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S – 6823

Reg. No. : ....

Name : ....

Third Semester M.Sc. Degree Examination, February 2024

Physics

PH : 231 ADVANCED QUANTUM MECHANICS

(2020 Admission Onwards)

Time : 3 Hours

Max. Marks : 75

SECTION – A

Answer **any five** questions. Each question carries **3 marks**.

1. Discuss Rayleigh- Ritz method.

2. Explain the emission of alpha particle by nucleus.

3. Discuss the first order correction to the wave function.

4. Prove that the conservation of linear momentum is a consequence of the translational invariance of the Hamiltonian of the system.

5. Write a short note on scattering cross section.

6. Discuss Pauli exclusion principle.

7. What do you mean by negative energy states?

8. Discuss commutation relations of angular momentum operators.

(5 × 3 = 15 Marks)

P.T.O.

SECTION – B

Answer **all** questions. Each question carries **15** marks.

9. Explain variational principle and discuss ground state energy of helium.

OR

10. Discuss the effect of electric field on the ground state and first excited sate of hydrogen.

11. Derive Breit Wigner Formula.

OR

12. Derive Hartree equation.

13. What is Klein Gordon equation and Discuss the interpretation of Klein Gordon equation.

OR

14. Obtain eigen values of J^2 and J_z.

(3 × 15 = 45 Marks)

SECTION – C

Answer any **three** of the following questions. Each question carries **5** marks.

15. Calculate the ground state energy up to first order of the anharmonic oscillator having a potential energy $V = H_0 = bx + \dfrac{m\omega^2 x^2}{2}$

where b = independent of x and $bx \ll \dfrac{m\omega^2 x^2}{2}$

16. The potential of a particle confined to a positive x axis is mgx. The wave function tends to zero as x tends to zero and infinity. Use the trial wave function $x e^{-ax}$ and obtain the best value of parameter a.

17. Derive scattering amplitude in terms of differential scattering cross section.

18. Explain how the momentum operator becomes the generator of infinitesimal translation in space.

19. Evaluate the Clebsh – Gordan coefficients for $j_1 = 1/2$ and $j_2 = 1/2$.

20. Starting from the Klein Gordon equation, obtain the equation of continuity.

(3 × 5 = 15 Marks)

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