Reg. No. : ....

Code No. : 6865   **Sub. Code : PPHM 41**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2021.

Fourth Semester

Physics — Core

QUANTUM MECHANICS – II

(For those who joined in July 2017 onwards)

Time : Three hours   Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The eigen function of Lz are

    (a) $\Psi = e^{im\varphi}$

    (b) $\Psi = e^{im\varphi} f(r, \theta) \psi *$

    (c) $\Psi = e^{im\varphi} f(r, \theta)$

    (d) $\Psi = e^{im\varphi} \psi *$

2. The orbital angular momentum for particle system is defined by

    (a) $Lij = x_i p_j + x_j p_i$

    (b) $Lij = x_i p_j - x_j p_i$

    (c) $Lij = x_i p_j * x_j p_i$

    (d) $Lij = x_i p_j / x_j p_i$

3. _____ Represents the operator $\left(-\hbar/2m\right)\nabla^2 + V$.

(a) Perturbed Hamiltonian

(b) Unperturbed Hamiltonian

(c) Hamiltonian H

(d) Eigen functuntions ψ

4. The Eigen function ψ_n for the perturbed system must satisfy the condition

(a) $H\psi_n = E_n\psi_n$ (b) $H\psi_n = E\psi$

(c) $H\psi_n = E_n/\psi_n$ (d) $H_n\psi_n = E_n\psi_n$

5. In case of _____ the Hamiltonian changes slowly with time.

(a) Transition probability

(b) Sudden approximation

(c) Adiabatic Perturbations

(d) Constant perturbation

6. In case of $E_m^{(0)}$ is _____ from $E_1^{(0)}$, then the probability is small.

(a) Closest   (b) Far away

(c) Middle   (d) None of the above

7. Scattering of _____ gives an idea about the magnetic properties of the nucleus.

   (a) Nucleons

   (b) High energy electrons

   (c) Neutrons

   (d) Mesons

8. $\Sigma(w)$ is known as _____ of the particle by the target in the direction (θ, φ).

   (a) Differential scattering cross section

   (b) Scattering cross section

   (c) Total scattering cross section

   (d) Scattering amplitude

9. E is defined by the operator

   (a) $E = i\,\hbar\,\Box$ (b) $E = i\,\hbar(\partial/.\partial t)$

   (c) $E = h/2\pi i$ (d) $E = i\,\hbar/2\pi i$

10. A _____ in relativistic quantum mechanics will have positive and negative energy eigen values.

    (a) Particle in box

    (b) Particle in square well potential

    (c) Free Particle

    (d) Particle in electromagnetic field

PART B — (5 × 5 = 25 marks)

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

Each answer should not exceed 250 words.

11. (a) Determine the expression for L^2.

Or

(b) Describe the Eigen functions of L^2 and L_2.

12. (a) Write notes on time dependent perturbation theory.

Or

(b) Discuss the perturbation theory for non-degenerate case.

13. (a) Derive an expression for first order time dependant perturbation theory.

Or

(b) Explain transition probability.

14. (a) Discuss about centre of mass and laboratory co-ordinate systems.

Or

(b) Derive an expression for scattering amplitude.

15. (a) Discuss about spin of Dirac equation.

Or

(b) Discuss about spin orbit energy.

PART C — (5 × 8 = 40 marks)

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

Each answer should not exceed 600 words.

16. (a) Evaluate the matrix form of Lx and Ly .

Or

(b) Discuss in detail about the addition of angular momentum.

17. (a) Discuss in detail applications on non degenerate levels.

Or

(b) Describe briefly about first order stark effect in hydrogen atom.

18. (a) Discuss in detail about adiabatic Perturbations.

Or

(b) Determine the Einstein coefficients of transition probability.

19. (a) Discuss in detail about born approximation.

    Or

    (b) Discuss about scattering form of square well systems.

20. (a) Derive Klein–gorden equation for a free particle.

    Or

    (b) Discuss about hydrogen atom under relativistic condition.

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