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5 SEM TDC PHY M 2

2016

(November)

PHYSICS

(Major)

Course : 502

(Electrodynamics)

Full Marks : 60

Pass Marks : 24 (Backlog) / 18 (2014 onwards)

Time : 3 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer : 1×6=6

(a) Which of the following relations is correct?

(i) $\sqrt{\varepsilon_0 E_0} = \sqrt{\mu_0}$

(ii) $E_0 = \sqrt{(\varepsilon_0 \mu_0)} B_0$

(iii) $\sqrt{(\varepsilon_0 \mu_0)} E_0 = B_0$

(iv) $\sqrt{\varepsilon_0 E_0} = \sqrt{\mu_0 B_0}$

(b) In polarization for normal incidence, the reflected coefficient (R) and transmission coefficient (T) is related by

(i) $R+T=1$

(ii) $R+T=2$

(iii) $R=T$

(iv) $R=2T$

(c) If V is the potential difference between the two ends of a wire of length L, the magnetic field is circumferential at the surface of radius r, then the magnitude of the Poynting vector is

(i) $\frac{VI}{2\pi rL}$

(ii) $\frac{VI}{4\pi rL}$

(iii) $\frac{2VI}{\pi r^2 L}$

(iv) $\frac{2}{3}\frac{VI}{\pi rL}$

(Where the symbols have their usual meanings.)

(Continued)

(d) The kinetic energy of a particle moving with relativistic speed v is given by

(i) $\frac{1}{2}mv^2$

(ii) $\frac{1}{2}\frac{m_0 v^2}{\sqrt{\left[1-\left(\frac{v^2}{c^2}\right)\right]}}$

(iii) $\frac{m_0}{\sqrt{\left[1-\left(\frac{v^2}{c^2}\right)\right]}}c^2$

(iv) $\left(\frac{m_0}{\sqrt{\left[1-\left(\frac{v^2}{c^2}\right)\right]}}-m_0\right)c^2$

(Where the symbols have their usual meanings.)

(e) In electric and magnetic field vectors of a monochromatic plane wave in conducting medium, the skin depth is determined by the relation

(i) $\left(\frac{2\omega}{\mu_0\sigma}\right)^{1/2}$

(Turn Over)

(ii) $\left(\frac{2}{\mu_0 \sigma \omega}\right)^{1/2}$

(iii) $\left(\frac{\sigma}{2\mu_0 \omega}\right)^{1/2}$

(iv) $\left(\frac{\sigma \omega}{2\mu_0}\right)^{1/2}$

(Where the symbols have their usual meanings.)

(f) The total power radiated by an accelerated charge at low velocity is

(i) $\frac{3}{2}\frac{e^2a^2}{\pi\varepsilon_0\varepsilon}$

(ii) $\frac{e^2a^2}{2\pi\varepsilon_0\varepsilon}$

(iii) $\frac{e^2a^2}{4\pi\varepsilon_0\varepsilon}$

(iv) $\frac{e^2a^2}{6\pi\varepsilon_0\varepsilon^3}$

(Where the symbols have their usual meanings.)

(Continued)

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

(a) What are the various properties of electromagnetic wave?

(b) Establish Maxwell's first equation in differential and integral forms.

(c) A neutron is travelling through the laboratory at three-fifths of speed of light. If the lifetime of neutron is 16 min, how long does it last?

(d) Derive and explain Brewster's law on the basis of electromagnetic theory.

(e) Discuss the phenomenon of total internal reflection of electromagnetic waves.

(f) Explain in brief the invalidity of ether hypothesis.

(g) Deduce the differential form of Lorentz gauge.

3. How was displacement current in electromagnetic wave introduced by Maxwell from generalized Ampere's law? 5

(Turn Over)

4. Find the momentum density and radiation pressure of electromagnetic waves. 2+2=4

5. Deduce the equation for electric and magnetic field vectors of electromagnetic waves propagated in a conducting medium. 5

6. Deduce Fresnel's equation for reflection and refraction of electromagnetic wave at normal incidence. 5

7. How is the polarization of an electromagnetic wave affected when it crosses the plane interface between two dielectrics? 5

8. Calculate the time averaged energy density of an electromagnetic wave in a conducting medium. 5

Or

Derive the equation for phase velocity of electromagnetic wave propagating in conducting medium. 5

9. Derive Lorentz transformation equations. 5

10. *(a)* Deduce Einstein mass energy relation $E = mc^2$. 3

(b) What do you mean by improper length? 2

Or

Derive the relation for the relativistic transformation of velocities. 2

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