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**DHANALAKSHMI SRINIVASAN COLLEGE
OF ARTS & SCIENCE FOR WOMEN
(AUTONOMOUS)**



(For Candidates admitted from 2020-2021 onwards)

PG DEGREE EXAMINATIONS APRIL – 2021

M.SC - PHYSICS

QUANTUM MECHANICS

Time: 3 Hrs

Max.Marks: 75

PART – A

CHOOSE THE CORRECT ANSWER

(10×1=10)

- For the Schrodinger equation for a free particle in the equation
 a) $V=0$ b) $V \neq 0$ c) $V < 0$ d) None of these
- The expectation value of any quantity $f(r)$ which depends upon position, for normalized function may be written as
 a) $\langle f(r) \rangle = \int \Psi^* (t) \Psi (t) dt$ b) $\langle f(r) \rangle = \int \Psi (r,t) f(r) \Psi^* (r,t) dt$
 c) $\langle f(r) \rangle = \int \Psi^* (r,t) f(r) \Psi (r,t) dt$ d) None of these.
- In case of a potential step, the potential function under goes only
 a) Continuous change b) One discontinuous change
 c) Continuous and discontinuous change d) None of these
- The particle's penetration of potential barrier is called
 a) Transmission co-efficient b) Tunnel effect c) Reflected wave d) Transmitted wave
- The splitting of energy level due to an external electric field along the Z direction is
 a) Zeeman effect b) Degenerate levels
 c) Stark effect d) Non-degenerate levels
- The Hamiltonian of the.....oscillator is $H = H_0 + \lambda H^1$
 a) Perturbed b) Unperturbed c) Harmonic d) Anharmonic
- If ρ is the number of me particles per unit volume in the incident beam and v is the velocity of the incident particles, then
 a) $\rho = v J$ b) $J = \rho v$ c) $\rho = J v$ d) None of these
- Green's function is a solution of theproblem for a source of unit strength at the point r' .
 a) Scattering b) Reflection c) Refraction d) Transmission

9. Eigen values of the Dirac matrices must be
 a) +1 b) 0 c) ± 1 d) -1
10. Energy gap isbetween the positive and negative energy states
 a) mc^2 b) $2mc^2$ c) $2m_0c$ d) $2m_0c^2$

PART - B

ANSWER ALL THE QUESTIONS

(5×7=35)

11. a) Write a short note on Hilbert space.
 (OR)
 b) Obtain equation of motion in the Heisenberg's picture.
12. a) Obtain and solve the radial equation of hydrogen atom.
 (OR)
 b) Write down Schrodinger wave equation for a particle in a box.
13. a) Discuss the effect of perturbation over a non- degenerate state.
 (OR)
 b) Estimate the ground state energy of helium atom using variation principle.
14. a) Show that $[L_x, L_y] = i \hbar L_z$
 (OR)
 b) Give the theory of Born approximation in scattering calculation.
15. a) Derive the K.G equation for relativistic wave equation for a free particle.
 (OR)
 b) Obtain Dirac matrices.

PART - C

ANSWER ANY THREE QUESTIONS

(3×10=30)

16. Solve the Schrodinger equation for a linear harmonic oscillation and find the energy eigen values and eigen functions.
17. Obtain the analysis of rotational energy of diatomic molecules.
18. Obtain the time independent perturbation equation and also give the eigen states and eigen values of the unperturbed Hamiltonian in degenerate case.
19. Give the theory of approximation for the scattering process. Calculate the differential cross-section for scattering of an electron by screened coulomb potential.
20. Obtain the energy eigen values and eigen functions of a Dirac equation for a free particle.