jz.
- f) What are the Pauli spin matrices? Show that
 - i) $[\sigma x, \sigma y] = 2 i \sigma z$
 - ii) $[\sigma y, \sigma z] = 2i \sigma x$
 - iii) $[\sigma z, \sigma x] = 2i \sigma y$

5. Answer all the followings.

a)	Explain the quantum mechanical concept of 'expectation values?	4
b)	Define Dirac's Bra and Ket notation. What is the relation between the wave function Ψ and corresponding Ket function.	4
c)	Discuss in detail the degeneracy of hydrogen atom energy levels.	4
d)	Derive matrices for the operators	4
	J^2 , J_z , J_x and J_y for $j = \frac{3}{2}$.	

8

8

8

8