(Pages:2)

Name ....

Reg.No..................................

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, JULY 2016

(CUCSS - PG)

(Physics)

CC 15P PHY2 C05 - QUANTUM MECHANICS - I

(2015 Admissions)

Time : Three Hours Maximum : 36 Weightage

Section A

Answer all questions

Each question has weightage of 1.

1. Compare Commutator brackets and Poisson brackets.
2. Write down the Hamiltonian for L.H.O., in momentum representation.
3. Plot the wavefunction of L.H.O., for the first four cases.
4. What are spherical harmonics.
5. What is the choice of phase, during angular momentum addition.
6. Give the algebra obeyed by Pauly spin matrices.
7. Introduce the concept of spin angular momentum as a postulate in Quantum Mechanics.
8. Discuss the orthogonality property of C.G. - Coefficients.
9. Show that two identical fermions cannot occupy a single state.
10. Discuss the symmetry under time reversal.
11. Define differential and total scattering cross section.
12. What are partial waves.

($12 \times 1 = 12$ weightage)

Section B

Answer any two question
Each question has weightage of 6.

13. Solve the Hydrogen atom problem. Obtain the eigen functions and eigen values.
14. Obtain the eigen values of the angular momentum operators J^2 and J_z. Work out their matrix representations.
15. How symmetry leads to conservation laws. Discuss various consevation laws and obtain the operators in each case.
16. What is Born approximation. Obtain an expression for the scattering cross-section for a beam scattered by a rigid sphere.

($2 \times 6 = 12$ weightage)

Section C

Answer any four questions
Each question has weightage of 3.

17. Obtain the zero point energy of a linear harmonic oscillator, using uncertainty principle.
18. Show that Slater determinant leads to Pauly's exclusion principle.
19. For L.H.O. ladder operators $\hat{a}$ and $\hat{a}^\dagger$ show that $[\hat{a}, \hat{a}^\dagger] = 1$
20. Evaluate the C-G coefficient involved in angular momentum coupling of two spin half particles.
21. Establish the following commutation relations for the components of angular and linear momenta:

$$[L_i, p_j] = i\hbar\epsilon_{ijk}p_k$$

Hence show that $[L, p] = 0$

22. In the Born approximation, calculate the scattering amplitude for scattering from the square well potential $V(r) = -V_0$ for $0 < r < r_0$ and $V(r) = 0$ for $r > r_0$

($4 \times 3 = 12$ weightage)

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