# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2019**

**PH 5510– QUANTUM MECHANICS AND RELATIVITY**

Date: 15-04-2019 Dept. No. Max. : 100 Marks

Time: 09:00-12:00

## PART-A

Answer **ALL** Questions **(10x2=20)**

1. Define de Broglie's wavelength
2. A microscope using photons, is employed to locate an electron in an atom to within the distance of 0.2Å.What is the uncertainty in the momentum of the electron located in this way?
3. Mention any two admissibility conditions on the wave function.
4. Show that the expectation value of H is the total energy E of the system.
5. What is meant by potential barrier? Sketch the diagram that represents it.
6. Write the eigen values of the operators $\widehat{L^2}$ and $\widehat{L_z}$.
7. State Newtonian principle of relativity.
8. What is time dilation?
9. Write the transformation equations for the components of momentum.
10. Distinguish between inertial and non-inertial frames.

## PART-B

Answer ANY **FOUR** Questions **(4x7.5=30)**

11. With a neat diagram, describe Davisson and Germer'sexperiment for the study of electron diffraction.
12. What do you mean by i) work function ii) threshold energy and iii) stopping potential? **(2.5+2.5+2.5)**
13. What is a Hermitian operator? Show that the eigen functions of a Hermitian operator are orthogonal if they correspond to distinct eigen values and that the eigen values are real. **(2+5.5)**
14. What is tunneling effect? Use it to explain the phenomenon of α - decay. **(1.5+6)**
15. Explain the four dimensional Euclidean space time continuums in detail.
16. Statethe principle of equivalence. Discuss any three applications of it**.** **(1.5+6)**

## PART–C

Answer **ANY FOUR**Questions : **(4x12.5 = 50)**

17. What are the basic postulates of Planck's law of radiation? Derive the expression for energy density as a function of wavelength. Show that Wien's law and Rayleigh-Jeans law are only the special cases of Planck's law. **(2.5+6+2+2)**

18. State and prove Ehrenfest's theorems. **(2.5+10)**

19. Derive energy eigen values and normalized functions for a particle in a one dimensional square well potential of finite depth V. Plot the first 3 eigen function of the particle.

**(9.5+3)**

20. Establish Schrodinger equation for a one dimensional linear harmonic oscillator and solve it to obtain eigen value and eigen functions. Discuss the significance of zero point energy.

**(5+5+2.5)**

21. Describe the Michelson-Morley experiment and explain the physical significance of negative results.

**(9.5+3)**

22.i) Obtain Einstein's mass - energy relation. Discuss the importance of it. Derive the relation between the total energy, the rest energy and the momentum. **(5.5+3+2)**

ii) Show that 1u = 931 MeV. **(2)**

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