



Chapter 8

Electromagnetic Wave

Chapter 8 Electromagnetic Wave

BOARD-2013

1. (i) write Gauss's Law for magnetism in the form of Maxwell's eqn.
(ii) write value of $4/\mu_0 E_0$

\Rightarrow (i) $\oint \vec{B} \cdot d\vec{A} = 0$

(ii) $C = \frac{1}{\sqrt{\mu_0 E_0}} = 3 \times 10^8 \text{ m/s}$

BOARD-2013 (Supp.)

2. (i) write the mathematical form of Ampere- Maxwell Law.
(ii) write wavelength range of Infra-red rays. write the name of two gaseous molecules which can absorb it.

\Rightarrow (i) $\oint \vec{B} \cdot d\vec{l} = \mu_0 I + \mu_0 E_0 \frac{d\phi}{dt}$

(ii) Range of Infra-red rays - 1mm to 700 nm
 CO_2, NH_3 can absorb infra-red.

BOARD-2014

3. write mathematical eqn of Ampere - Maxwell Law.
4. Identify the radiation of EM spectrum which-
- is absorbed by ozone layer in atmosphere.
 - is produced by bombarding a metal target by high speed electron.
 - is used in satellite communication.
 - have wavelength range of 400 - 700 nm.

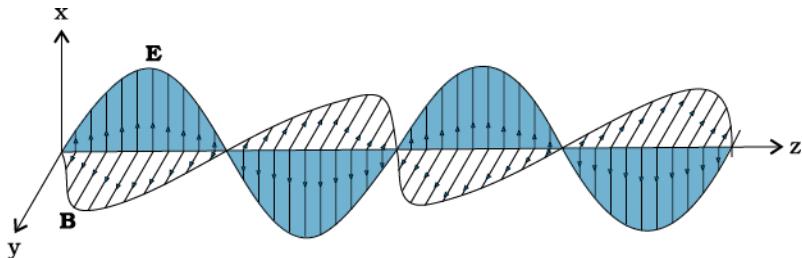
- \Rightarrow
- UV Rays.
 - X-Rays
 - Radio waves
 - Visible light wave

BOARD-2015

5. write the name of electromagnetic wave generated by vacuum tube magnetron.
 \Rightarrow Microwave.

6. Draw the propagation of EM wave and write two properties.

⇒



- (i) The velocity of EM wave is $\frac{1}{\sqrt{\mu_0 \epsilon_0}}$ in vacuum and equal to $C = 3 \times 10^8 \text{ m/s}$
- (ii) No physical medium is required for propagation of EM wave.
- (iii) Electric field and magnetic fields in an EM wave are \perp to each other and also to the direction of propagation.
- (iv) Velocity of EM wave in medium is $\frac{1}{\sqrt{\mu \epsilon}}$.
7. The amplitude of magnetic field associated with a EM wave in vacuum is $B_0 = 50 \times 10^{-8} \text{ T}$. write the value of amplitude of Electric field associated with wave in V/m .

⇒

$$\frac{E_0}{B_0} = C$$

$$E_0 = C \times B_0$$

$$E_0 = 3 \times 10^8 \times 50 \times 10^{-8}$$

$$E_0 = 150 \text{ V/m.}$$

BOARD-2016

8. Which EM waves are used in remote controllers (switches)?

⇒ Infrared waves.

9. What is displacement current? obtain an expression of displacement current for charged capacitor. write Ampere - Maxwell's Law.

⇒ (i) Displacement current - The current due to change in electric field b/w plates of capacitor is called displacement current.

(ii) Expression of displacement current -

$$\phi = \frac{q}{\epsilon_0}$$

$$q = \phi \epsilon_0$$

differentiate $\omega \cdot \sigma \cdot t$ time both side

$$\frac{dq}{dt} = \frac{d(\phi \epsilon_0)}{dt}$$

$$I_d = \epsilon_0 \frac{d\phi}{dt}$$

BOARD-2017

10. A charged particle oscillates about its equilibrium position with a frequency of 100 MHz. What is the frequency of EM waves produced by the oscillator? [1]
- ⇒ Frequency of EM wave = Frequency of charged oscillated particle
= 100 MHz
11. Which waves normally broadcast the frequencies in ultra high frequency (UHF) range?
- ⇒ Radio waves.
12. Write the name of any four waves produced in EM spectrum.
- ⇒ wave wavelength Range
- | | |
|---------------|---------------------|
| 1. Radio | > 0.1m |
| 2. Microwave | 0.1m to 1mm |
| 3. Infra red | 1mm to 700nm |
| 4. Light | 700nm to 400 nm |
| 5. UV rays | 400nm to 1nm |
| 6. X-rays | 1nm to 10^{-3} nm |
| 7. Gamma rays | $< 10^{-3}$ nm |

BOARD-2017 (Supp.)

13. Write the value, with unit of $\frac{1}{\mu_0 \epsilon_0}$.
- ⇒ 3×10^8 m/s
14. Write the name of EM waves, which-
- Is absorbed by ozone layer in the atmosphere.
 - Has wavelength range almost b/w 1nm to 10^{-3} nm.
 - Used in video recorders and in Hi-Fi system.
 - Used in Microwaves ovens.
- ⇒ (i) UV Rays
(ii) X Rays
(iii) Infra-red Rays
(iv) Microwaves.

BOARD-2018

15. Write any two Maxwell's equation.
- ⇒

Maxwell's equations in vacuum

1. Gauss's Law for electricity - $\oint \vec{E} \cdot d\vec{A} = Q/\epsilon_0$

2. Gauss's Law for magnetism - $\oint \vec{B} \cdot d\vec{A} = 0$

3. Faraday's Law - $\oint \vec{E} \cdot d\vec{l} = -\frac{d\phi_B}{dt}$

4. Ampere - Maxwell Law - $\oint \vec{B} \cdot d\vec{l} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$

BOARD - 2018 (Supp.)

16. Write definition of displacement current. Prove that displacement current is equal to conduction current.

⇒

$$I_d = \epsilon_0 \frac{d\phi}{dt}$$

$$I_d = \epsilon_0 \frac{d}{dt} \left(\frac{q}{\epsilon_0} \right)$$

$$I_d = \frac{dq}{dt}$$

$$I_d = I_c$$

BOARD - 2019

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17. In electromagnetic waves write the value of -

(a) angle (b) Phase difference b/w electric field & magnetic field

⇒ (a) angle = 90°

(b) Phase difference = 0°

18. The magnitude to the electric field E at any point in free space is 300 v/m find magnetic field.

⇒ $\frac{E}{B} = C$

$$B = E/C = \frac{300 \text{ v/m}}{3 \times 10^8 \text{ m/s}} = 1 \times 10^{-6} \text{ T}$$

BOARD-2020 (Supp.)

19. Write any four characters of EM waves.

BOARD-2021

20. In electromagnetic wave, the value of angle b/w \vec{E} & \vec{B} is -
 $\Rightarrow 90^\circ$

BOARD-2022

21. Write relation b/w ϵ_0 , μ_0 & C.

$$(i) \mu_0 \epsilon_0 = C^2$$

$$(ii) \frac{1}{\mu_0 \epsilon_0} = C^2$$

$$(iii) \sqrt{\mu_0 \epsilon_0} = C^2$$

$$(iv) \frac{1}{\sqrt{\mu_0 \epsilon_0}} = C^2$$

BOARD-2023

22. The communication frequency band range for FM broadcasting is -

$$\Rightarrow 88-108 \text{ MHz}$$

23. Write the name of EM wave generated by magnetron in vacuum.
 \Rightarrow Microwave.

TABLE 8.1 DIFFERENT TYPES OF ELECTROMAGNETIC WAVES

Type	Wavelength range	Production	Detection
Radio	> 0.1 m	Rapid acceleration and decelerations of electrons in aerials	Receiver's aerials
Microwave	0.1 m to 1 mm	Klystron valve or magnetron valve	Point contact diodes
Infra-red	1 mm to 700 nm	Vibration of atoms and molecules	Thermopiles Bolometer, Infrared photographic film
Light	700 nm to 400 nm	Electrons in atoms emit light when they move from one energy level to a lower energy level	The eye Photocells Photographic film
Ultraviolet	400 nm to 1 nm	Inner shell electrons in atoms moving from one energy level to a lower level	Photocells Photographic film
X-rays	1 nm to 10^{-3} nm	X-ray tubes or inner shell electrons	Photographic film Geiger tubes Ionisation chamber
Gamma rays	< 10^{-3} nm	Radioactive decay of the nucleus	-do-

BOARD-2024

24. The formula of displacement current -

$$\Rightarrow I_d = \epsilon_0 \frac{d\phi}{dt}$$

25. Write the name of any three waves produced in EM spectrum -

- \Rightarrow (i) Gamma rays
- (ii) X-rays
- (iii) UV rays



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