17P210 (Pages: 2) Name…….

Reg. No……..

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, MAY 2018

(CUCSS - PG)

(Physics)

CC17P PHY2 C05 - QUANTUM MECHANICS - I

(2017 Admission: Regular)

Time: Three Hours Maximum: 36 Weightage

Section A

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

1. Write a note on classical view of particle wave duality.
2. Explain the importance of commutation bracket in quantum mechanics.
3. Define linear vector space. How is it related to Hilbert's space?
4. What is Parity operator? Explain its properties.
5. Write and explain Ehrenfest theorem.
6. Write the equations of motion in interaction picture.
7. Define eigen values and eigen functions.
8. Distinguish between symmetric and antisymmetric wave functions.
9. Briefly explain the relation between angular momentum and rotation.
10. What is normal Zeeman effect? Write the expression for frequency shift in Zeeman effect.
11. Explain the difference between the Born approximation and partial wave methods in scattering.
12. Explain the optical theorem. Why the theorem is called so?

(12 x 1 = 12 Weightage)

Section B

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

13. Explain the fundamental postulates appropriate to Hilbert's space formalism of quantum mechanics
14. What are spherical harmonics? Derive expression for normalized spherical harmonics and explain the properties of spherical harmonics.
15. Explain different pictures in quantum mechanics. Using the Schrodinger picture obtain the eigen values and eigen functions of a linear harmonic oscillator.
16. Define scattering amplitude and scattering cross section. How they are related? Using partial wave analysis derive the expression for scattering cross section.

(2 x 6 = 12 Weightage)

Section C

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

17. Find the canonical commutator $[A,B]$ of $A = i(xp_y - yp_x)$ and $B = (yp_z + zp_y)$.

18. Let $|0\rangle$ and $|1\rangle$ denote the normalized eigen states corresponding to the ground and first exited states of a one dimensional harmonic oscillator then find the uncertainty ΔX in the state $\psi \frac{1}{\sqrt{2}}(|0\rangle + |1\rangle)$

19. The Hamiltonian of an electron in a constant magnetic field is given by $H = \mu\vec{\sigma}\cdot\vec{B}$ where μ is a positive constant, $\vec{\sigma} = (\sigma_1, \sigma_2, \sigma_3)$ denotes the Pauli's spin metrics and $\vec{B} = \hat{n}B$ is the magnetic field. Let $\omega = \frac{\mu\vec{B}}{\hbar}$ and I be the 2X2 unit matrix then show that the operator $e^{iHt/\hbar} = I\cos\omega t + i\sigma\cdot\hat{n}\sin\omega t$

20. Discuss the symmetry under space inversion

21. Find the angular momentum metrics for J=1/2, Discuss the properties of Pauli's spin matrices.

22. Find the scattering amplitude $f(\theta)$ for the potential $V(r) = \beta e^{-\mu r}$ where β and μ are positive constants.

(4 x 3 = 12 Weightage)

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