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Electromagnetic waves their characteristics, their Transverse Nature.

CLASS-XII

SUBJECT : PHYSICS
CHAPTER NUMBER: 08
CHAPTER NAME : ELECTROMAGNETIC WAVES

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Electromagnetic Waves:

For a region where there are no charges and conduction current, Faraday's and Ampere's laws take the symmetrical form:

$$\oint_l \vec{E} \cdot \vec{dl} = -\frac{d\Phi_B}{dt} \qquad \text{and} \qquad \oint_l \vec{B} \cdot \vec{dl} = -\mu_0\varepsilon_0 \frac{d\Phi_E}{dt}$$

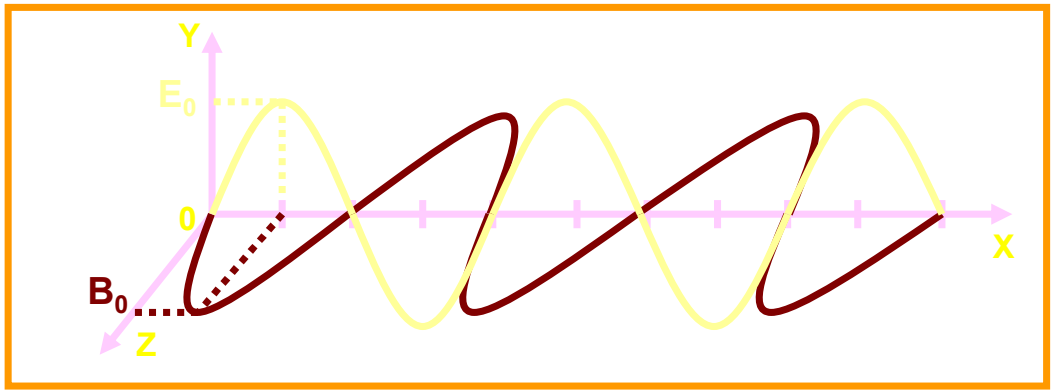
It can also be shown that time – varying electric field produces space – varying magnetic field and time – varying magnetic field produces space – varying electric field with the equations:

$$\frac{jE_y}{jx} = -\frac{jB_z}{jt} \qquad \text{and} \qquad \frac{jB_z}{jx} = -\mu_0\varepsilon_0 \frac{jE_y}{jt}$$

Electric and magnetic fields are sources to each other.

Electromagnetic wave is a wave in which electric and magnetic fields are perpendicular to each other and also perpendicular to the direction of propagation of wave.

Properties of Electromagnetic Waves:



1. Variations in both electric and magnetic fields occur simultaneously. Therefore, they attain their maxima and minima at the same place and at the same time.
2. The direction of electric and magnetic fields are mutually perpendicular to each other and as well as to the direction of propagation of wave.
3. The electric field vector E and magnetic field vector B are related by $c = E_0 / B_0$ where E_0 and B_0 are the amplitudes of the respective fields and c is speed of light.

Properties of Electromagnetic Waves:

4. The velocity of electromagnetic waves in free space, $c = 1 / \sqrt{\mu_0 \varepsilon_0}$

5. The velocity of electromagnetic waves in a material medium $= 1 / \sqrt{\mu\varepsilon}$ where μ and ε are absolute permeability and absolute permitivity of the material medium.

6. Electromagnetic waves obey the principle of superposition.

7. Electromagnetic waves carry energy as they propagate through space. This energy is divided equally between electric and magnetic fields.

8. Electromagnetic waves can transfer energy as well as momentum to objects placed on their paths.

9. For discussion of optical effects of EM wave, more significance is given to Electric Field, E. Therefore, electric field is called 'light vector'.

10. Electromagnetic waves do not require material medium to travel.

11. An oscillating charge which has non-zero acceleration can produce electromagnetic waves.

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