LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION – **PHYSICS**

FIFTH SEMESTER – **NOVEMBER 2022**

UPH 5501 – QUANTUM MECHANICS

Date: 23-11-2022 Dept. No. Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

PART – A

Answer all the questions **(10 x 2 = 20 Marks)**

1. List out the failures of classical mechanics.
2. What is meant by wave-particle duality?
3. What are stationary states?
4. Mention the significance of wave function Ψ.
5. Distinguish between group velocity and wave velocity.
6. Define quantum mechanical tunneling.
7. Mention any two properties of spherical harmonic.s
8. Compute $[L_x, L_y]$.
9. What is a free particle?
10. Write the eigenvalues and eigen functions of a particle in a 1D box of length L.

PART – B

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

11. State uncertainty principle. Using it i) prove the non-existence of electrons in the nuclues ii) evaluate the energy of the hydrogen atom.
12. Explain the postulates of quantum mechanics.
13. Setup and solve the Schrodinge wave equation for a particle of mass m in a one dimensional box of width L and obtain its energy eigenvalues and normalized eigen functions.
14. Describe in detail about Stern and Gerlach experiment and mention its importance in quantum mechanics.
15. Evaluate the following: $[L^2, L_z], [L_+, L_-], [L_z, L_+]$
16. Derive the equation of continuity in quantum mechanics.

PART – C

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

17. Describe the Davisson – Germer experiment to prove the wave nature of the electron.
18. State and prove Ehrenfest theorems.
19. Obtain the eigenvalues and eigen functions for the one dimensional linear harmonic oscillator.
20. Setup the eigenvalue equation of the angular momentum operator L^2 and obtain its eigenvalues and eigen functions.
21. Obtain the eigenvalue and eigen functions for the particle present in the 3 dimensional infinite potential well.
22. What is Compton effect? Derive the expression for the shift in wavelength of a photon scattered by a stationary electron.

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