LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

SIXTH SEMESTER – APRIL 2017

PH 6609 / PH 6605 / PH 6603 / PH 6600 - QUANTUM MECHANICS & RELATIVITY

Date: 20-04-2017   Dept. No.   Max. : 100 Marks
  09:00-12:00

PART-A

Answer **ALL** the questions   **(10x2=20)**

1) What is photoelectric effect?

2) Give any two phenomena where classical theory failed.

3) If $H\varphi_1 = E\varphi_1$ and $H\varphi_2 = E\varphi_2$, what can you say about the energy eigen value E?

4) State the Born's interpretation of the wave function.

5) Why are the physical observables represented by Hermitian operator?

6) Given $x = i\hbar \dfrac{\partial}{\partial x}$ and $p_x = p$, evaluate the commutator $[x, p]$.

7) What are non –inertial frames?

8) A meter scale moves with a speed of $u = \dfrac{\sqrt{3}}{2}c$, what is its length as seen by a stationary observer?

9) State Mach's principle.

10) State equivalence principle.

PART-B

Answer any **FOUR** questions   **(4x7.5=30)**

11) State the uncertainity principle. Give an argument to show that an electron does not exist inside the nucleus .

12) State and prove the Ehrenfest theorem $\dfrac{d\langle p \rangle}{dt} = -\langle \nabla V \rangle$, the symbols have their usual meaning.

13) Prove that the eigen values of a hermitian operator are real and the eigen functions corresponding to distinct eigen values are orthogonal..

14) State the postulates of relativity. Given that a particle of rest mass 0.5 MeV/c^2, moves with a speed of u=0.6c find its momentum and kinetic energy.

15) Explain gravitational red shift and obtain an expression for it.

PART-C

Answer any **FOUR** questions **(4x12.5=50)**

16) a) Obtain an expression for the change in the wave length of a scattered photon, in Compton effect.

(9.5 marks)

b) Find the momentum of a particle whose de Broglie wave length is 6.63×10^{-10} m. **(3 marks)**

17) Solve for the eigen values and eigen functions of a one dimensional harmonic oscillator.

18) Solve the radial wave equation for the hydrogen atom and obtain its eigen values.

19) Discuss the Michelson-Morley experiment in detail. What were the possible explanations for the null result?

20) Discuss the following:

a) Bending of light, b) Gravitational lensing and

c) Precision of perihelion of Mercury. **(4+4+4.5 marks)**

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