(FOR THE CANDIDATES ADMITTED

SUB CODE 20 UPS 612

DURING THE ACADEMIC YEAR 2020-21 ONLY)

REG.NO. :

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : MAY – 2023

B.Sc. – PHYSICS

MAXIMUM MARKS: 70

VI SEMESTER

TIME : 3 HOURS

PART – III

RELATIVITY AND QUANTUM MECHANICS

SECTION – A   **(10 X 1 = 10 MARKS)**

ANSWER THE FOLLOWING QUESTIONS.

MULTIPLE CHOICE QUESTIONS.   **(K1)**

1. If an object reaches the speed of light, its moving length changes to _____

    a) Infinite   b) Double of the value

    c) Half of the value   d) Zero

2. In relativistic case, as the velocity of the particle approaches the speed of light, the kinetic energy approaches _____

    a) Zero   b) Infinite

    c) Rest Energy   d) Kinetic Energy as in non-relativistic case

3. If a container has dimensions L, then the wave function of the particle in the container will be in _____ region.

    a) $x < 0$ b) $x > 0$ c) $x > L$ d) $0 < x < L$

4. Which function is considered independent of time to reach a steady state?

    a) ψ b) $U(x)$ c) $d\psi/dt$ d) $d^2\psi/dt^2$

5. The Energy level of the hydrogen atom (in terms of the principal quantum number n) is proportional to _____

    a) n   b) n^2 c) $1/n^2$ d) $1/n^3$

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES   **(K2)**

6. A 20-year-old person goes at high speed in a rocket on his birthday. When he comes back to earth after 1 earth year, what will be his age?

7. A source of sound moves towards an observer. What happens to the speed of sound in the medium?

8. Give the expression for de-Broglie wavelength of an electron.

9. What is a free particle?

10. What is the expression for the total angular momentum L of a quantum particle in a hydrogen atom?

ETHICAL PAPER

SECTION – B (5 X 4 = 20 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE
FOLLOWING QUESTIONS. (K3)

11. a) Discuss the postulates of Einstein's special theory of relativity.
    (OR)
    b) Derive an expression for variation of mass of a body with speed.

12. a) Explain the structure of space-time (Minkowski) diagram and bring out its salient features.
    (OR)
    b) State the principle of equivalence and highlight its importance to general theory relativity.

13. a) What is group velocity? Explain and deduce an expression for group velocity.
    (OR)
    b) State and explain Heisenberg's uncertainty principle and discuss one of its example.

14. a) Using Schrodinger equation write a brief note on barrier penetration problem.
    (OR)
    b) Discuss the application of Schrodinger equations to an infinite Square well potential.

15. a) Using quantum theory deduce an expression for the energy of electron in the ground state of a hydrogen atom.
    (OR)
    b) What is electron probability density? Explain with an example.

SECTION - C (4 X 10 = 40 MARKS)

ANSWER ANY FOUR OUT OF SIX QUESTIONS
(16th QUESTION IS COMPULSORY AND ANSWER ANY THREE QUESTIONS
(FROM Qn. No : 17 to 21) (K4 (Or) K5)

16. What are the postulates of wave mechanics? Explain and give the properties of wave function.

17. Derive Lorentz transformation equations and apply them to explain
    (i) Length contraction
    (ii) Time dilation.

18. Using general theory of relativity deduce the relation between total energy, particle momentum and rest energy of a particle.

19. Discuss the principle, construction and working of a gamma ray microscope.

20. Deduce expression for time dependent and time independent forms of Schrodinger equation.

21. Briefly explain the orbital and magnetic quantum numbers and give its significance.

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ETHICAL PAPER