

19. Write notes on spin angular momentum. Discuss about spin $\frac{1}{2}$ and spin 1 particles and arrive at their matrices.
20. Derive Klein Gordon relativistic wave equation of a free particle and obtain the equation of continuity.
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S.No. 3234

P 16 PY 22

(For candidates admitted from 2016-2017 onwards)

M.Sc. DEGREE EXAMINATION, NOVEMBER 2022.

Physics

QUANTUM MECHANICS

Time : Three hours

Maximum : 75 marks

SECTION A — (10 × 2 = 20)

Answer ALL questions.

1. State Heisenberg uncertainty principle.
2. What are the situations that represent the variation of $\langle A \rangle$ with time?
3. Define quantum mechanical tunnelling.
4. What do you mean by spherically symmetric potential.
5. Why there is no Stark effect in the ground state of an atom?
6. What is the application of harmonic perturbation?
7. Explain phase shift in scattering theory.

8. Write down Pauli's spin matrices.
9. What is the relativistic equation used for treating spin $\frac{1}{2}$ particles?
10. Why the dimension of Dirac matrices is restricted to be an even number?

SECTION B — ($5 \times 5 = 25$)

Answer ALL questions, choosing either (a) or (b)

11. (a) What are Hermitian operators? Show that Hermitian operators have real eigen values.

Or

- (b) Write about the physical interpretation of a wave function.

12. (a) Set up the Schrodinger equation for a rigid rotator.

Or

- (b) Explain the operator method of solving the linear harmonic oscillator problem.

13. (a) Write in detail about the first order time independent perturbation theory for non degenerate case.

Or

- (b) State the principle and deduce the expression of WK B approximation.

14. (a) Discuss the theory of scattering using Born approximation.

Or

- (b) List and prove some commutation relations of angular momentum.

15. (a) Obtain the plane wave solution of Dirac's equation Explain their significance.

Or

- (b) Show that σ does not commute with the Dirac Hamiltonian but $\sigma \cdot p$ commutes with the Dirac Hamiltonian.

SECTION C — ($3 \times 10 = 30$)

Answer any THREE questions.

16. Show that probability current density J together with probability density $P = \Psi^* \Psi$ satisfies the equation of continuity.
17. Solve the radial part of the Schrodinger equation for Hydrogen atom problem.
18. Obtain an expression for transition probability per unit time for first order transition under constant perturbation.