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5 SEM TDC PHY M 2

2013

(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 magnetic field vector $\vec{H}$ propagates as a wave in nonconducting wave with a velocity v, where v is equal to

(i) $\frac{1}{\mu_0 \varepsilon_0}$ *(ii)* $\frac{1}{\mu_0^2 \varepsilon_0^2}$

(iii) $\frac{1}{\sqrt{\mu_0 \varepsilon_0}}$ *(iv)* $\frac{1}{C^2}$

(b) At grazing angle of incidence, the value of reflection coefficient is

(i) 1

(ii) >1

(iii) <1

(iv) 0

(c) Energy density of electromagnetic field is given by

(i) $U = \frac{1}{2}\varepsilon_0 E^2$

(ii) $U = \frac{1}{2}(\varepsilon_0 E^2 + \mu_0 H^2)$

(iii) $U = \frac{1}{2}\mu_0 H^2$

(iv) None of the above

(d) The value of Poynting vector at the surface of sun is found to be

(i) $6 \cdot 4 \times 10^7$ watt/m^2

(ii) $6 \cdot 172 \times 10^7$ watt/m^2

(iii) $5 \cdot 12 \times 10^7$ watt/m^2

(iv) None of the above

(e) The momentum of a photon of energy $1 \cdot 00 \times 10^{-12}$ erg is

(i) $\frac{1}{2} \times 10^{-27}$ joules

(ii) $\frac{1}{3} \times 10^{-27}$ erg

(iii) $\frac{1}{3} \times 10^{-27}$ joules

(iv) None of the above

(f) The reflection and transmission coefficients at glass air interface ($\mu_g = 1 \cdot 5$ and $\mu_a = 1 \cdot 0$) for normal angle of incidence are

(i) $R = 0 \cdot 96, T = 0 \cdot 04$

(ii) $R = 0 \cdot 04, T = 0 \cdot 96$

(iii) $R = 0 \cdot 05, T = 0 \cdot 95$

(iv) None of the above

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

(a) Define reflection and transmission coefficients at the interface between two conducting media.

(b) Explain Brewster's law on the basis of electromagnetic theory.

(c) Calculate the degree of polarization for ordinary light reflected from glass (RI = 1·5) at an angle of incidence 45°.

(d) Explain the phenomenon of twin paradox in special theory of relativity.

(e) Discuss the relativity of simultaneity on the basis of Lorentz transformation equations.

(f) Show that if the first media is denser, there is a difference between the reflected parallel and perpendicular components by

$$\tan\frac{\delta}{2} = \frac{\cos\theta_i \sqrt{[\sin^2\theta_i - (n_2/n_1)^2]}}{\sin^2\theta_i}$$

(g) A rod has length 1 meter. When the rod is in a satellite moving with velocity 0·8 c relative to the laboratory, what is the length of the rod as determined by the observer *(i)* in the satellite and *(ii)* in the laboratory?

3. Establish Maxwell's first equation in differential and integral form. Explain its physical significance. 3+2=5

4. What is displacement current? Explain the Maxwell postulate for displacement current. 1+4=5

5. Obtain the Poynting theorem for conservation of energy in an electromagnetic field and discuss the physical meaning of each term in the resulting equation. 5

6. (a) Deduce the expression for electric and magnetic fields of an oscillating electric dipole. 5

Or

(b) Show that total power radiated by an accelerated charge at low velocity is

$$P = \frac{e^2 a^2}{6\pi\varepsilon_0 c^3}$$

where symbols have their usual meaning.

7. (a) Discuss the propagation of plane electromagnetic wave in an isotropic dielectric (non-conducting) and hence obtain the wave equation for magnetic field vector $\vec{H}$. 5

Or

(b) A plane electromagnetic wave is incident obliquely at the boundary of two non-conducting media. Discuss the phenomena of reflection and refraction and hence establish the Snell's law of refraction.

8. Describe Fresnel's equation for propagation of light in crystalline (conducting) media on the basis of electromagnetic theory. 5

9. Describe in brief Michelson's experiment indicating the importance of its results. 5

10. Deduce the Einstein mass energy relation $E = mc^2$. 4

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