6 SEM TDC PHYH (CBCS) C 13

2 0 2 3

(May/June)

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) If E is the electric field intensity, then the electrostatic energy density is proportional to

   (i) E

   (ii) $E^{1/2}$

   (iii) E^2

   (iv) $\dfrac{1}{E^2}$

   (b) The direction of propagation of electromagnetic wave is given by

   (i) $\vec{E} \cdot \vec{B}$

   (ii) $\vec{E}$

   (iii) $\vec{B}$

   (iv) $\vec{E} \times \vec{B}$

(c) In Lorentz gauge, Lorentz condition is given by

   (i) $\operatorname{div}\vec{A} - \mu\varepsilon\dfrac{\partial\phi}{\partial t} = 0$

   (ii) $\operatorname{div}\vec{A} + \mu\varepsilon\dfrac{\partial\phi}{\partial t} = 0$

   (iii) $-\operatorname{div}\vec{A} + \mu\varepsilon\dfrac{\partial\phi}{\partial t} = 0$

   (iv) $-\operatorname{div}\vec{A} - \mu\varepsilon\dfrac{\partial\phi}{\partial t} = 0$

(d) When angle of incidence is greater than Brewster's angle, the reflected ray suffers a phase change of

   (i) $\dfrac{\pi}{2}$

   (ii) π

   (iii) 0

   (iv) 2π

(e) The degree of polarization for ordinary light reflected from glass (index 1·5) at an angle-incidence at 45° is

   (i) 83·3%

   (iii) 28·1%

   (ii) 6·7%

   (iv) 61·9%

(f) The set of cutoff frequencies for TM and TE modes of a rectangular wave guide is

   (i) same

   (ii) different

   (iii) independent

   (iv) None of the above

(Continued)

2. Answer any *five* of the following questions :

                             2×5=10

   (a) What is displacement current?

   (b) What are momentum density and angular momentum density?

   (c) Define relaxation time.

   (d) State Brewster's law.

   (e) Distinguish between uniaxial and biaxial crystals.

   (f) What are step and guided indices?

3. (a) Write down Maxwell's equations in differential and integral forms and explain their physical meaning.   2+2=4

Or

Use Maxwell's equations in free space to show that $\vec{E}$ and $\vec{B}$ are in phase and in constant ratio.   4

   (b) What are gauge transformations? What are Coulomb and Lorentz gauges? What are their importances?   1+2+1=4

4. (a) Discuss the propagation of plane electromagnetic waves in an isotropic dielectric medium and show that electric field vector $(\vec{E})$ and magnetic field vector $(\vec{H})$ are perpendicular to each other.   5

   (b) What is plasma frequency?   2

(Turn Over)

(4)

5. Discuss the reflection and refraction of electromagnetic waves at a plane interface between dielectrics. Under what condition will the incident wave be totally internally reflected? 5+2=7

Or

Derive Fresnel's equation for reflection of light from a dielectric surface. How are the relations verified experimentally? 5+2=7

6. *(a)* Discuss the propagation of electromagnetic wave in anisotropic medium. 5

Or

Discuss the Fresnel's theory of optical rotation.

(b) Explain phase and group velocities of guided wave. 3

7. Write short notes on any *two* of the following : 4×2=8

(a) Skin depth

(b) Quarter-wave plate

(c) Optical fibre

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  (iii) $\vec{B}$ *(iv)* $\vec{E} \times \vec{B}$