LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – APRIL 2017

PH 5510- QUANTUM MECHANICS AND RELATIVITY

Date: 28-04-2017 Dept. No. Max. : 100 Marks
01:00-04:00

PART-A

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

1) Write the photoelectric equation and explain the terms.

2) If the Bohr radius is 0.5 A°, in an hydrogen atom. What is the radius of the second excited State?

3) Define Group velocity.

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

5) What are stationary states?

6) State the selection rules for allowed transitions.

7) How does the velocity and acceleration transform under Galilean transformation?

8) State the postulates of special theory of relativity.

9) Find the relativistic kinetic energy of an electron moving with v= $\frac{\sqrt{3}}{2}$ c. Given the rest mass of electron is 0.5 Mev.

10) State equivalence principle in general theory of relativity.

PART-B

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

11) Describe Davisson-Germer experiment.

12) State the postulates of quantum mechanics.

13) Explain the theory of α-decay,through the theory of barrier penetration, and obtain the Geiger-Nuttal law.

14) From the Lorentz transformation obtain the relativistic velocity transformation rule.When does it reduce to the Galilean velocity addition rule? If two particles are moving with 0.75c,each, in opposite directions; what is the relative speed of one with the other?

15) Explain gravitational red shift.

16) Derive Einstien's mass-energy relation. Give the mass equivalent of 0.51Mev.

PART-C

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

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

b) Using Heisenberg's uncertainty relation argue that an electron cannot be inside a nucleus.

18) a) Normalize the wave function $\varphi_n = A\sin(\frac{n\pi}{L}x)$; $0 \le x \le L$.

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

19)a) Obtain the eigen values of a one dimensional harmonic oscillator, by solving the Schrodinger's equation.

b) Is $\psi = \sqrt{\frac{1}{2}}\varphi_1 + \sqrt{\frac{1}{2}}\varphi_2$ a possible state of the oscillator? Where φ_1 and φ_2 are the first and second excited states of the oscillator. Give reason.

20) a) Derive the Lorentz transformation.

b) What is the life time of a mu-meson travelling at a speed of 0.8c. If it's proper life time is $2x10^{-6}$ sec. (c-speed of light).

21)Discuss the following: a) Bending of light, b) Gravitational lensing and c) Precision of perihelion of Mercury.

22) State and prove Ehrenfest's theorems.

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