5 SEM TDC PHY M 2

2017

(November)

PHYSICS

(Major)

Course : 502

Full Marks : 60

Pass Marks : 24/18

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following : 1×6=6

(a) If $\vec{A}$ and V are vector and scalar potentials, then which of the following is correct?

(i) $\vec{\nabla} \cdot \vec{A} = -\mu_0 \varepsilon_0 \frac{\partial V}{\partial t}$

(ii) $\vec{\nabla} \cdot \vec{A} = -\frac{1}{\mu_0 \varepsilon_0} \frac{\partial V}{\partial t}$

(iii) $\vec{\nabla} \cdot \vec{A} = -\sqrt{\frac{1}{\mu_0 \varepsilon_0}} \frac{\partial V}{\partial t}$

(iv) $\vec{\nabla} \cdot \vec{A} = (\mu_0 \varepsilon_0)^2 \frac{\partial V}{\partial t}$

(b) The electromagnetic energy density is equal to

(i) $\frac{1}{2}\left(\varepsilon_0 E + \frac{1}{\mu_0} B\right)^2$

(ii) $\frac{1}{2}\left(\varepsilon_0 E^2 + \frac{1}{\mu_0} B^2\right)$

(iii) $\frac{1}{2}\varepsilon_0\mu_0\left(\varepsilon_0 E^2 + \frac{1}{\mu_0} B^2\right)$

(iv) $\frac{1}{2\sqrt{\varepsilon_0\mu_0}}\left(\varepsilon_0 E^2 + \frac{1}{\mu_0} B^2\right)$

(c) If an electromagnetic wave is incident on the interface between two media and if $B_1^{\perp}$ and $B_2^{\perp}$ are the perpendicular components of magnetic field vectors at those media, then which of the following is true?

(i) $B_1^{\perp} + B_2^{\perp} = 0$

(ii) $B_1^{\perp} - B_2^{\perp} = 0$

(iii) $B_1^{\perp} - B_2^{\perp} = 1$

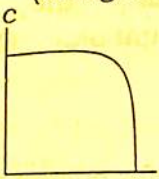
(iv) $B_1^{\perp} + B_2^{\perp} = 1$

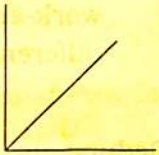
(d) The apparent length of a meterstick measured by an observer at rest, when the stick is moving along its length with a velocity equal to c is

(i) 0 (ii) $\frac{1}{\sqrt{2}}$

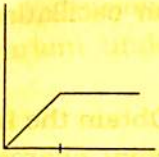
(iii) $\frac{1}{2}$ (iv) $\frac{\sqrt{3}}{2}$

(e) Which of the following figures gives the correct variation of $\frac{m}{m_0}$ (along y-axis) with $\frac{v}{c}$ (along x-axis)?

(i) 

(ii) 

(iii) 

(iv) 

(f) Lorentz transformations assume

(i) space and time both are relative

(ii) space is relative, but time is absolute

(iii) space is absolute, but time is relative

(iv) space and time both are absolute

2. *(a)* Discuss the physical significance of Maxwell's 1st and 2nd equations. 2+2=4

(b) What is magnetic vector potential? Why was it introduced despite the existence of scalar potential? 1+2=3

Or

Deduce the d'Alembertian wave equations using Lorentz gauge conditions. 3

(c) State Poynting theorem. Discuss the physical signification of each term associated with the Poynting work-energy equation. Obtain its differential form. 2+3+2=7

3. Deduce an expression for energy radiated by an oscillating electric dipole. 8

Or

Obtain the Larmor formula for an accelerated point charge at low velocity. 8

4. *(a)* Establish the Snell's law in the light of electromagnetic theory. 5

(b) Obtain Fresnel's equations when electric field vector is polarized perpendicularly. 7

Or

An electromagnetic wave is incident normally at the interface between two nonconducting media. Obtain the expressions for reflection and transmission coefficients and show that they obey the principle of conservation of energy. 6+1=7

5. *(a)* Calculate the degree of polarization for ordinary light reflected from glass ($\mu = 1 \cdot 5$) at an angle of incidence 45°. 3

(b) What is skin depth? Find an expression for skin depth in a good conductor. 1+2=3

6. *(a)* Derive the Lorentz transformation equations. 4

(b) Prove that the three-dimensional volume element is not invariant under Lorentz transformation. 2

Or

Derive Einstein's velocity addition rule. 2

7. *(a)* The half-life of a particle as measured in the laboratory comes out to be 4×10^{-8} s when its speed is $0 \cdot 8c$ and 3×10^{-8} s when its speed is $0 \cdot 6c$. Explain this. 3

(b) Explain the negative result in Michelson-Morley experiment. Mention the postulates of special theory of relativity. 3+2=5

Or

Write a short note on length contraction. How fast would a rocket have to go relative to an observer for its length to be contracted to 99% of its length at rest? 3+2=5

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