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Reg. No. | | | | | | | | |

II Semester M.Sc. Degree Examination, November - 2022

PHYSICS

Quantum Mechanics - II

(CBCS -Repeaters Scheme)

Paper : P-203

Time : 3 Hours **Maximum Marks : 70**

Instructions To Candidates :

All Parts are Compulsory.

PART - A

Answer any Four of the following: **(4×5=20)**

1. State and prove variational principle.
2. Explain Zeeman Effect using the perturbation theory.
3. Show that the differential scattering cross section can be expressed as the square of the scattering amplitude.
4. Show that the linear momentum operator is the generator of infinitesimal linear transformations.
5. Show that time reversal operator is antilinear.
6. Write a note on Negative energy states of a free particle in Dirac's theory.

PART - B

Answer any Four of the following: **(4×10=40)**

7. Discuss the time-independent perturbation theory and obtain the expression for first order correction to energy of a non-degenerate system.
8. Discuss the time dependent perturbation theory with a constant perturbation. Deduce the Fermi's Golden rule.
9. Adopting the method of partial waves, obtain an expression for scattering cross section in terms of scattering angle and phase shift.

|P.T.O.

10. a) Explain the symmetry transformations in quantum mechanics.

    b) Discuss the classification of particles based on the eigenvalues of the permutation operator. (5+5)

11. Set up Klein-Gordon relativistic wave equation of a free particle. Discuss in detail, the difficulties present in its interpretation.

12. Show that the orbital angular momentum, L of a Dirac particle is not a constant of motion. Describe how the addition of appropriate spin operation makes the sum J=L+S, a constant of motion.

PART - C

Answer any Two of the following: (2×5=10)

13. Calculate the first order perturbation correction to the energy of a harmonic oscillator with a perturbation $V=\frac{1}{2} b x^2$ ('b' is a constant).

14. Using the I Born approximation, evaluate the differential scattering cross section and arrive at Rutherford's scattering formula, for scattering by a screened coulomb potential, $v(r)=\frac{-Z_1 Z_2 e^2}{r}\exp(-ar)$ where α is a screening constant Given $\int_0^\infty \sin(qx)e^{-ax}dx=\frac{q}{q^2+a^2}$

15. Show that the helium atom in its ground state can exist only in singlet state.

16. Prove that the operator cα, where α stands for Dirac matrix, can be interpreted as the velocity operator.