23P306 (Pages: 2) Name: .....

Reg.No: .....

THIRD SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2024

(CBCSS - PG)

(Regular/Supplementary/Improvement)

CC19P PHY3 C09 - QUANTUM MECHANICS - II

(Physics)

(2019 Admission onwards)

Time : 3 Hours Maximum : 30 Weightage

Section A

Answer ***all*** questions. Each question carries 1 weightage.

1. What is meant by degeneracy and lifting of degeneracy?
2. What is the effect of the application of an electric field in the linear Stark effect?
3. What is the criterion for validity of WKB approximation?
4. Write an expression for transition probability when a constant perturbation is acting on the system, and explain.
5. Distinguish between stimulated and spontaneous emission.
6. Briefly describe the effect of scattering potential on a partial wave.
7. Give the formula which gives the energy-dependence of the total (s-wave) cross-section at low energies.
8. Give the Pauli equation for electrons.

(8 × 1 = 8 Weightage)

Section B

Answer any ***two*** questions. Each question carries 5 weightage.

9. Explain the second-order correction to energy in non-degenerate perturbation theory with an example.
10. Discuss variation method for the evaluation of eigen values. Obtain the ground state energy of Helium atom by variation method.
11. Solve the scattering cross section in the Born approximation for a given potential.
12. Obtain Klein-Gordon equation. Discuss how the reinterpretation helped to overcome the limitations.

(2 × 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. What is the significance of the relativistic correction to the hydrogen atom?
14. Use the WKB approximation to calculate the energy levels of a spin less particle of mass m moving in a one dimensional box with walls at x=0 and x=-L.

15. Explain tunnelling in quantum mechanics using the WKB approximation.
16. A system in an unperturbed state “n” is suddenly subjected to a constant perturbation H(r). Find the transition probability from the initial state “n” to the final state “k”.
17. By using partial wave analysis, obtain the expression for scattering cross section when the size of the scattering center is greater than the wave length of the incident particle. Compare the result with classical scattering cross section.
18. Derive expressions for the probability density and probability current density in Dirac theory.
19. What is hole theory and how does it relate to the Dirac equation?

(4 × 3 = 12 Weightage)

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