5 SEM TDC PHY M 2

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(November)

PHYSICS

(Major)

Course : 502

(Electrodynamics)

Full Marks : 60

Pass Marks : 24

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×6=6

    (a) The radiation pressure of the electromagnetic wave when it is totally reflected from the surface of substance is

    (i) u

    (ii) $2u$

    (iii) $\frac{1}{2}u$

    (iv) $\frac{u}{c}$

(b) Two particles X and Y having equal charges after being accelerated through the same potential difference, enters a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of mass of X to that of Y is

(i) $\left(\dfrac{R_1}{R_2}\right)^{1/2}$

(ii) $\dfrac{R_2}{R_1}$

(iii) $\left(\dfrac{R_1}{R_2}\right)^2$

(iv) $\dfrac{R_1}{R_2}$

(c) A positively charged particle moving with a velocity $\vec{V}$ enters a region of space having a constant magnetic induction $\vec{B}$. The particle will experience the largest deflecting force when the angle between vectors $\vec{V}$ and $\vec{B}$ is

(i) 0°

(ii) 45°

(iii) 90°

(iv) 180°

(d) The energy of elctromagnetic wave in vacuum is given by the relation

(i) $\dfrac{E^2}{2\varepsilon_0} + \dfrac{B^2}{2\mu_0}$

(ii) $\dfrac{1}{2}\varepsilon_0 E^2 + \dfrac{1}{2}\mu_0 B^2$

(iii) $\dfrac{E^2 + B^2}{C}$

(iv) $\dfrac{1}{2}\varepsilon_0 E^2 + \dfrac{B^2}{2\mu_0}$

(e) Brewster's law is

(i) $_1 n_2 = \sin\theta_p$ (ii) $_1 n_2 = \cos\theta_p$

(iii) $_1 n_2 = \tan\theta_p$ (iv) $_1 n_2 = \cot\theta_p$

(f) A cube is moving with a velocity v in the direction parallel to one of its edges, expression for its volume is

(i) $L_0\sqrt{1 - \dfrac{v^2}{c^2}}$

(ii) $L_0^2\sqrt{1 - \dfrac{v^2}{c^2}}$

(iii) $L_0^3\sqrt{1 - \dfrac{v^2}{c^2}}$

(iv) $L_0^3\left(1 - \sqrt{\dfrac{v^2}{c^2}}\right)$

2. Answer any *five* of the following : 3×5=15

(a) What do you mean by polarisation of electromagnetic wave?

(b) Explain skin depth on the basis of electromagnetic theory. Write its expression for good conductor.

(c) What are the main postulates of Einstein's special theory of relativity?

(d) Deduce Maxwell's equation from Faraday's law of induction.

(e) Mention the characteristics of displacement current.

(f) In electromagnetic waves, what are the directions of electric vector $\vec{E}$ and magnetic vector $\vec{H}$ with respect to the propagation vector $\vec{K}$?

(g) What is length contraction in relativistic mechanics?

3. Deduce the expression for Poynting theorem relating with Poynting vector.   5

4. Deduce Maxwell's first field equation in integral form and give its physical significance.   3+1=4

5. What do you mean by electromagnetic potential and gauge transformation? Deduce the differential form of Lorentz gauge. 2+3=5

6. Obtain the boundary conditions satisfied by electromagnetic field vector $\vec{E}$, on the plane interface between two media. 4

7. Show that speed of electromagnetic waves in an isotropic dielectric is less than the speed of electromagnetic waves in free space. 5

8. Derive an expression for the velocity of plane electromagnetic waves in a conducting medium. 5

Or

Derive Fresnel's equation for reflection and refraction of electromagnetic waves at a plane boundary separating two media when the incident wave is polarized with $\vec{E}$ vector parallel to plane of incidence. 5

9. Describe Michelson-Morley experiment and discuss its results. 6

10. (a) What is relativistic energy? Prove the relation, $E^2 - p^2 C^2 = m_0^2 C^4$. 3

(b) Explain whether the twin paradox in special theory of relativity has been resolved. 2

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