SUBJECT CODE : PH/MC/QR64

B.Sc. DEGREE EXAMINATION APRIL 2013
BRANCH III - PHYSICS
SIXTH SEMESTER

REG. No._____

COURSE   :   MAJOR – CORE
PAPER   :   QUANTUM MECHANICS AND RELATIVITY
TIME   :   30 MINS.   MAX. MARKS : 30
SECTION – A
TO BE ANSWERED IN THE QUESTION PAPER ITSELF

ANSWER ALL QUESTIONS: **(30 x 1 = 30)**
I   **CHOOSE THE CORRECT ANSWER:**

1. Light is propagated in small packets or bundles of energy is

   (a) $h\nu$ (b) $h\nu/2$ (c) h/w (d) None of these.

2. The wave associated with material particle is called

   (a) Sine wave   (b) Square wave   (c) Matter wave (d) Triangular wave

3. Expression for group velocity is

   (a) $u = du/dv$ (b) $u = d\omega/dk$ (c) $v = dk/d\omega$ (d) $v = dv/du$

4. The sum of reflectance and transmission must be equal to

   (a) E   (b) V_0 (c) 1   (d) 0.5

5. In rectangular potential barrier, the incident wave of energy and height of a potential barrier is

   (a) $E > V_0$ (b) $E = V_0$ (c) $E < V_0$ (d) None of these.

6. No. of nodes and anti-nodes of particle in one dimensional box are

   (a) 1,2 respectively   (b) 2,3 respectively

   (c) 1,3 respectively   (d) None

7. Quantum mechanical operator for x- component of momentum is

   (a) $i(h/2\pi) \partial/\partial x$ (b) $-i(h/2\pi) \partial/\partial x$ (c) $ih \partial/\partial t$ (d) $(h/i) \partial/\partial x$

8. Value of $[L_x, L_y]$ is

    (a) $i(h/2\pi)L_z$ (b) ihLz   (c) –ihL   (d) –ih

9. The value of $[H, P_x]$ for a free particle is

    (a) 0   (b) 1   (c) -1   d) i h

10. According to postulates of special theory of relativity,

    the speed of light in free space ----

    (a) increases   (b) remains constant   (c) changes   (d) decreases

11. Galilian transformation equations are

    (a) y'=x-vt, y'=y, z'=z, t'=t   (b) x'=x-vt, y'=y, z'=z, t'=t

    (c) z'=y'-vt, y'=y, z'=z, t'=t   (d) None of these.

12. Accelerated frames are called

    (a) inertial   (b) static frames   (c) non-inertial frames   d) None

13. The mesons mean life is

    (a) 3×10^{-5} sec.   (b) 2×10^{-6} sec.   (c) 2×10^{-5} sec.   (d) 2.5×10^{-6} sec.

14. All clocks on the space ship will go slow by a factor

    (a) $\frac{1}{2}(1-v^2/c^2)^{1/2}$ (b) $(1-v^2/c^2)^{1/2}$ (c) $(1-v^2/c^2)^{-1/2}$ (d) None

15. When a body is at rest its internal energy is

    (a) mc^2 (b) m_0c^2 (c) m_0c^4 (d) None of these.

II   Fill in the blanks

16.   The momentum of a photon, p = -------.

17.   The electron beam is produced from ---------.

18.   The expectation value for position of the particle, $<x> =$ --------.

19.   The mass of the body in motion in given by --------.

20. If the velocity of the body approaches velocity of light, then mass of the body, m = -------.

III State whether true or false

21. Davisson and Germer's experiment is the direct conformation for the existence of de-Broglie's waves.

22. In stationary orbit, angular momentum of electron is an integral multiple of $h/2\pi$.

23. In wave packet, group velocity, v_g will be equal to the particle velocity v.

24. Both the time dilation and length contraction occurs in the case of stable particles, called μ mesons.

25. In Michelson - Morley experiment, the negative result suggests that it is possible to measure the speed of the Earth relative to the Ether.

26. The laws of physics are the same in all inertial frame of reference.

IV   Give short answer

27. Define phase velocity.

28. State Newtonian principle of relativity.

29. Explain eigen functions and eigen values.

30. What is an inertial frame of reference?

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STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086.
(For candidates admitted during the academic year 2008-09 & thereafter)

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TIME   :   2 ½ HOURS   MAX. MARKS : 70

SECTION – B

ANSWER ANY FIVE QUESTIONS: **(5 x 5 = 25)**

1. State postulates of quantum mechanics.

2. Derive expression for group velocity and obtain the relation between group velocity and wave velocity.

3. What is tunnel effect? Describe briefly transmission and reflection coefficients for rectangular potential barrier.

4. Explain the normalization process of wave function. How will you find the value of linear momentum operator?

5. Find (a) $[H , P_x]$ and (b) $[L_x , x]$

6. Derive length contraction and time dilation in relativity.

7. What is the length of a metre stick moving parallel to its length, when its mass is 3/2 of its rest mass.

SECTION – C

ANSWER ANY THREE QUESTIONS: **(3 X 15 = 45)**

8.(a) Describe the Davisson – Germer experiment and discuss its importance in relation to de-Broglie's hypothesis of matter waves.
  (b) Calculate the wavelength of associated with an electron subjected to potential difference of 1.25 kv.

9.   Solve Schrodinger's equation for a particle in dimensional box and its eigen values and eigen functions. Also explain its degeneracy.

10.(a) Write the physical meaning of commutations between the operators.
   (b) Obtain commutation relation between the components of angular momentum and position and
   (c) Find $[x^n, p_x]$.

11.   Derive Lorentz transformation equations.

12.   Derive $E = mc^2$. Find the relation between total energy (E), rest energy (E_0) and momentum of the particle (p).