GIET UNIVERSITY, GUNUPUR – 765022
M. Sc. (First Semester) Examinations, May – 2021
20PHPC104 – QUANTUM MECHANICS-I
(Physics)

Time: 2 hrs   Maximum: 50 Marks

(The figures in the right hand margin indicate marks.)

PART – A   **(2 x 10 = 20 Marks)**

Q.1. Answer *ALL* questions
   a. What is Hilbert space?
   b. State expansion theorem.
   c. List any four salient features of unitary transformations.
   d. Why creation and annihilation operators are known so?
   e. What do you understand by spin of an electron?
   f. What are raising and lowering operators?
   g. Write Pauli's spin matrices.
   h. Two electrons both are in d state. Determine the total orbital angular momenta.
   i. Show that operators having common set of Eigen functions commute.
   j. Show that the fundamental commutation relation $[x, p_x] = i\hbar$ remains unchanged under unitary transformation.

PART – B   **(6 x 5 = 30 Marks)**

Answer *ANY FIVE* questions   Marks

2. Discuss the Schmidt Orthogonalization procedure for systems having two fold degeneracy.   (6)

3. The base vectors of a representation are $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 0 \\ 1 \end{pmatrix}$. Construct a transformation matrix   (6)

    U for transformation to another representation having base vectors $\begin{pmatrix} 1/\sqrt{2} \\ 1/\sqrt{2} \end{pmatrix}$

    and $\begin{pmatrix} -1/\sqrt{2} \\ 1/\sqrt{2} \end{pmatrix}$.

4. Express the operators for angular momentum components L_x, L_y, and L_z in spherical polar coordinates.   (6)

5. Obtain the angular momentum matrices for J_+, J_-, J_x, Jy for j=$^1/_2$ (6)

6. Conservation of angular momentum is a consequence of the rotational invariance of the system. Substantiate.   (6)

7. What are linear operators? Explain their properties.   (6)

8. For a spin half system, state the matrices for S_x, S_y, and S_z. List their eigenvalues with the corresponding eigenvectors.   (6)

--- End of Paper ---