K17P 0610

Reg. No. : BGPSPH1609

Name : Sreya K

**Second Semester M.Sc. Degree (Regular/Supplementary/Improvement) Examination, March 2017**

**PHYSICS**

**(2014 Admission Onwards)**

**PHY2C06 : Quantum Mechanics – I**

Time : 3 Hours Max. Marks : 60

SECTION – A

Answer both questions (Either **a** or **b**) **Each** questions carries **12** marks :

1. a) Discuss the problem of similarity transformation. Prove that the matrix representing a similarity transformation in a unitary matrix. Show that a Hermitian operator remains Hermitian under a unitary transformation.

OR

b) Distinguish between Heisenberg and Schrodinger pictures. Show that the state vectors and operators are the same in both the pictures at t= 0.

2. a) What are Glebsh-Gordon coefficients ? Obtain the recursion relations and hence compute the Glebsh-Gordon coefficients.

OR

b) Discuss the first order time independent perturbation theory for non degenerate stationary state. Obtain the corrected eigen functions and eigen value.

**(2×12=24)**

SECTION – B

Answer **any four**. **Each** question carries **9** marks :

**1** mark for Part – **a**, **3** marks for Part – **b**, **5** marks for Part – **c** :

1. a) Outline Dirac's bra and ket rotation.

b) Explain the properties of ket and bra space.

c) Prove that the two eigen vectors of a Hermitian operator belonging to different eigen values are orthogonal.

P.T.O.

2. a) What is a Hermitian operator ?
   b) Show that the eigen values of a Hermitian operator are real.
   c) Evaluate the commuters
      a) $[d/dx, d^2/dx^2]$
      b) $[d/dx, F(x)]$.

3. a) Outline the interaction picture.
   b) Obtain the equation of motion for the state vector in the interaction picture.
   c) Derive the equation of motion for operator in the interaction picture.

4. a) Define a general angular momentum operator.
   b) Explain why the definition of angular momentum given by $\bar{L} = \bar{r} \times \bar{p}$ is not a general one.
   c) Derive expressions for L+, L– and $L^2$ in spherical polar coordinates.

5. a) What is symmetry transformation ?
   b) Prove that a symmetry transformation conserves probabilities.
   c) Prove that the parity operator is Hermitian and unitary.

6. a) Give the principle of time independent perturbation theory.
   b) Determine the first order correction to wave function.
   c) Calculate the ground state energy of an anharmonic oscillator up to the first order. Whose potential energy is

$$V = \frac{1}{2} mw^2 x^2 + ax^3$$

Where $ax^3 << \frac{1}{2} mw^2 x^2$.

(4×9=36)

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