C 82892

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Name.....

Reg. No.....

SECOND SEMESTER M.A./M.Sc./M.Com. DEGREE EXAMINATION JUNE 2020

(CUCSS)

Physics

PHY 2C 05—QUANTUM MECHANICS—I

(2017 Admissions)

Time : Three Hours

Maximum : 36 Weightage

Section A

Total 12 *questions each answerable within* 5 *minutes.*

Answer **all** *questions, each carries weightage* 1.

1. What is square integrable wave function ? Explain its relevance in quantum mechanics.
2. What is unitary operator ? Comment on the eigen values and eigen vectors of unitary operator.
3. Give the superposition principle to represent the state of a system.
4. Define Poisson Bracket. What are its properties ?
5. What are the properties of spherical harmonics ?
6. Give the three Pauli spin matrices.
7. Find the time evolution of state vector in interaction picture.
8. What is slater determinant ? What does it physically represent ?
9. What is isotropic Harmonic oscillator ? Give the degeneracy for its n^{th} excited state.
10. Show that the Hamiltonian is the generator of infinitesimal time translations.
11. What is optical theorem ? What does it imply ?
12. What is scattering amplitude and differential cross-section ? How are they related ?

(12 × 1 = 12 weightage)

Section B

4 *Essay questions, each answerable within* 30 *minutes.*

Answer any **two** *questions, each carries weightage* 6.

13. Discuss position and momentum representations. Establish Parseval's theorem.
14. State and prove Ehrenfest Theorem. How is it related to Hamilton Jacobi equations ?

Turn over

15. Discuss eigen functions and eigen values of L_z and L^2.

16. Discuss First order Born approximation method for scattering. Illustrate it for coulomb potential.

(2 × 6 = 12 weightage)

Section C

6 Problem questions, each answerable within 15 minutes.
Answer any **four** *questions, each carries weightage 3.*

17. Derive uncertainty product of two operators and hence derive Heisenberg's uncertainty relations.

18. Consider a particle of mass m confined to move inside an infinitely deep potential Well defined by :

$$\begin{aligned} V(x) &= +\infty \quad x < 0 \\ &= 0 \quad 0 \le x \le a \\ &= +\infty \quad x > a. \end{aligned}$$

Show that energy is quantised. Also find the generalized solutions of time independent Schrödinger equations.

19. Compute the Clebsch Gordan coefficients for two spin ½ particles.

20. Find the wave functions of systems of identical, non-interacting particles for a system of two spin ½ particles.

21. Write the time dependent Schrödinger equation for Hydrogen atom. Discuss the quantization of energy.

22. Calculate the total cross-section in the low-energy limit for scattering of a particle from a hard sphere potential.

(4 × 3 = 12 weightage)