20P207 (Pages: 2) Name: …….

Reg. No: ...……..

SECOND SEMESTER M.Sc. DEGREE EXAMINATION, APRIL 2021

(CUCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY2 C05 - QUANTUM MECHANICS I

(Physics)

(2019 Admission onwards)

Time: Three Hours Maximum: 30 Weightage

Section A

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

1. Explain Stern Gerlach experiment and their analog with polarization of Light.
2. What is meant by expectation value of an operator?
3. Establish the connection between spin and statistics of particles
4. What are compatible and incompatible observables? Discuss with example
5. What are identical particles? Explain in distinguishability principle
6. In a triplet state of 2 electron system, the spins are said to be parallel S.T they are actually at an angle of about 70^o to each other?
7. Explain Ehrenfest's theorem?
8. What is the action of parity operation? Is this a conserved quantity? Explain.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. State and explain the general uncertainty relation. Discuss its relevance with respect to Gaussian Wave packet
10. What is the relation between symmetries of systems and conservation Laws? How the translation and rotation in space is connected to conservation of Linear momentum and angular momentum.
11. Explain the Eigen values and Eigen Vectors of Angular momentum Operators J^2 and J_Z?
12. What are the different pictures in Quantum Mechanics? Apply Schrödinger picture to study L.H.O?

(2 × 5 = 10 Weightage)

Section C

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

13. Consider the $|\varphi\rangle=\frac{1}{\sqrt{2}}|\emptyset_1\rangle+\frac{1}{\sqrt{5}}|\emptyset_2\rangle+\frac{1}{\sqrt{10}}|\emptyset_3\rangle$. An operator B acting on it such that $B\,|\emptyset_n\rangle = n^2|\emptyset_n\rangle$. Find expectation value of B.
14. How the position and momentum representations are related. Express the position operator in momentum representation
15. The state of a spin ½ particle is given by $|\varphi\rangle=\begin{pmatrix}\sqrt{3/2}\\ \frac{1}{2}\end{pmatrix}$.what is the probability to find it in spin up and spin down states.
16. Find the C.G coefficient for $j_1=1/2$ and $j_2=1/2$
17. Find the wave functions and corresponding energy Eigen values of Isotropic Harmonic Oscillator.
18. Determine [a,a†],[N,a], [N,a†]
19. The Hamiltonian of a system is given by $H=\frac{p^2}{2m}+mgz$.

    Calculate $\frac{d}{dt}<x>,\frac{d}{dt}<Px>,\frac{d}{dt}<H>$

(4 × 3 = 12 Weightage)

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