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Name.....

Reg. No.....

THIRD SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2024

(CBCSS)

Physics

PHY 3C 09—QUANTUM MECHANICS—II

(2019 Admission onwards)

Time : Three Hours

Maximum : 30 Weightage

Section A

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

1. Why the hydrogen atom in the ground state does not show a first order stark effect ?
2. Explain briefly the variation method for excited state.
3. Briefly discuss optical theorem.
4. Explain Fermi's golden rule.
5. What do you understand by classical turning points ?
6. Distinguish between normal and anomalous Zeeman effect.
7. Explain quadratic stark effect.
8. What are negative energy states ? What are holes ?

(8 × 1 = 8 weightage)

Section B

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

9. Discuss the first order time independent perturbation theory for non-degenerate stationary state. Obtain the corrected eigen value and eigen function.
10. What are Einstein's transition probabilities ? Outline the way in which absorption and emission of radiation is explained in quantum mechanics. Explain how the selection rules follow naturally.

Turn over

11. What is scattering cross section? Obtain an expression for scattering cross section using Green's function method.

12. Write an essay on nonrelativistic limit of an operator in Dirac theory.

(2 × 5 = 10 weightage)

Section C

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

13. Work out the splitting of the $^1P \rightarrow {}^1S$ transition of an atom placed in a magnetic field B along z axis.

14. A particle of mass m moving in the potential $V(z) = mgz, z > 0$ and $V(z) =$ infinity, $z < 0$. Optimize the trial wave function $\phi = Az\, e^{-\alpha z}$, where α is the variable parameter and estimate the ground state energy of the system.

15. Explain the Dirac particle in an electromagnetic field.

16. Write a note on Born approximation.

17. Explain how the Klein Gordan equation leads to positive and negative probability density values.

18. Obtain Dyson Series. Define transition probability.

19. Obtain the first order correction to the energy eigen value of an anharmonic oscillator.

(4 × 3 = 12 weightage)