Or

(*b*) Obtain the eigen values and eigen functions of L_z and L^2 and discuss the matrix representation of L_x and L_y.

6. (*a*) Define Pauli spin matrices and explain their properties. Obtain the eigen functions and eigen values of spin $\frac{1}{2}$ particles.

Or

(*b*) Discuss the conditions required for the addition of angular momenta and obtain the C. G. coefficients for the states with $J_1 = J_2 = \frac{1}{2}$ and $J_1 = 1, J_2 = \frac{1}{2}$.

M.Sc.—Phy-IS (104)

2019

(January)

Time : 3 hours

Full Marks : 80

Answer from **both** the Sections as per direction

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(QUANTUM MECHANICS)

SECTION – A

1. Answer any *four* of the following : 4 × 4

(*a*) Explain the Dirac's bra and ket notations in linear vector space.

(*b*) Discuss the expansion theorem.

(*c*) What are creation and annihilation operators ? Explain.

(*d*) Explain the matrix representation of L_x and L_y.

(*e*) Obtain the eigen values of J_x and J^2.

(*f*) Explain the closer properties of the basis set.

Or

2. Answer *all* questions from the following : 2 × 8

(*a*) Define Linear Vector space in quantum mechanics.

(*b*) What do you mean by degeneracy ?

(*c*) Define basis vector.

(*d*) Explain the properties of creation operator.

(*e*) Define Heisenberg picture.

(*f*) Define orbital angular momentum.

(*g*) What is spin ? Explain.

(*h*) Give the properties of C. G. coefficients.

SECTION – B

Answer **all** questions : 16 × 4

3. (*a*) Write about linear, adjoint and unitary operators and discuss the orthonormality of eigen vectors.

Or

(*b*) Explain the representations of ket and bra vectors and operators in matrix form and discuss the unitary transformation of operators.

4. (*a*) Define interaction picture and obtain the equation of motion in interaction picture.

Or

(*b*) Using operator method solve the Schrödinger equation for a harmonic oscillator. Give the matrix representation of creation operator.

5. (*a*) Define orbital angular momentum operator and explain its properties. Show that L^2 commutes with L_z. Obtain the commutation relations for L_x, L_y, L_z and L^2.