6 SEM TDC PHYH (CBCS) C13

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(June/July)

PHYSICS

(Core)

Paper : C–13

(Electromagnetic Theory)

Full Marks : 53
Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct answer (any *five*) :   1×5=5

   (a) The displacement current arises due to

      (i) positive charges only

      (ii) negative charges only

      (iii) both positive and negative charges

      (iv) time varying electric field

(Turn Over)

(b) An electromagnetic wave travells along z-axis. Which of the following pairs of space and time varying fields would generate such a wave?

   (i) E_x, B_y

   (ii) E_y, B_x

   (iii) E_z, B_x

   (iv) E_y, B_z

(c) Considering the reflection and refraction of a plane wave at a dielectric interface, which of the following is true?

   (i) The energy of the wave does not change

   (ii) The frequency of the wave does not change

   (iii) The polarization does not change

   (iv) The momentum of the wave does not change

(d) A plane polarized monochromatic electromagnetic wave incident on a plane interface at the Brewster angle gives rise to a reflected wave, which is

   (i) partially polarized

   (ii) unpolarized

   (iii) polarized parallel to the interface

   (iv) polarized perpendicular to the interface

(e) The energy of e.m. 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) $\dfrac{1}{2}\varepsilon_0 E^2 + \dfrac{B^2}{2\mu_0}$

(f) The ratio of electric field vector $\vec{E}$ and magnetic field vector $\vec{H}$ (i.e., $\vec{E}/\vec{H}$) has the dimension of

   (i) inductance

   (ii) resistance

   (iii) capacitance

   (iv) product of inductance and capacitance

2. Answer the following (any *five*) :   2×5=10

(a) Define scalar and vector potential.

(b) Distinguish between Lorentz gauge and Coulomb gauge.

(c) What are the peculiarities of metallic reflection?

(d) What are ordinary and extra-ordinary refractive indices?

(Continued)

(e) What are Fresnel's equations for reflection of plane polarized light from transparent media?

(f) Define single and multimode fibre.

3. (a) State and prove Poynting theorem related to the flow of energy at a point space in an electromagnetic field. What is physical significance of Poynting vector? 1+5+1=7

Or

Show that for an electromagnetic field, the energy density

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

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(b) Write Maxwell's equations in differential form and discuss the physical significance. 4

4. (a) Starting from Maxwell's equations, discuss the plane electromagnetic waves in a dielectric isotopic medium. 7

Or

Discuss the phenomena of total internal reflection on the basis of electromagnetic theory of light.

(b) Discuss in detail how two electromagnetic waves combine to form—

   (i) elliptically polarized light;

   (ii) circularly polarized light.   7

5. What is waveguide? Describe the propagation of electromagnetic wave along a hollow waveguide of uniform cross section. Explain, how cutoff mode arises.   2+2+1=5

Or

For transverse electric waves perfectly propagating in a rectangular waveguide with perfectly conducting walls, find—

(a) the cutoff wavelength;

(b) the velocity with which energy is transmitted along the guide.   5

(Continued)

6. Write short notes on (any *two*) : 4×2=8

   (a) Skin depth

   (b) Brewster's law

   (c) Nicol prism

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