LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

FIFTH SEMESTER – **APRIL 2023**

PH 5510 – QUANTUM MECHANICS AND RELATIVITY

Date: 08-05-2023 Dept. No. Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

	PART – A	**(10 x 2 = 20 Marks)**
Q. No	**Answer ALL questions**	
1	State de Broglie's hypothesis.	
2	State Heisenberg's uncertainty principle.	
3	Mention the physical significances of wave function.	
4	Distinguish between phase velocity and group velocity.	
5	What is quantum tunnelling?	
6	State the box normalization condition.	
7	Write down the Galilean transformation equations for an inertial frame of reference S' moving in a positive X direction with respect to the inertial frame of reference S at rest.	
8	A rod 1 m long is moving along its length with a velocity 0.6c. Calculate its length as it appears to an observer on the earth.	
9	State the principle of equivalence in the general theory of relativity.	
10	What is gravitational red shift?	
	PART – B	**(4 x 7.5 = 30 Marks)**
	Answer any FOUR questions	
11	Describe the Davisson – Germer experiment to establish the wave nature of electron.	
12	Write a note on postulates of quantum mechanics.	
13	Obtain the energy eigen functions and eigenvalues of a particle in a one dimensional box of width L.	
14	Derive the Lorentz space-time transformation formulae.	
15	Obtain Einstein's mass-energy relation.	
16	Using Heisenberg uncertainty principle i) show that the electrons cannot exist inside the nucleus ii) estimate the Bohr radius.	(3.5+4)
	PART – C	**(4 x 12.5 = 50 Marks)**
	Answer any FOUR questions	
17	What is Compton effect? Derive an expression for the change in the wavelength of a photon of frequency ν scattered by a stationary electron.	(2.5+10)
18	State and prove Ehrenfest theorems.	
19	Derive Schrodinger time dependent and time independent wave equations.	
20	Describe the Michelson-Morley experiment and explain the physical significance of its negative result.	
21	Deduce the formula for relativistic variation of mass with velocity.	
22	Solve the radial part of Schrodinger wave equation for hydrogen atom and obtain the energy eigenvalues and eigenfunctions.	