LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – PHYSICS

FIFTH SEMESTER – APRIL 2022

UPH 5501 – QUANTUM MECHANICS

Date: 15-06-2022   Dept. No.   Max. : 100 Marks
Time: 09:00 AM - 12:00 NOON

PART – A

Q. No   Answer **ALL** questions   **(10 x 2 = 20 Marks)**

1. What is de Broglie hypothesis?

2. State Heisenberg's uncertainty principle.

3. Find the commutation relation between position and momentum operators.

4. What are the physical significances of wave function?

5. Determine the probability of a particle in a box to be found between x=0 and x=L/4 in the ground state.

6. Write a brief note on group velocity and wave velocity.

7. Compute the relation $[\hat{L}_z , \hat{L}_+]$.

8. Write down the three Pauli's spin matrices.

9. What is a meant by degeneracy?

10. What is the zero point energy of 3D harmonic oscillator?

PART – B

Answer any **FOUR** questions   **(4x 7.5 = 30 Marks)**

11. Describe the Davisson – Germer Experiment to establish the wave nature of electron.

12. Derive the equation of continuity in quantum mechanics.

13. Obtain the energy eigen functions and energy eigen values of a particle in a one dimensional box of width L.

14. Describe the Stern-Gerlach experiment and discuss its results.

15. Obtain the matrix representation of L_+ and L_- operators.

16. Explain in detail, the theory of alpha decay.

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PART – C

Answer any **FOUR** questions   **(4 x 12.5 = 50 Marks)**

17. Obtain the expression for Planck's law of blackbody radiation.

18. State and prove the Ehrenfest theorems.

19. Solve harmonic oscillator problem using operator method.

20. Write down the eigenvalue equation for angular momentum operator $\hat{L}_z$ and L^2 and solve it to obtain its eigenvalues.

21. Solve the radial part of Schrodinger wave equation for hydrogen atom and obtain the energy eigen values and eigen functions.

22. i) Using Heisenberg uncertainty principle show that electrons cannot exist inside the nucleus.(4.5)

    ii) State and prove the two theorems on hermitian operators.   (8)

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