



LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

B.Sc. DEGREE EXAMINATION - PHYSICS

FIFTH SEMESTER – NOVEMBER 2015

PH 5510 - QUANTUM MECHANICS AND RELATIVITY

Date : 03/11/2015

Dept. No.

Max. : 100 Marks

Time : 09:00-12:00

PART-A

Answer **ALL** the questions:

(10x2=20 marks)

- 1) State de Broglie's hypothesis.
- 2) State Heisenberg's uncertainty principle.
- 3) Show whether $\psi = e^x$, is a physically admissible function for $x < 0$.
- 4) Give the dimensions of a one and three dimensional wave function.
- 5) What are stationary states?
- 6) Calculate the degeneracy of the hydrogen atom in an n^{th} state without spin.
- 7) Obtain the velocity addition rule in special theory of relativity.
- 8) A mu-meson has a proper life time of 2×10^{-6} sec. If it moves with a speed of $0.99c$, find its life time.
- 9) Why a particle cannot be accelerated to the speed of light?
- 10) What is gravitational lensing?

PART-B

Answer any **FOUR** questions:

(4x7.5=30 marks)

- 11) Sketch an electron microscope and explain its functioning.
- 12) State the postulates of quantum mechanics.
- 13) Obtain the, one dimensional, time independent Schrodinger from the time dependent one.
- 14) Explain the theory of alpha decay with the help of barrier penetration and obtain the Geiger – Nuttall law.
- 15) Derive an expression for the variation of mass with speed.
- 16) Obtain an expression for gravitational red shift.

PART-C

Answer any **FOUR** questions:

(4x12.5=50 marks)

- 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) Explain the significance of normalizing a wave function. Normalize the wave function $\psi = \sin\left(\frac{n\pi}{L}x\right); 0 \leq x \leq L$.
b) Prove that the eigen values of a hermitian operator are real and the eigen functions corresponding to distinct eigen values are orthogonal.
- 19) Solve the radial wave equation for the hydrogen atom and obtain its eigen values.
- 20) a) Discuss in detail the Michelson –Morley experiment. What were the possible explanations for the null result?
- 21) Discuss the following:
a) Bending of light, b) Clock paradox and c) Precision of perihelion of Mercury.
- 22) State and Prove Ehrenfest theorems.

\$\$\$\$\$\$