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° to each other?
- 7. Explain Ehrenfest's theorem?
- 8. What is the action of parity operation? Is this a conserved quantity? Explain.

 $(8 \times 1 = 8 \text{ Weightage})$

Section B

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

- 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?

 $(2 \times 5 = 10 \text{ Weightage})$

Section C

Answer any four questions. Each question carries 3 weightage.

- 13. Consider the $|\phi\rangle = \frac{1}{\sqrt{2}} |\emptyset_1\rangle + \frac{1}{\sqrt{5}} |\emptyset_2\rangle + \frac{1}{\sqrt{10}} |\emptyset_3\rangle$. 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 $|\phi\rangle = \begin{pmatrix} \sqrt{3/2} \\ \frac{1}{2} \end{pmatrix}$ 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
$$\frac{d}{dt} < x >, \frac{d}{dt} < Px >, \frac{d}{dt} < H >$$

 $(4 \times 3 = 12 \text{ Weightage})$
