GIET UNIVERSITY, GUNUPUR – 765022

RD19MSC034

Roll No: | | | | | | |

Total Number of Pages : 1 AR-19 M.SC

M.Sc 1ST SEMESTER REGULAR EXAMINATIONS, NOV/DEC 2019-20

PHPC104-QUANTUM MECHANICS-I

Time: 3 Hours Max Marks: 80

The figures in the right hand margin indicate marks

SECTION A

Q.1 Answer any four of the following: [4 X4 =16]

a Define a Hermitian operator. Show that the eigenvalues of a Hermitian operator are real.

b Distinguish between coordinate and momentum representations.

c Outline Dirac's bra and ket notation.

d Evaluate the commutator $[L_x, L_y]$ in the momentum representation.

e Write a short note on unitary transformation of basis vectors.

f Outline Schmidt orthogonalization procedure for a doubly degenerate system.

OR

2. Answer all questions from the following [2 x 8 =16]

a What is Hilbert space?

b With examples explain linear operator.

c What are creation and annihilation operators? How do they define number operator?

d What is the SI unit of $\Psi(x,t)$?

e Write the matrix form of σ_x and σ_z.

f What are lowering and raising operators?

g Why does the wavefunction $\Psi(x,t)$ have no direct physical significance?

h What is orthonormal condition?

SECTION-B

3. Answer all Questions: [16 x4 =64]

a Obtain the energy eigenvalues and eigenfunctions for a linear harmonic oscillator using operator method.

OR

b A harmonic oscillator moves in a potential $V(x) = 0.5kx^2 + cx$, where 'c' is a constant. Find the energy eigenvalues.

4.

a Describe in brief the three different pictures of representation of quantum mechanics bringing out the essential differences between them.

OR

b Describe a time-evaluation operator and discuss its importance.

5.

a Obtain the Clebsh-Gordan coefficients for a system having $j_1 = 1$ and $j_2 = 1/2$

OR

b Derive matrices for the operators J^2, J_z, J_x and J_y for $j= 3/2$

6.

a For a spin - 1/2 system, state matrices for S_x, S_y and S_z . List their eigenvalues with the corresponding eigenvectors.

OR

b Define the uncertainty (Δ A) in the measurement of a dynamical variable. Derive the generalized uncertainty relation.