2012
M.Sc. (Physics)
First Semester
PHY-8013: Quantum Mechanics – 1

Time allowed: 3 Hours   Max. Marks: 80

*NOTE: Attempt **five** questions in all, including Question No. 9 (Unit-V) which is compulsory and selecting one question each from Unit I - IV.*

x-x-x

Unit –I

1. (a) Given a linearly independent set of vectors, construct an orthonormal set out of them   (8)

   (b) Explain Gram-Schmidt orthogonalization procedure   (8)

2. (a) Using Dirac operator method, solve one dimensional quantum simple harmonic oscillator for its eigenvalues   (8)

   (b) State and prove Schwarz Inequality   (8)

Unit -II

3. (a) Obtain the matrix representation for J_z for $J = \frac{1}{2}$ (8)

   (b) Find the eigenvalues of L^2 operator   (8)

4. (a) Calculate C.G. coefficients for $J_1 = 1$, $J_2 = \frac{1}{2}$ (8)

   (b) For $J_1 = \frac{1}{2}$ and $J_2 = 1$, find all possible values of $J_1.J_2$ (8)

Unit -III

5. (a) Write a note on variational principle.   (8)

   (b) Obtain the first order correction to the energy for non degenerate case in time independent perturbation theory   (8)

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6. (a) Explain stark effect and show that there is no stark effect for ground state of an atom. (8)

(b) Explain degenerate perturbation theory (8)

Unit -IV

7. (a) Explain Fermi golden rule. (8)

(b) Discuss the concept of absorption, induced emission and spontaneous emission of radiation using Einstein's coefficients. (8)

8. (a) Discuss briefly the time dependent perturbation theory and obtain the general expression for probability transition from one state to another under harmonic time dependent perturbation. (10)

(b) Explain the selection rules for emission and absorption of light. (6)

Unit -V

9. (a) What are the properties of linear vector space. (3)

(b) What is Zeeman effect. (3)

(c) Write properties of projection operator. (3)

(d) Define Hilbert space. (2)

(e) What is Hermitian operator? Give its relevance. (3)

(f) Find the value of $\frac{1}{2}(L_-L_+ + L_-L_+)$ (2)

x-x-x