62121

Reg. No. | | | | | | | | |

III Semester M.Sc. Degree Examination, April/May - 2022

PHYSICS

Quantum Mechanics - II

Paper : 301

(CBCS Scheme 2019-2020)

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Time : 3 Hours **Maximum Marks : 70**

Instructions to Candidates:

Answer all questions.

(3×15=45)

1. a. Solve the Schrödinger's equation in three dimensions for a free particle and discuss the features of the wave function. **(10)**

   b. Explain parity and time reversal operators. **(5)**

(OR)

2. a. Solve the Schrödinger's equation for a three dimensional harmonic oscialltor and obtain its Eigen values and Eigen functions. **(10)**

   b. Discuss the physical significance of zero - point energy of harmonic oscillator. **(5)**

3. a. Discuss the time - independent perturbation theory and obtain the expression for first order correction to energy of a non - degenerate system. **(10)**

   b. State and prove variational principle. **(5)**

(OR)

4. a. Describe W.K.B approximation method. **(5)**

   b. Discuss the first order time dependent perturbation theory and derive the Fermi golden rule for the transition rate. **(10)**

5. a. Using partial wave analysis, obtain the expression for scattering cross section in terms of scattering angle and phase shift. **(10)**

   b. Write the Klein - Gordon relativistic wave equation and discuss the difficulties associated with its interpretation. **(5)**

(OR)

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6. a. Set up the Dirac equation for a free particle. Obtain the plane wave solutions of Dirac equation for a free particle. **(12)**

   b. What is a helicity operator? **(3)**

7. Answer any **five** of the following : **(5×5=25)**

   a. Write the Schrödinger's equation for the hydrogen atom and eigen values of hydrogen atom.

   b. Write a note on ortho and para states of helium atom.

   c. Using the trial wave function ψ=N Exp $(-ax^2)$ estimate the gorund state energy of a harmonic oscillator by variational method (a is Variational Parameter).

   d. Calculate the first order perturbation correction to the energy of a harmonic oscillator with a perturbation $V = \frac{1}{2} bx^2$ ('b' is a constant).

   e. Find the differential cross - section in the I Born approximation for the Yukawa potential $V(r) = V_0 \frac{e^{-\alpha r}}{r}$ 'V_0' and 'α' are constants.

   f. Evaluate [H,P], where H is a Dirac's Hamiltonian. What conclusion can be drawn from the value of this commutator?

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