LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **NOVEMBER 2019**

16/17UPH5MC01 – QUANTUM MECHANICS

Date: 29-10-2019 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

Part A

Answer all the questions (10 x 2 = 20 marks)

1. Calculate the de-Broglie wavelength of an electron accelerated through a potential of 3600 volts
2. List out the inadequacies of classical mechanics
3. Define probability density of wave function.
4. What is meant by a linear vector space?
5. An electron is trapped in one dimensional box of width 1 Å. How much energy must be supplied to excite the electron from ground state to first excited state?
6. What is meant by zero point energy of a linear harmonic oscillator?
7. Show that $[L_x, L_y] = i\hbar L_z$
8. What are spherical harmonics?
9. What do you mean by central potential?
10. What is the degeneracy of a 3D harmonic oscillator in n = 2 state?

Part B

Answer any four questions (4 x 7.5 = 30 marks)

11. Derive the expressions for wave velocity and group velocity
12. State and prove the two theorems on Hermitian operators.
13. State and explain any three postulates of quantum mechanics.
14. Set up the Schrodinger equation for a rigid rotator.by reducing it to a single body problem and obtain its energy eigenvalues.
15. What are Pauli spin matrices? Establish any three properties of these matrices. (1.5+6)
16. Obtain energy eigenvalues of a linear harmonic oscillator by operator method.

Part C

Answer any four questions (4 x 12.5 = 50 marks)

17. Discuss in detail the Davisson-Germer experiment that establishes the concept of matter waves
18. State and prove Ehrenfest's theorems.
19. Determine the energy levels of one dimensional potential of finite depth.
20. Discuss tunnel effect in a square potential barrier problem and derive expression for the transmission coefficient.
21. With a neat diagram, explain how Stern-Gerlach experiment establishes the spin of an electron.
22. From the radial part of Schrodinger wave equation for hydrogen atom obtain its eigenvalues.

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