GLA University, Mathura

I Mid Term Examination 2011-12

B.Tech : Ist Year   Sub: Physics (AHP-101)   Time : 1½ Hr
Date:27/9/2011   Sem : I   M.M. : 40

Section - A

Q.1 This question contains ten parts. Attempt all parts. $1 \times 10 = 10$

Q.1 (i) A square of length L is moving along one of its sides with relativistic velocity v with respect to a frame. Area of square in this frame will be:

(a) L^2 (b) $L^2(1 - \frac{v^2}{c^2})^{1/2}$ (c) $L^3(1 - \frac{v^2}{c^2})^{1/2}$ (d) $L^3(1 - \frac{v^2}{c^2})^{3/2}$

Q.1 (ii) A particle of rest mass m_0 is moving with velocity c/2. Its relativistic mass will be :

(a) $2 m_0/(3)^{1/2}$ (b) $m_0/(3)^{1/2}$ (c) $2 m_0(3)^{1/2}$ (d) $2 m_0$

Q.1 (iii) Which of the following relation is correct:

(i) $E^2 = p^2c^2 + m_0c^4$ (ii) $E = p^2c^2 + m_0c^4$ (iii) $E^2 = pc + m_0c^4$ (iv) $E^2 = p^2c^2 + m_0^2 c^4$

Q.1(iv) The correct Lorentz transformation is :

(a) $x' = (x-vt)/[1-(v/c)^2]^{1/2}$ (b) $x' = (x-vt)[1-(v/c)^2]^{1/2}$

(c) $x' = (x-vt)/[1-(v/c)^2]^{3/2}$ (d) $x' = (x-vt)/[1-(v/c)^2]^{5/2}$

Q.1(v) An observer moves with a speed c/2 towards a stationary source of light, speed of light appears to the observer to be

(a) 3c/2   (b) c   (c) 2c   (d) c/2

Q.1(vi) Which of the following is variant under Galilean transformations ?

(i) time   (ii) torque   (iii) angular momentum   (iv) none of these

Q.1(vi) Which of the following inequalities is correct for proper time (t_0) and improper time (t)?

(a) $t > t_0$ (b) (a) $t < t_0$ (c) $t = t_0$ (d) None of these

Q.1(vii) Michelson –Morley experiment showed that

(a) Newtonian mechanics is correct for all low and high speeds (b) there is no absolute frame like ether

(c) velocity of light is relative in all cases   (d) there is no absolute frame, but all frames are relative

Q.1(viii) At absolute zero, semiconductors behaves as

(i) insulators (ii) conductors (iii) superconductors   (iv) none of these

Q.1(ix) A p - type crystal is

(i) positively charged (ii) negatively charged   (iii) neutral   (iv) none of these

Q.1(x) Energy spacing in the sub energy levels of band is

(a) 10^{-20} eV   (b) 10^{-30} eV   (c) 10^{-40} eV   (d) 10^{-50} eV

Section – B

Attempt any three : $4\times3=12$

Q.1 Derive Galilean transformations for position and velocity.   (3+1)

Q.2 Prove that the expression $x^2 - c^2t^2$ is invariant under Lorentz transformations.

Q.3 A rod is moving with velocity 0.6c in a direction inclined at 30^0 to its own length. Calculate percentage contraction in the length of the rod.

Q.4 Define (i) conductor (ii) semiconductor (iii) insulator (iv) energy band gap   (1+1+1+1 = 4)

Q.5 Mean life of meson is 4×10^{-8} sec. Calculate the mean life of meson moving with a velocity 0.6 c.

Section – C

Attempt any two: $9 \times 2=18$

Q.1 What was the objective of Michelson – Morley experiment ? Discuss the experiment and its consequences.   (1+ 6 + 2 = 9)

OR

Derive Lorentz transformations. Under what condition Lorentz transformations reduce to Galilean transformations?   (8+1= 9)

Q.2 (a) Obtain the relativistic formula for addition of velocities.   (5)

Q.2(b)What are donor and acceptor impurities ? Explain their effect on conductivity of the semiconductors.   (2+2= 4)

Q.3(a)Obtain Einstein's mass energy relationship   (5)

Q.3(b) What is meant by bands? Explain their formation in solids.   (4)