Sl. No. 50031

75452

No. of Printed Pages : 2

I Semester M.Sc. Degree Examination, April / May - 2021
PHYSICS
PH HCT - 120 : Quantum Mechanics - I
(CBCS)

Time : 3 Hours

Maximum Marks : 70

Instructions :   (i)   *Answer all the questions.*
 (ii) *Question no.1 to 8 carry 15 marks each.*
 (iii) *Question no.9 to 12 carry 5 marks each.*

1. (a) With a neat diagram explain the black body spectrum and discuss the inadequacy of classical physics.   **10+5**

 (b) State and explain uncertainty and complementarity principle.

OR

2. (a) Develop the theory of one-dimensional Schrodinger wave equation for a free particle and extend it to three dimensions.   **10+5**

 (b) Normalize the wave function $\psi(x) = A \exp(-ax^2)$, where 'A' and 'a' are constants over the domain $-\infty \le x \le \infty$.

3. Obtain an expression for the transmission and reflection coefficient when a particle of energy E is incident on a one dimensional rectangular potential barrier of height 'V_0' and thickness 'a'. Discuss the above problem for two cases, $E<V_0$ and $E>V_0$.   **15**

OR

4. Obtain the normalized radial wave function and energy Eigen values of hydrogen atom by solving radial part of the Schrodinger wave equation.   **15**

5. (a) Write a note on Hilbert space and orthogonal functions.   **5+10**

 (b) Define Harmitian operator and explain its important properties.

OR

6. (a) State and explain the five fundamental postulates of quantum mechanics.   **10+5**

 (b) Give a brief account of matrix representation of an operator.

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7. (a) Develop the time independent perturbation theory up to first order corrections to   10+5
         wave function and Energy for non-degenerate case.

    (b) A linear harmonic oscillator is perturbed by $H' = br^4$, calculate the first order
         corrections to its ground state.

OR

8. (a) Explain the variation method and apply this method to find out ground state   10+5
         energy of the helium atom.

    (b) Write a note on scattering cross section.

9. Explain the concept of probability, Normalization and Expectation value of wave   5
    function.

OR

10. Write down the Schrödinger wave equation in spherical polar coordinates and explain   5
    each term in it. https://www.vskub.com

11. Explain the Dirac Bra and Ket notations.   5

OR

12. Write a note on optical theorem.   5

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