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UDHB (VI)

CC (13)

PHE-13 → Electromagnetic Theory

2020

Time : 3 hours

Full marks : 70

Group A
(compulsory)

1. Answer the following multiple choice questions : $2 \times 10 = 20$

(i) If $\vec{E}$ is an electric field and $\vec{B}$ is magnetic field, then the energy per unit area per unit time in the electromagnetic field is given by

(a) $\vec{E} \times \vec{B}$ (b) $\vec{E} \cdot \vec{B}$ (c) $E^2 + B^2$ (d) $\frac{E}{B}$

Ans → (a) $\vec{E} \times \vec{B}$

(ii) which of the following four equations show that, the magnetic field lines cannot start from a point nor end at a point

(a) $\vec{\nabla} \cdot \vec{E} = \frac{\rho}{\epsilon_0}$ (b) $\vec{\nabla} \cdot \vec{B} = 0$ (c) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$

(d) $\text{curl } \vec{H} = \vec{J} + \frac{\partial \vec{D}}{\partial t}$

Ans (b) $\vec{\nabla} \cdot \vec{B} = 0$

(iii) The poynting theorem is a mathematical statement of conservation of

(a) momentum (b) charge (c) electromagnetic energy (d) states

Ans → (c) Electromagnetic energy

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(iv) If a plane electromagnetic wave propagating in space has an electric field of amplitude 9×10^3 V/m, then the amplitude of the magnetic field is

(a) 2.7×10^{12} T (b) 9×10^{-3} T (c) 3×10^{-4} T (d) 3×10^{-5} T

Ans (d) 3×10^{-5} T

(v) The dielectric constant of a material at optical frequency is mainly due to

(a) ionic polarizability (b) electronic polarizability
(c) dipolar polarizability (d) None of these

Ans (b) Electronic polarizability.

(vi) consider the set of following waves and say about their state of polarization

$$E_x = E_1 \cos(\omega t - kz)$$
$$E_y = E_2 \cos(\omega t - kz)$$

(a) Plane polarized (b) circularly polarized
(c) elliptically polarized (d) unpolarized

Ans (a) Plane polarized

(vii) If light is incident at the Brewester angle on a dielectric

(a) The reflected light is completely circularly polarized
(b) The reflected light is completely linearly polarized
(c) The transmitted light is completely circularly polarized
(d) The transmitted light is completely linearly polarized

Ans (b) The reflected light is completely linearly polarized.

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(VIII) The sum of two oppositely rotating circularly polarized waves of equal amplitude will be

(a) a circularly polarized wave
(b) a linearly polarized wave
(c) an elliptically polarized wave
(d) an unpolarized wave

Ans → (b) a linearly polarized wave

(IX) The specific rotation is

(a) Independent of wavelength
(b) directly proportional to wavelength
(c) inversely proportional to wavelength
(d) inversely proportional to square wavelength

Ans (d) inversely proportional to square wavelength

(X) which of the following is used to convert unpolarized light into polarized light

(a) Nicol prism (b) calcite prism (c) Tourmaline crystal (d) None of above

Ans (a) Nicol prism

Group - B

write any four short answer type question 5×4 = 20

2. what do you understand by Displacement current
3. what are scalars and vector potentials
4. Define Dielectric constant and Refractive index

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5. Prove the transverse nature of EM waves
6. Discuss the Boundary conditions at a plane interface between two media
7. state and explain Brewster's law
8. Discuss Double Refraction
9. write a short note on Numerical Aperture

Group C

Answer any two question of the following: $15 \times 2 = 30$

10. state and prove Poynting theorem

11. Discuss the propagation of EM wave through conducting media. what is skin depth

12. Derive Fresnel's Formulae for perpendicular and parallel polarization of waves.

14. Discuss the production and detection of plane, circularly and Elliptically polarized light.

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