17P209 (Pages: 2) Name………………....…..

Reg. No……………....…..

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, MAY-2018

(Supplementary/Improvement)

(CUCSS - PG)

CC15P PHY2 C05 - QUANTUM MECHANICS - I

(Physics)

(2015, 2016 Admission)

Time : Three Hours Maximum : 36 Weightage

Section A

*Answer **all** questions. Each question carries 1 weightage.*

(1) What is meant by a linear operator?

(2) Show that $(\hat{A}\hat{B})^\dagger = \hat{B}^\dagger \hat{A}^\dagger$

(3) Show that the sum of two projection operators cannot be a projection operator unless their product is zero.

(4) Distinguish between density operator and projection operator.

(5) For ThA Density Operator ρ Aorа Aure State, Show that $tr(\rho2)$= tr (ρ) = 1

(6) Obtain ThA closure Relation $\sum|a_i\rangle\langle a_i| = \hat{1}$

(7) What is the use of Clebsch-Gorden coefficients?

(8) Show that two identical fermions cannot occupy a single state.

(9) Compare partial wave analysis and Born approximation for obtaining scattering cross section.

(10) Show that Parity and translation in space are commuting operators.

(11) Show that linear momentum is the generator for translation symmetry.

(12) Obtain tAe expression for tAme rAversal symmetry operator as fAnction oA Pauli spin Aatrix σ_y.

(12 × 1 = 12 Weightage)

Section B

*Answer any **two** questions. Each question carries 6 weightage.*

(13) For two operators $\hat{A}$ and $\hat{B}$ satisfying $[\hat{A},\hat{B}] = i\hat{C}$, show that $\Delta\hat{A}\Delta\hat{B} \geq \hat{C}$.

(14) Obtain Eherenfests theorem in different pictures of quantum mechanics.

(15) Obtain the matrix elements of the operators J^2, and J_z.

(16) By using Born approximation, obtain Rutherford scattering formula.

(2 × 6 = 12 Weightage)

Section C

*Answer any **four** questions. Each question* carries 3 *weightage*.

(17) Show that eigenvalues of a Hermitian operator are real and the eigen vectors corresponding to different eigen values are orthogonal.

(18) Obtain zero point energy of a harmonic oscillator by using uncertainty principle.

(19) Show that $\left(\vec{\sigma} \times \vec{\sigma}\right) = 2i\vec{\sigma}$. Does this result is contradictory to the corresponding result for cartesian vectors.

(20) Show that $\left(\vec{\sigma} \cdot \mathbf{a}\right)\left(\vec{\sigma} \cdot \mathbf{b}\right) = \mathbf{a} \cdot \mathbf{b} + i\vec{\sigma} \cdot (\mathbf{a} \times \mathbf{b})$

(21) By using partial wave analysis, obtain the expression for scattering cross section when the size of the scattering center is greater than the wave length of the incident particle. Compare the result with classical scattering cross section.

(22) Obtain the relation between scattering cross section and scattering amplitude.

(4 × 3 = 12 Weightage)

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