

**CHAPTER-8**  
**Electromagnetic Wave**  
**ASSIGNMENT-3**

**1 MARK QUESTIONS**

Q1. The relative magnetic permeability of the medium is 2.5 and the relative electrical permittivity of the medium is 2.25. Compute the refractive index of the medium.

- (a) 2.37                      (b) 4.75                      (c) 0.25                      (d) 1.05

Q2. Compute the speed of the electromagnetic wave in a medium if the amplitude of electric and magnetic fields are  $3 \times 10^4$  and  $2 \times 10^{-4}$  tesla, respectively

- (a)  $3 \times 10^8$  m/s                      (b)  $1.5 \times 10^8$  m/s                      (c)  $6 \times 10^8$  m/s                      (d)  $5 \times 10^8$  m/s

Q3. The charging current for a capacitor is 0.25 A. What is the displacement current across its plates?

Q4. If the Earth did not have an atmosphere, would its average surface temperature be higher or lower than what it is now?

**ASSERTION REASON TYPE QUESTIONS**

Q5. **Assertion:** The frequencies of incident, reflected and refracted beams of monochromatic light incident from one medium to another are the same.

**Reason:** The incident, reflected and refracted rays are coplanar.

Q6. **Assertion:** The earth without its atmosphere will be inhospitably cold.

**Reason:** All heat would escape in the absence of atmosphere.

Q7. **Assertion:** Microwaves are better carriers of signal than optical waves.

**Reason:** Microwaves move faster than optical waves.

Q8. **Assertion:** Gamma rays are more energetic than x rays.

**Reason:** Gamma rays are of nuclear origin but x rays are produced due to sudden deceleration of high energy electrons while falling in the metal of high atomic number.

**CASE STUDY BASED QUESTION**

Q9. According to Maxwell's electromagnetic equations it has been proved that electric and magnetic field vectors are perpendicular to each other and also perpendicular to the direction of propagation as shown in the figure below. If  $E_x$  is the electric field along X axis, then  $B_y$  will be the direction of magnetic field along y axis and both which are perpendicular to the z axis showing direction of propagation. The light waves are also electromagnetic waves and may travel through

vacuum also. So, we can find the velocity of a light traveling through the material medium having permittivity  $\epsilon$  and magnetic permeability  $\mu$  as  $V = 1/\sqrt{\epsilon\mu}$

In this way, we proved that velocity of light also depends on the electrical and magnetic properties of that medium through which it is traveling. The velocity of light which is constant everywhere is having value as  $3 \times 10^8 \text{ m/s}$ . The most technological importance of electromagnetic waves is that they have a strong capacity to take energy from one place to another place. The best examples are radio waves, TV signals which also carry energy from their broadcasting stations. Also, life is possible on the earth only because of the sunlight coming from the sun to the earth which also carries energy and it is nothing but the electromagnetic waves. Due to which electromagnetic waves are considered as the transverse waves.

(i) The ratio of relative permittivity of the medium to the permittivity of vacuum is called as \_\_\_\_\_.

- (a) permeability (b) permittivity of free space  
(c) dielectric constant of the medium (d) electric intensity

(II) Who showed that electromagnetic waves can be polarised?

- (a) Maxwell (b) Hertz (c) Ampere (d) Michelson and Morley

(III) The pressure exerted by the electromagnetic waves is called as

- (a) light pressure (b) electric pressure (c) magnetic pressure (d) radiation pressure

(IV) What is the relationship between magnitude of magnetic field and electric field in case of electromagnetic waves from Maxwell's equations?

(V) What is meant by the permittivity and permeability of the medium?

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### MARKS QUESTIONS

Q10. The electric field of an electromagnetic wave is given by  $E = 50 \sin m(t - x/c)$  N/C. Find the energy contained in a cylinder of cross-section  $10 \text{ cm}^2$  and length  $50 \text{ cm}$  along the X-axis.

Q11. A variable-frequency a.c. source is connected to a capacitor. Will the displacement current increase or decrease with increase in frequency?

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### MARKS QUESTIONS

Q12. The magnetic field in a plane electromagnetic wave is given by  $B_y = 2 \times 10^{-7} \sin [0.5 \times 10^3 x + 1.5 \times 10^{11} t]$  (in T)

- (a) What is the wavelength and frequency of the wave?  
(b) Write an expression for the electric field.

Q13. Answer the following questions-

(i) Name the EM waves which are used for the treatment of certain forms of cancer.

Write their frequency range.

(ii) Thin ozone layer on top of stratosphere is crucial for human survival. Why?

(iii) Why is the amount of the momentum transferred by the EM waves incident on the surface so small?