20

526579

) 102183 (Pages : 2) Name.....

Reg. No.....

# SECOND SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, APRIL 2024

(CBCSS)

Physics

PHY 2C 05—QUANTUM MECHANICS—I

(2019 Admission onwards)

ime : Three Hours Maximum : 30 Weightage

## Section A

*8 Short questions answerable within 7.5 minutes.*
*Answer* **all** *questions, each question carries 1 weightage.*

1. Define Unitary operators. What is the importance of unitary operators ?
2. What are projection operators ?
3. How can you differentiate between a symmetric wave functions and antisymmetric wave functions ?
4. Calculate the commutator $\left[J_z^2, J_y\right]$.
5. Discuss the Pauli Exclusion Principle.
6. Explain the properties of Hilbert Space.
7. What is the principle of indistinguishability of identical particles.
8. Explain the important features of Schrödinger picture and Heisenberg picture.

(8 × 1 = 8 weightage)

Turn over

## Section B

*4 essay questions answerable within 30 minutes.*

*Answer any* **two** *questions, each question carries 5 weightage.*

9. Derive the generalized uncertainty relation. Deduce the three basic uncertainty re canonically conjugate operators

10. Explain the Sequential Stern-Gerlach experiment and describe experimental conclu lead to the fundamentals of quantum mechanics.

11. What are Clebsch-Gordan co-efficients ? Deduce recursion relations for Clebsch-Gordan c

12. Describe Schrödinger equation for central potentials and hence describe Hydrogen at

$(2 \times 5 = 10$

## Section C

*7 problems answerable within 15 minutes.*

*Answer any* **four** *questions, each question carries 3 weightage.*

13. What is time evolution operator ? Obtain the Schrödinger equation for the time evolu

14. Explain the Interaction picture. Obtain the equation of motion.

15. How do you represent position operator in momentum basis and the momentum operator basis.

16. Evaluate the $x$-$p$ uncertainty product $\left\langle (\Delta x)^2 \right\rangle \left\langle (\Delta p)^2 \right\rangle$ for a one-dimensional partic between two rigid walls,

$$V = \begin{cases} 0 \text{ for } 0 < x < a \\ \infty \text{ otherwise} \end{cases}.$$

17. Show that the law of conservation of angular momentum is a consequence of the rotational of the system.

18. For Pauli's matrices, prove that $\left[\sigma_x, \sigma_y\right] = 2i\sigma_z$.

19. State and prove the Jacobi identity.

$(4 \times 3 = 12$