PARISHRAM

2026

Lecture - 02

Electromagnetic Waves

PHYSICS | Practice Session

BY - RAKSHAK SIR

Topics *to be covered*

A Practice Session – AC + EMW

Alternating Current & Electromagnetic Waves Practice Questions

QUESTION

An ac voltage is applied across an ideal inductor. The current in it **[2024]**

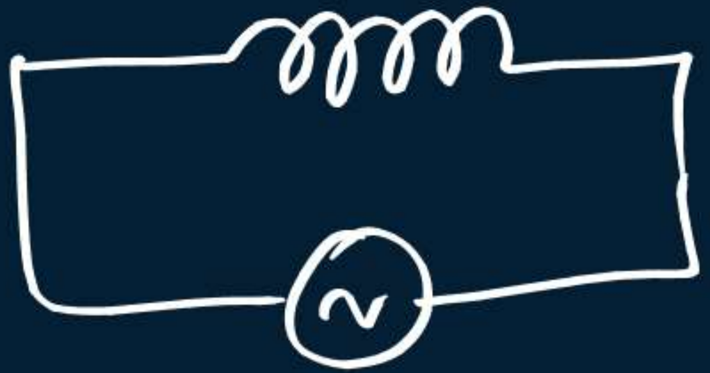
i leads
V lags

(A) ~~leads the voltage by $\left(\frac{1}{4}\right)$ cycle.~~

(B) lags the voltage by $\left(\frac{1}{4}\right)$ cycle.

(C) ~~leads the voltage by $\left(\frac{1}{2}\right)$ cycle~~

(D) ~~lags the voltage by $\left(\frac{1}{2}\right)$ cycle~~



Phase Jump — $\frac{\pi}{2}$

Time Jump — $\frac{T}{4}$

V leads I by $\frac{\pi}{2}$

I lags V by $\frac{\pi}{2}$

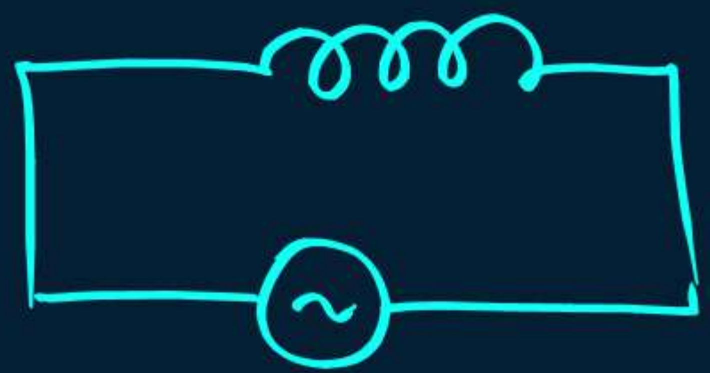
$\frac{T}{4}$

QUESTION

Note> ⟵ LCR

Distinguish between reactance and impedance of an ac circuit. Show that an ideal inductor in an ac circuit does not dissipate any power. [2024]

L



$$P_{av} = V_{rms}\, i_{rms} \cos\phi$$

$$P_{av} = V_{rms}\, i_{rms} \cos 90$$

$$= 0$$

$$\phi = \frac{\pi}{2}$$

Phase Diff

- V lead i by $\frac{\pi}{2}$
- i lag V by $\frac{\pi}{2}$

QUESTION

Which of the following quantity/quantities remains same in primary and secondary coils of an ideal transformer?

Current, Voltage, Power, Magnetic flux [2024]

(A) Current only ✗

(B) Voltage only ✗

(C) Power only ✗

(D) Magnetic flux and Power both ✓

ideal Transformer :-

i) $P_{in} = P_{out}$

ii) flux loss ✗

QUESTION

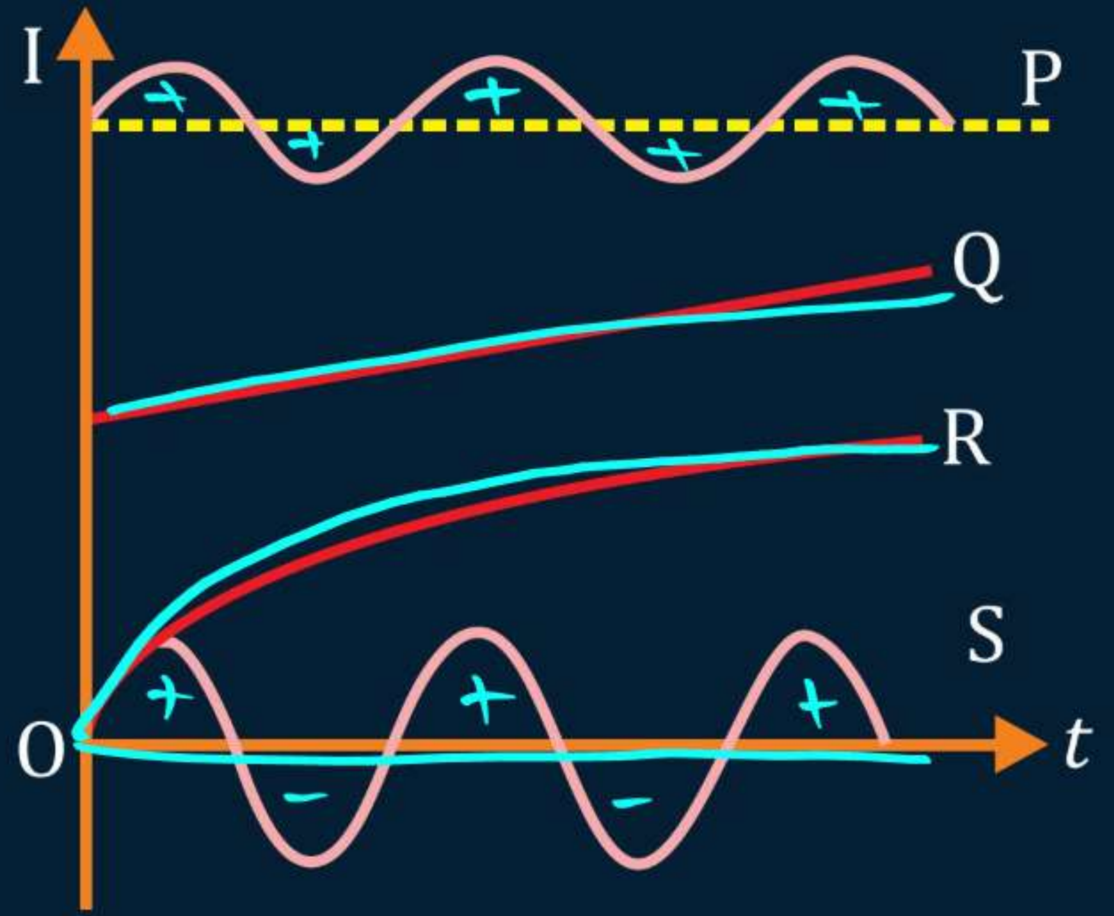
The figure shows variation of current (I) with time (t) in four devices P, Q, R and S. The device in which an alternating current flows is [2023]

(A) P

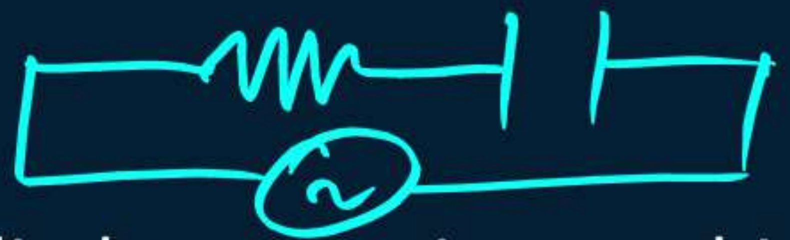
(B) Q

(C) R

(D) S



QUESTION



An ac voltage $v = v_0 \sin(\omega t)$ is applied to a series combination of a resistor R and an element X. The instantaneous current in the circuit is $I = I_0 \sin\left(\omega t + \frac{\pi}{4}\right)$. Then which of the following is correct? **[2023]**

I leads V by $\frac{\pi}{4}$

(A) X is a capacitor and $X_C = \sqrt{2}R$

(B) ~~X is an inductor and $X_L = R$~~

(C) ~~X is an inductor and $X_L = \sqrt{2}R$~~

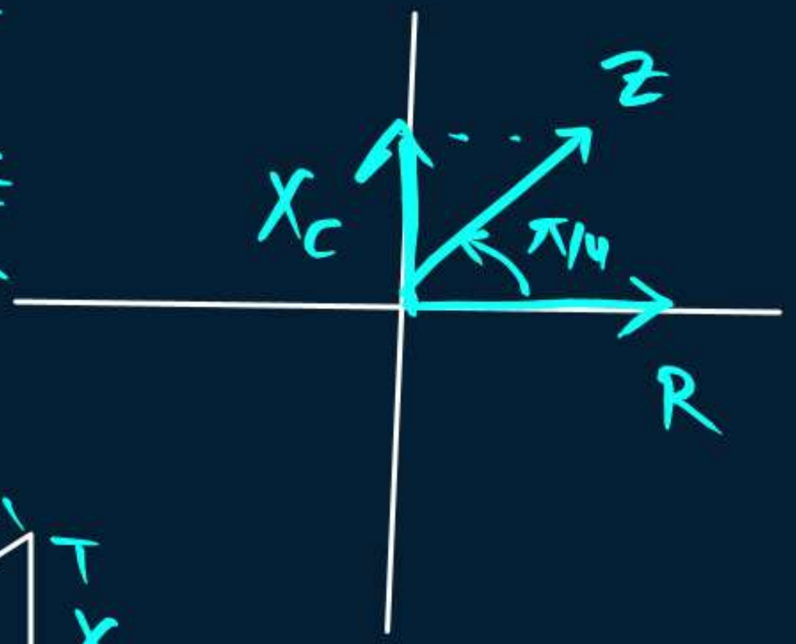
(D) X is a capacitor and $X_C = R$

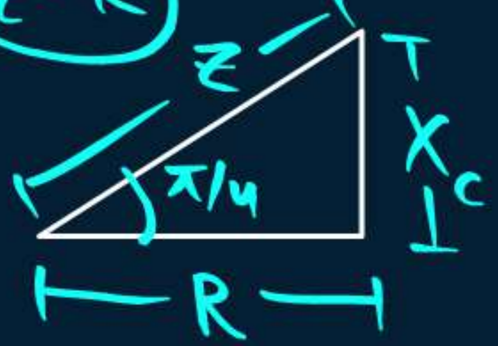
$\tan\phi = \frac{P}{B}$

$\tan\frac{\pi}{4} = \frac{X_C}{R}$

$1 = \frac{X_C}{R}$

$X_C = R$





QUESTION

Which of the following statements about a series LCR circuit connected to an ac source is correct? **[2023]**

A If the frequency of the source is increased, the impedance of the circuit first decreases and then increases.

B If the next reactance $(X_L - X_C)$ of circuit becomes equal to its resistance, then the current leads the voltage by 45°

C At resonance, the voltage drop across the inductor is more than the across the capacitor.

D At resonance, the voltage drop across the capacitor is more than that across the inductor.

QUESTION

What is the ratio of inductive and capacitive reactance in an ac circuit? [2023]

(A) $\omega^2 LC$

(B) LC^2

(C) $\frac{LC}{\omega^2}$

(D) $\omega^2 L$

$$\frac{X_L = \omega L}{X_C = \frac{1}{\omega C}} = \omega^2 LC$$

Ans

QUESTION

A resistor of 30Ω and a capacitor of $\frac{250}{\pi}$ μF are connected in series to a 200 V, 50 Hz ac source. Calculate:

(i) the current in the circuit, and

(ii) voltage drops across the resistor and the capacitor.

(iii) Is the algebraic sum of these voltages more than the source voltage? If yes, solve the paradox.

[2023]

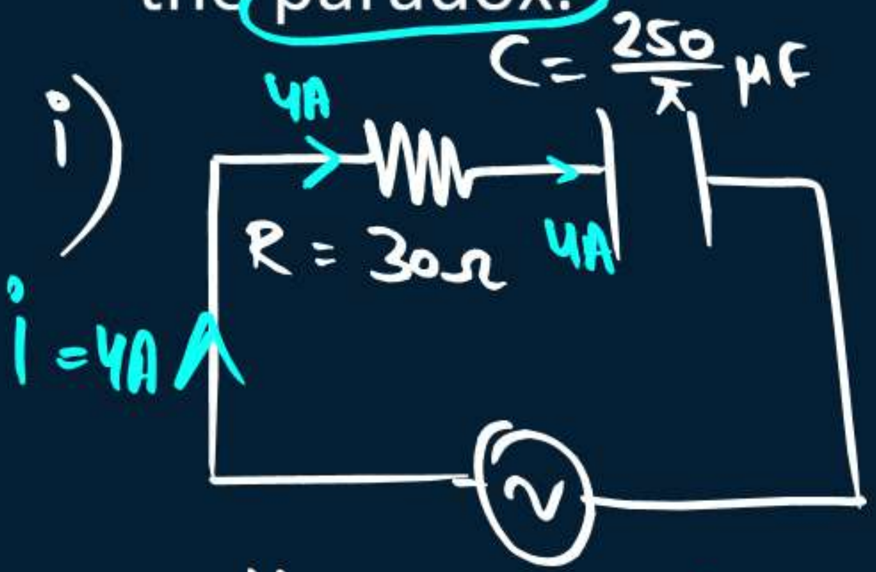
$$X_c = \frac{1}{\omega C} = \frac{1}{2\pi \nu C}$$

$$= \frac{1}{2 \times \cancel{\pi} \times 50 \times \frac{250}{\cancel{\pi}} \times 10^{-6}}$$

$$= \frac{1}{25000 \times 10^{-6}}$$

$$= \frac{1000000}{25000} = 40\Omega$$

i)



$V_{rms} = 200V$ ✓

$\nu = 50Hz$

$$V = iZ$$

$$i_{rms} = \frac{V_{rms}}{Z}$$

$$= \frac{200}{50} = 4$$

$$i_{rms} = 4A$$ ✓

$$Z = \sqrt{R^2 + X_c^2}$$

$$Z = \sqrt{(30)^2 + (40)^2}$$

$$Z = \sqrt{50^2} = 50\Omega$$

ii) $V_R = iR$

$= 4 \times 30 = 120\,V$

$V_C = i X_C$

$= 4 \times 40 = 160\,V$

iii) $V = V_R + V_C$

$= 120 + 160$

$V = 280\,V$

Add ×

$V_{source} = 200\,V \rightarrow$ RMS

$V = \sqrt{V_R^2 + V_C^2}$

$= \sqrt{(120)^2 + (160)^2}$

$= \sqrt{14400 + 25600}$

$= \sqrt{40000} = 200\,V$

QUESTION

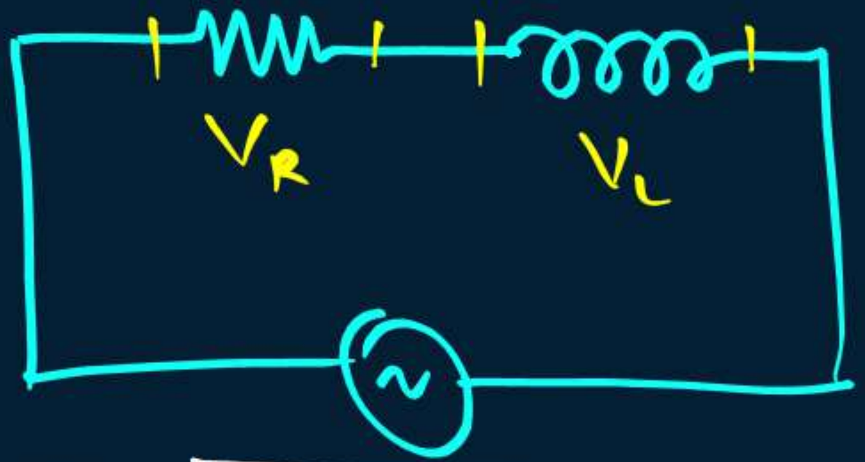
$I = I_0 \sin(\omega t)$

$I_0 = 14\,A$, $I_{rms} = \frac{I_0}{\sqrt{2}} = \frac{\cancel{14}^{10}}{\cancel{1.4}}$

An alternating current I = 14 sin (100 πt). A passes through a series combination of a resistor of 30Ω and inductor of $\left(\frac{2}{5\pi}\right)$H. Taking $\sqrt{2} = 1.4$, calculate the

(i) rms value of the voltage drops across the resistor and the inductor and

(ii) power factor of the circuit. [2023]



$Z = \sqrt{R^2 + X_L^2}$

$= \sqrt{(30)^2 + (40)^2} = \sqrt{50^2} = 50$

i)

$V_R = i_{rms} R$

$= 10 \times 30 = 300V$

$V_L = i_{rms} X_L$

$= i_{rms} (\omega L)$

$= \cancel{10}^{2} \times 100 \cancel{\pi} \times \frac{2}{\cancel{5}\cancel{\pi}_1}$

$= 400V$

ii) $\cos\phi$

$\cos\phi = \frac{R}{Z}$

$= \frac{3\cancel{0}}{5\cancel{0}}$

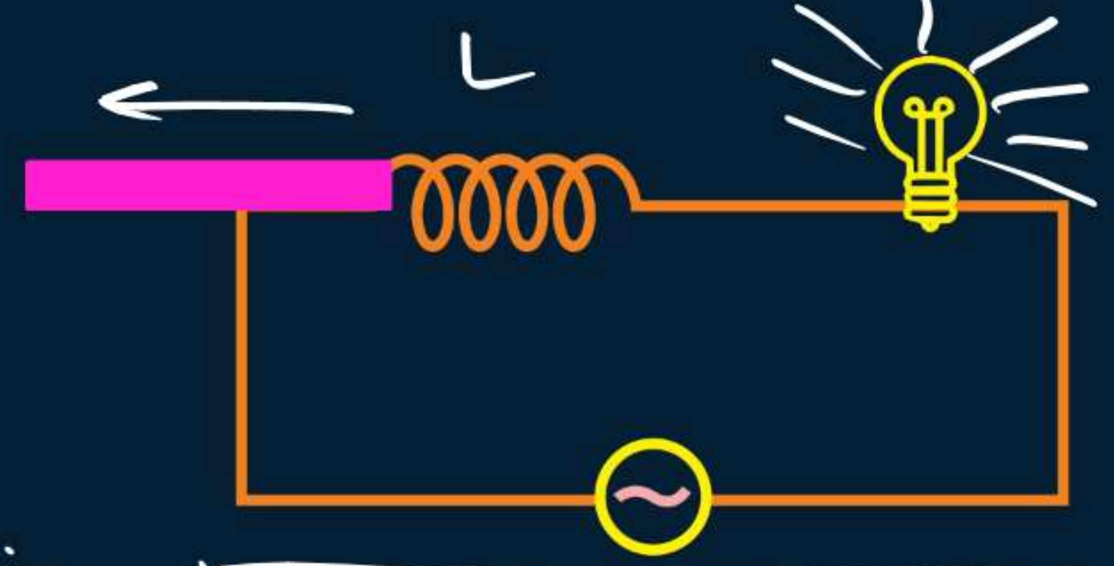
$= \frac{3}{5}$ Ans

QUESTION

An iron cored coil is connected in series with an electric bulb with an AC source as shown in figure. When iron piece is taken out of the coil, the brightness of the bulb will

$\mu_r \downarrow \; L \downarrow \; X_L \downarrow \; i \uparrow$

[2022-2023]



(A) decrease

(B) increase

(C) remain unaffected

(D) fluctuate

Inserting the rod ← $\boxed{\mu_r \uparrow \; L \uparrow \; X_L \uparrow = \omega L \uparrow \quad i \downarrow}$

QUESTION

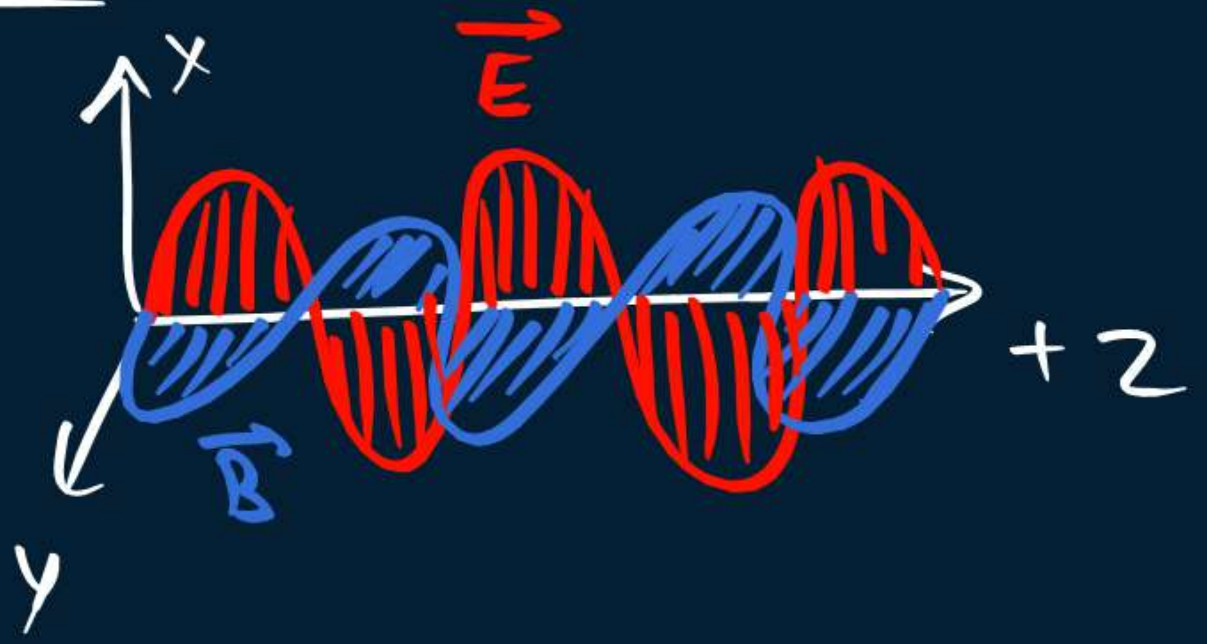
$$v = \frac{1}{\sqrt{\mu\epsilon}} \quad , \quad c = \frac{1}{\sqrt{\mu_0\epsilon_0}}$$

(a) On what factors does the speed of an electromagnetic wave is medium depend?

(b) How is an electromagnetic wave produced? → Accelerating charge

(c) Sketch a schematic diagram depicting the electric and magnetic fields for an electromagnetic wave propagating along z-axis. [2024]

$\vec{E} \times \vec{B}$



a) depends on permeability and permittivity of the medium

QUESTION

$V = \lambda \nu$

Electromagnetic waves with frequency 1.0×10^{18} Hz are knows as [2024]

A. Infrared rays

B. Ultraviolet ray

C. X-rays

D. Gamma rays

QUESTION

The electromagnetic waves used to purify water are [2024]

A. Infrared rays

B. Ultraviolet ray

C. X-rays

D. Gamma rays

QUESTION

Name the electromagnetic waves also known as 'heat waves'. [2023]

A. Radiowaves

B. Microwaves

C. X-rays

D. Infrared waves

QUESTION

Which one of the following electromagnetic radiation has the least wavelength? [2023]

(A) Gamma rays

(B) Microwaves

(C) Visible light

(D) X-rays

$E\uparrow = h\nu\uparrow$

$E\uparrow = \frac{hc}{\lambda\downarrow}$

G X U V I M R

$\lambda\uparrow$

$\nu\uparrow$

$E\uparrow$

QUESTION

Write any two characteristics of an electromagnetic wave. Why are microwaves used in radar systems?

[2023]

Notes...

Shorter λ

$\downarrow$

More ν

$\downarrow$

More E

$\downarrow$

More penetrating Power

QUESTION

Displacement current exists only when

[2020]

(A) electric field is changing

(B) magnetic field is changing

(C) electric field is not changing

(D) magnetic field is not changing

$$\boxed{i_d = \epsilon_0 \left(\frac{d\phi_E}{dt} \right)}$$

QUESTION

Write the expression for the speed of light in a material medium of relative permittivity ϵ_r and relative magnetic permeability μ_r. [2023]

$$\frac{V}{C} = \frac{\frac{1}{\sqrt{\mu\epsilon}}}{\frac{1}{\sqrt{\mu_0\epsilon_0}}}$$

$$= \sqrt{\left(\frac{\mu_0}{\mu}\right)\left(\frac{\epsilon_0}{\epsilon}\right)}$$

$$\frac{V}{C} = \sqrt{\frac{1}{\mu_r} \times \frac{1}{\epsilon_r}} = \frac{1}{\sqrt{\mu_r\epsilon_r}}$$

$$V = \frac{1}{\sqrt{\mu\epsilon}} \quad \text{---- (1)}$$

$$C = \frac{1}{\sqrt{\mu_0\epsilon_0}} \quad \text{---- (2)}$$

$$\boxed{V = \frac{C}{\sqrt{\mu_r\epsilon_r}}} \rightarrow V = \frac{C}{n} \rightarrow n = \frac{C}{V}$$

$$\frac{1}{\epsilon_r} = \left(\frac{\epsilon_0}{\epsilon}\right)$$

$$\boxed{\epsilon_r = \frac{\epsilon}{\epsilon_0}}$$

$$\boxed{\mu_r = \frac{\mu}{\mu_0}}$$

$$\frac{1}{\mu_r} = \left(\frac{\mu_0}{\mu}\right)$$

QUESTION

A welder wears special glasses to protect his eyes mostly from the harmful effect of

[2020]

A. Very intense visible light

B. Infrared radiation

C. Ultraviolet rays

D. microwaves

QUESTION

Electromagnetic waves used as a diagnostic tool in medicine are [2020]

A X-rays

B Ultraviolet rays

C Infrared rays

D Ultrasonic waves.

QUESTION

Arrange the following electromagnetic waves in order of increasing frequency:

~~γ~~X-rays, Microwaves, Infrared rays and Ultraviolet rays. [2014]

X M I U

G X U V I M R

$\nu \uparrow$

M < I < U < G

Microwaves < Infra < UV < Gamma

Electromagnetic Spectrum

1. Radio Waves $= 5 \times 10^3 - 10^9$ Hz
2. Micro Waves $= 10^9 - 3 \times 10^{11}$ Hz
3. Infrared $= 10^{11} - 10^{14}$ Hz
4. Visible $= 4 \times 10^{14} - 7 \times 10^{14}$ Hz
5. Ultraviolet $= 8 \times 10^{14} - 5 \times 10^{16}$ Hz
6. X-ray $= 10^{16} - 10^{21}$ Hz
7. Gamma Rays $= 10^{18} - 10^{22}$ Hz

1. Radio Waves

It is produced by the accelerated motion of charges in conducting wires. (i.e., by oscillating electric charge).

Used in radio and T.V. communication.

2. Microwaves

It is produced by special vacuum tubes (called Klystrons, Magnetrons and Gunn diodes)

(1) It is used to detect speed of tennis ball, cricket ball, automobile.

(2) It is used in microwave ovens.

3. Infrared

- It is produced by hot bodies i.e. vibrations of atoms and molecules. (Hence also called heatwaves).
- It is not detected by human eye but snake can detect it.
- Used to see through fog and smoke, muscular pain
- It is responsible for keeping average temperature through green-house effect.

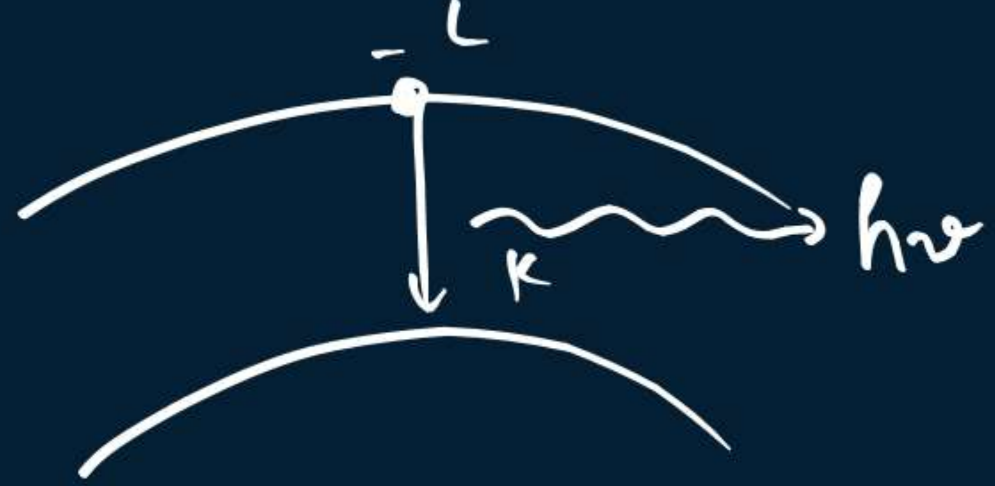
4. Visible

400nm — 700nm → λ

V I B G Y O R

It is a narrow range of electromagnetic spectrum

It is produced when electrons jump to lower level.



$$E = h\nu$$

$$E = \frac{hc}{\lambda}$$

5. Ultra-Violet

- It is produced by sun, special lamps and very hot bodies.
- It is produced when electrons jump to lower level
- Most of the ultraviolet radiations coming from the sun are absorbed by the ozone layer in the earth's atmosphere.
- The UV rays in large quantity produce harmful effect on human being, it causes production of melanin, tanning of the skin.
- It is used in water purifiers..

6. X-Ray

It is produced in a tube called modern X-ray tube and electronic transition.

X-ray are used as a diagnostic tool in medicine

In engineering it is used for detecting faults, cracks, flaws and holes.

7. Gamma Rays

- It is high frequency radiation which is produced in nuclear reactions they are emitted by radioactive nuclei.
- They are used for cancer therapy.
- They provide important information regarding nuclear structure.

QUESTION

Match List-I (Electromagnetic wave type) with List-II (Its association/ application) and select the correct option from the choices given below the lists:

	List 1		List 2
1.	Infrared waves	(i)	To treat muscular strain
2.	radio waves	(ii)	For broadcasting
3.	X-rays	(iii)	To detect fracture of bones
4.	Ultraviolet rays	(iv)	Absorbed by the ozone layer of the atmosphere

Electromagnetic Spectrum – Detailed Overview

Region	Frequency Range (Hz)	Wavelength Range (m)	Discoverer	Source	Applications
Radio Waves	$< 3 \times 10^{9}$	$> 10^{-1}$	Maxwell, Hertz	Antennas, Oscillators	Radio, TV, Wi-Fi, Mobile
Microwaves	$3 \times 10^{9} - 3 \times 10^{11}$	$10^{-3} - 10^{-1}$	Maxwell	Magnetrons, Cosmic	Microwave oven, Radar
Infrared (IR)	$3 \times 10^{11} - 4.3 \times 10^{14}$	$7.5 \times 10^{-7} - 10^{-3}$	W. Herschel	Thermal, IR LEDs	Night vision, Heating
Visible Light	$4.3 \times 10^{14} - 7.5 \times 10^{14}$	$4 \times 10^{-7} - 7.5 \times 10^{-7}$	Isaac Newton	Sunlight, Lasers	Vision, Optics, Illumination
Ultraviolet (UV)	$7.5 \times 10^{14} - 3 \times 10^{17}$	$10^{-8} - 4 \times 10^{-7}$	J. W. Ritter	Sun, Mercury lamps	Sterilization, Forensics
X-Rays	$3 \times 10^{17} - 3 \times 10^{19}$	$10^{-12} - 10^{-8}$	W. Roentgen	X-ray tubes	Medical imaging, Security
Gamma Rays	$> 3 \times 10^{19}$	$< 10^{-12}$	Paul Villard	Nuclear, Cosmic	Cancer therapy, Astronomy

Homework

Ch 1 - - - - 8 (Book - I completed)

Short Notes (1-3 Pg)

PARISHRAM

2026

"One-shot"

Electromagnetic Waves (Easy + Learning based)

PHYSICS ONE SHOT

BY - RAKSHAK SIR

Topics *to be covered*

1. Displacement Current ✓
   ONE SHOT
2. Ampere – Maxwell Law ✓
3. Maxwell's Equations ✓
4. Equation of EM Waves ✓

Unit–V	**Electromagnetic Waves**	
	Chapter–8: Electromagnetic Waves — 3 PYQ too less + AC	
Unit–VI	**Optics**	**18**
	Chapter–9: Ray Optics and Optical Instruments	
	Chapter–10: Wave Optics	

Unit V: **Electromagnetic waves**

Chapter–8: Electromagnetic Waves

Basic idea of displacement current, Electromagnetic waves, their characteristics, their transverse nature (qualitative idea only).

Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) including elementary facts about their uses.

YAAD
(informative)

Introduction

Y.K.B.
Sound Wave → Longitudinal 
Sound Wave → Mechanical
Material (S, L, G)

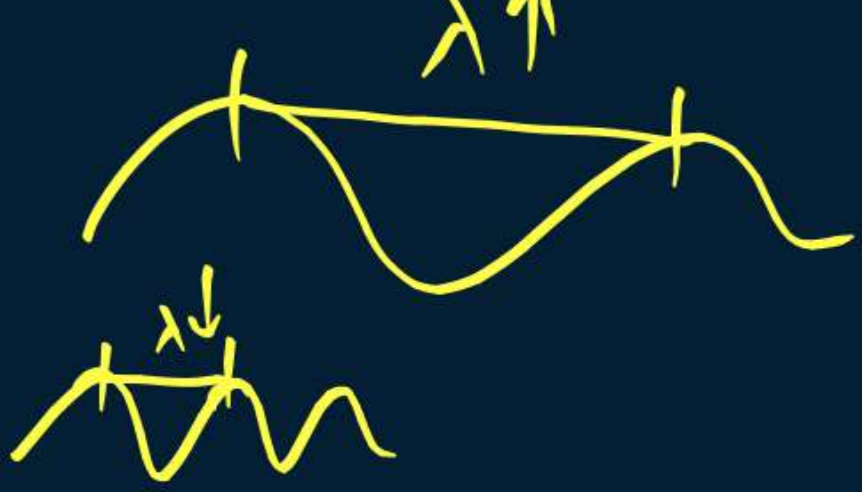
Transverse 

Electromagnetic waves are ‘Light waves’ → Transverse
Electromagnetic waves are ‘Light waves’ → Non-Mechanical
↳ Material not reqd. (Vacuum)

These are non mechanical waves, which do not require the medium to travel.

History

1. Maxwell: Told about the existence of EM waves.
2. Hertz: Production of EM waves for the first time.
3. J.C.Bose: EM waves of shorter wavelength produced.
4. Marconi: Transmitted EM waves from one place to another via antenna.



Concept

Faraday's Law of EMI : $\mathcal{E} = -\frac{d\phi_B}{dt}$

$V = -\frac{d\phi_B}{dt}$

Y.K.B.

$$\boxed{E = -\frac{dV}{dr}}$$

The changing magnetic flux (field) produces electric field.

Since nature is symmetric, so, changing electric flux (field) must produce magnetic field.

$V = -\frac{d\phi_B}{dt}$

$\int E \cdot dr = V$

$$\boxed{\int \vec{E} \cdot d\vec{r} = -\frac{d\phi_B}{dt}}$$

Faraday :- $\Delta B \rightarrow E$

Changing B produces E

Ulta :- $\Delta E \rightarrow B$

Changing E produces B

Magnetic flux Ko Change Karke Electric field Ka Janm Hoga

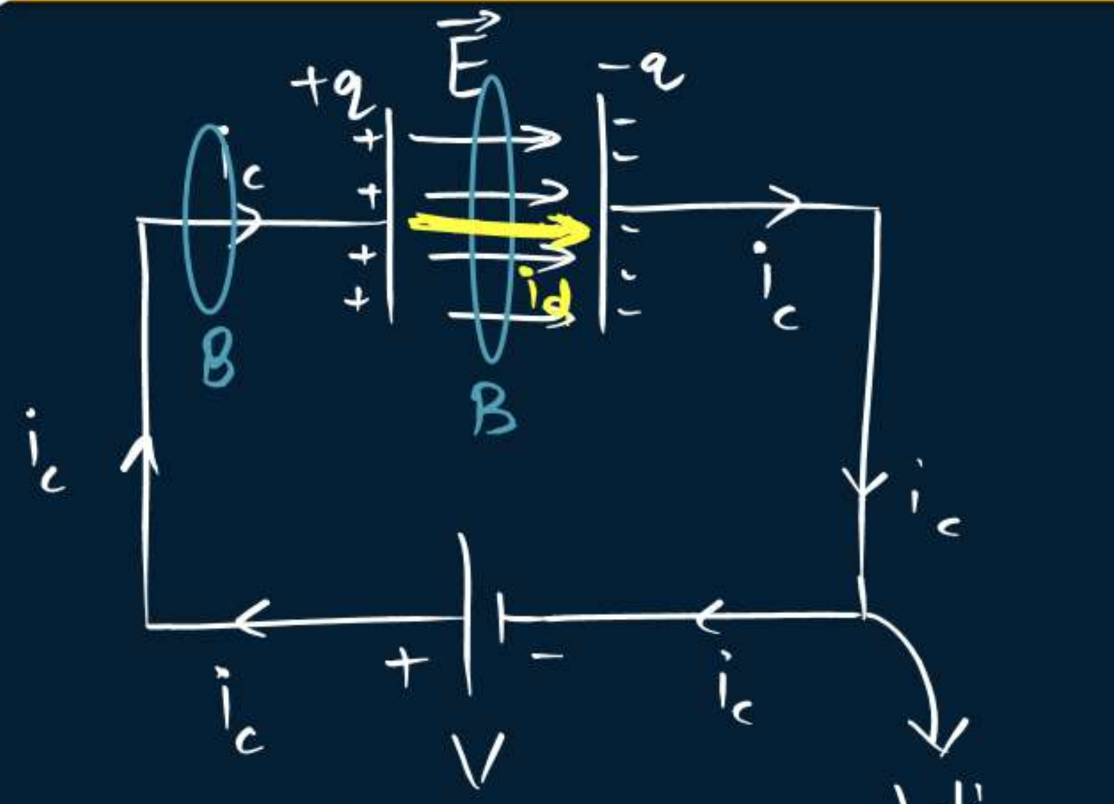
Displacement Current

→ Maxwell Sahab

→ (i_d)

→ 1. Continuity of current

→ 2. Magnetic field is sensed b/w plates.



When Capacitor is connected, (Conduction current) (i_c)

Transient State

$i_c \uparrow$

$q \uparrow$

$E \uparrow \rightarrow B \neq 0, i_d \neq 0$

When C is fully charged

$i_c = 0$

$\left.\begin{aligned} q &\to \text{Max} \\ E &\to \text{Max} \end{aligned}\right\}$ constant

$B = 0, i_d = 0$

* Conclusion :-

$\Delta E \longrightarrow B$

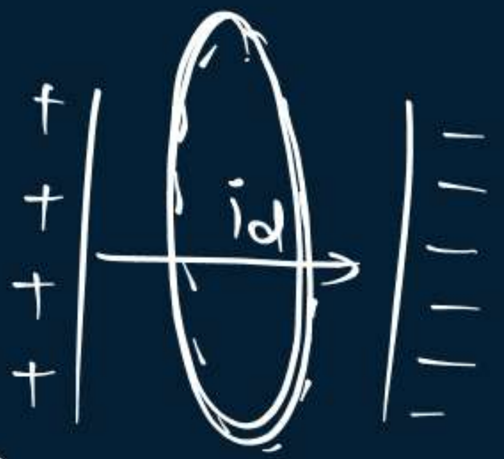
Ampere – Maxwell Law

Ampere's Law :-

$$\int \vec{B}\cdot d\vec{l} = \mu_0 i_{enc}$$

Acc. to Gauss

$$\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0} = \phi_e$$



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

$$\boxed{q = \epsilon_0 \phi_e}$$

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

$$i = \frac{d(\epsilon_0 \phi_e)}{dt}$$

$$\boxed{i_d = \epsilon_0 \frac{d\phi_e}{dt}}$$

Ampere - MaxWell law :-

$$\boxed{\int \vec{B}\cdot d\vec{l} = \mu_0 (i_c + i_d)}$$

$$\int \vec{B}\cdot d\vec{l} = \mu_0 \left(i_c + \epsilon_0 \frac{d\phi_e}{dt}\right)$$

$\vec{E}$ ke change se B produce

Maxwell's Equations of Electromagnetism :-

1. Gauss law of Electrostatics :-

$$\oint \vec{E}\cdot d\vec{A} = \frac{q_{enc}}{\epsilon_0} = \phi_e$$

2. Gauss law of Magnetism :-

$$\oint \vec{B}\cdot d\vec{A} = 0$$

↳ Monopoles do not exist

3. Faraday's Law of EMI :-

$$\int \vec{E}\cdot d\vec{l} = \mathcal{E} = -\frac{d\phi_B}{dt}$$

ΔB produces E

4. Ampere - Maxwell Law :-

$$\int \vec{B}\cdot d\vec{l} = \mu_0\left(i_c + \epsilon_0 \frac{d\phi_e}{dt}\right)$$

ΔE produces B

5. Lorentz Force

$$\vec{F}_L = \vec{F}_E + \vec{F}_B$$

$$= q\vec{E} + q(\vec{V}\times\vec{B})$$

$$F_L = q(\vec{E} + \vec{V}\times\vec{B})$$

Source of EM Waves

A stationary charge produces Electric Field only.

A charge moving with constant velocity produces Electric and Magnetic Field both.

An accelerating charge produces Electric Field and Magnetic field both, both are variable and produce each other and hence EM Waves are produced.

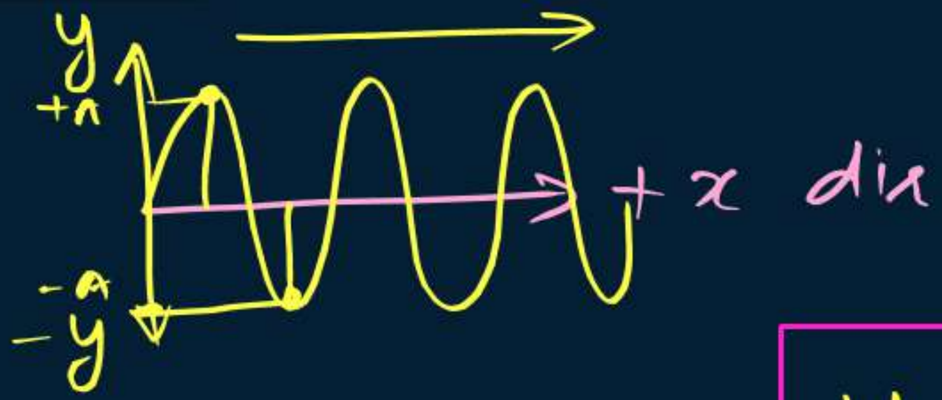
$$\Delta B \longrightarrow E$$

$$\Delta E \longrightarrow B$$

Basics of Wave Motion

→ Y.K.B.

$$y = A \sin(\omega t - kx)$$



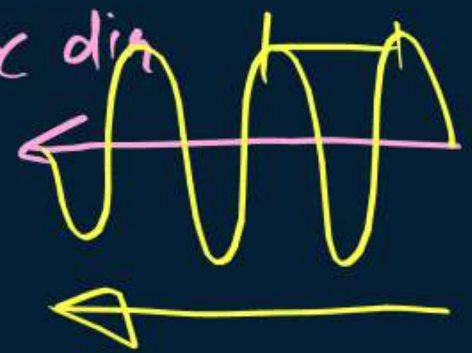
y axis ke Along Oscillating

Amplitude

Wave disha

$$y = A \sin(\omega t + kx)$$

- x dir



Angular frequency

$$\boxed{\omega = \frac{2\pi}{T} \qquad \omega = 2\pi\nu}$$

$$\boxed{k = \frac{2\pi}{\lambda}}$$

k → Angular Wave No.

λ → Wavelength

$$\boxed{\text{Wave speed} : V = \lambda\nu}$$

λ → Wave length

ν → frequency

Equation of EM Waves

Speed of EM Wave $\leftarrow$ $\boxed{\begin{array}{l} E = VB \\ V = \dfrac{E}{B} \end{array}}$ or $C = \dfrac{E}{B}$

$C \to$ Vacuum

$\boxed{\vec{E} \times \vec{B} = \vec{V}}$

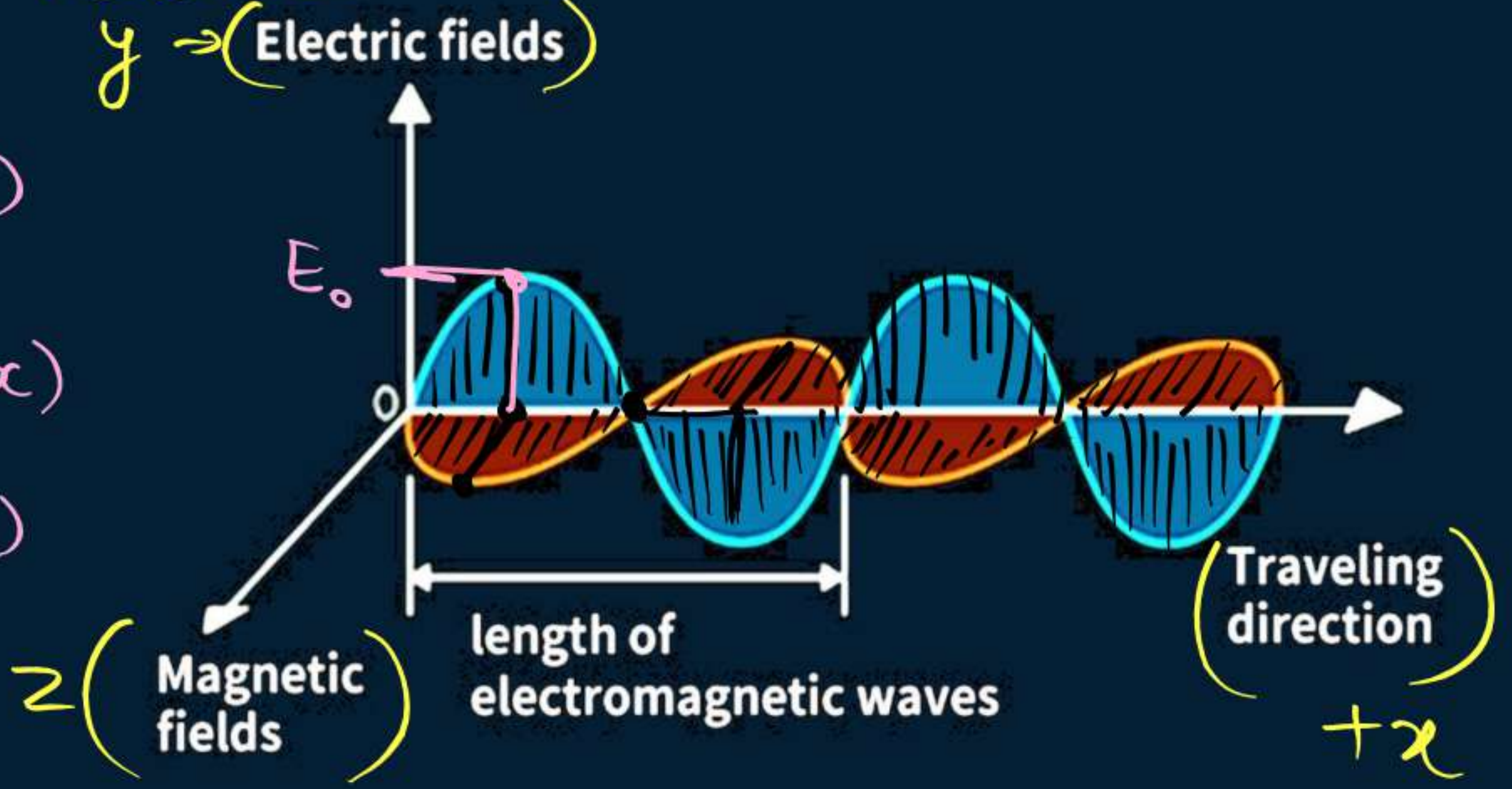
$\vec{V}$: Direction of propagation

EM Waves contain oscillating (Changing) Electric and Magnetic Field vectors.

$y = A \sin(\omega t - kx)$

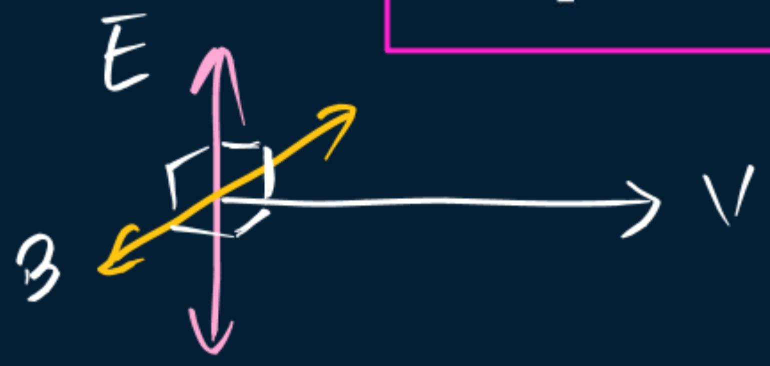
$E_y = E_0 \sin(\omega t - kx)$

$B_z = B_0 \sin(\omega t - kx)$



Properties of EM Waves

(1) In these waves $\vec{E}$ and $\vec{B}$ vary sinusoidally. $\vec{E}$ and $\vec{B}$ become maximum at same place and at the same time. Therefore the phase difference between the two fields is zero.



(2) $\vec{E}$ and $\vec{B}$ are perpendicular to each other as well as to direction of propagation.

The direction of propagation can be determined by $\vec{E} \times \vec{B}$

(3) These waves do $\boxed{\text{not require material medium}}$ for their propagation.

(4) It travels in free space with speed equal to $\boxed{3 \times 10^8\ \text{m/s}}$ which is given by $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$.

$\to$ Vacuum

(5) The $\boxed{\text{speed of electromagnetic wave in a medium}}$ is $\boxed{v = \frac{1}{\sqrt{\mu\varepsilon}}}$.

free space (Vacuum)

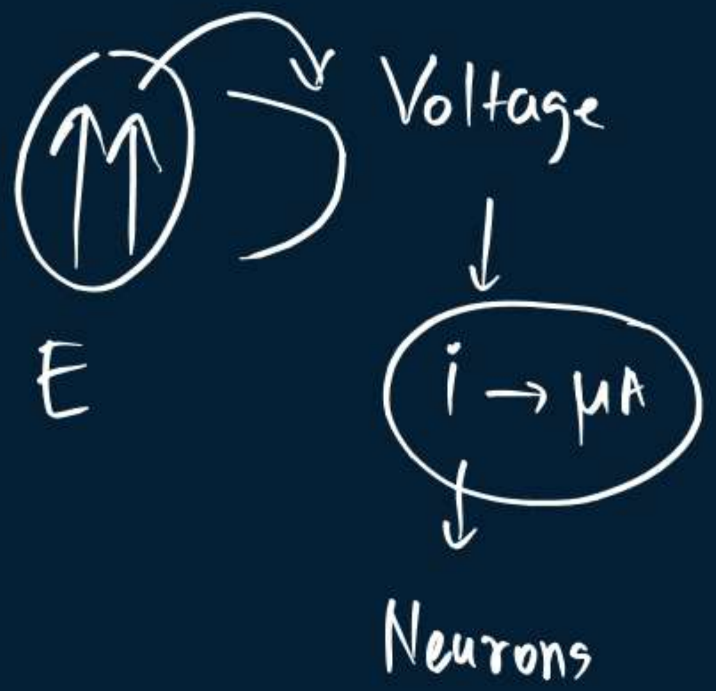
$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

$$c = 3 \times 10^8\ \text{m/s}$$

Medium

$$v = \frac{1}{\sqrt{\mu \epsilon}}$$

(6) Electric field vector of an electromagnetic wave produces (optical effect) hence it is also known as light/optical vector.



Energy Density

'Risk cover'

$$\boxed{\begin{aligned} u_{\substack{EM\\wave}} &= u_e + u_B \\ &= \frac{1}{2}\epsilon_0 E^2 + \frac{B^2}{2\mu_0} \end{aligned}}$$

Light is a form of energy.

Electric Energy density

$$u_e = \frac{1}{2}\epsilon_0 E^2$$

Magnetic Energy density

$$u_B = \frac{B^2}{2\mu_0}$$

Energy is equally distributed in both E and B

$$u_e = u_B$$

$$\cancel{\frac{1}{2}}\epsilon_0 E^2 = \frac{B^2}{\cancel{2}\mu_0}$$

$$\epsilon_0 E^2 = \frac{B^2}{\mu_0}$$

$$\frac{E^2}{B^2} = \frac{1}{\epsilon_0\mu_0}$$

$$\boxed{\frac{E}{B} = \frac{1}{\sqrt{\mu_0\epsilon_0}} = C}$$

Intensity of EM Wave

'Risk Cover'

Class 11

Y.K.B.

$$\boxed{\text{Intensity} = \frac{\text{Energy}}{\text{Area} \times \text{time}}}$$

SI unit of

$I \rightarrow \frac{W}{m^2}$

Or

$$I = \left(\frac{E}{At}\right)$$

$$\boxed{I = \frac{P}{A}} \rightarrow \left(\frac{\text{Watt}}{m^2}\right)$$

$$I = \frac{E}{A \times t}$$

$$I = \frac{u \times Vol}{A \times t}$$

$$I = \frac{u \times \cancel{A} \times l}{\cancel{A} \times t}$$

याद *

$$\boxed{I = u\,c}$$

I → Intensity of EM wave

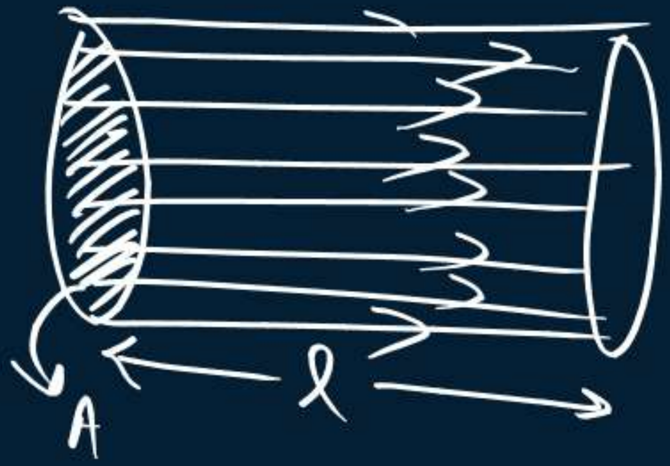
u → Energy density

c → light ki speed

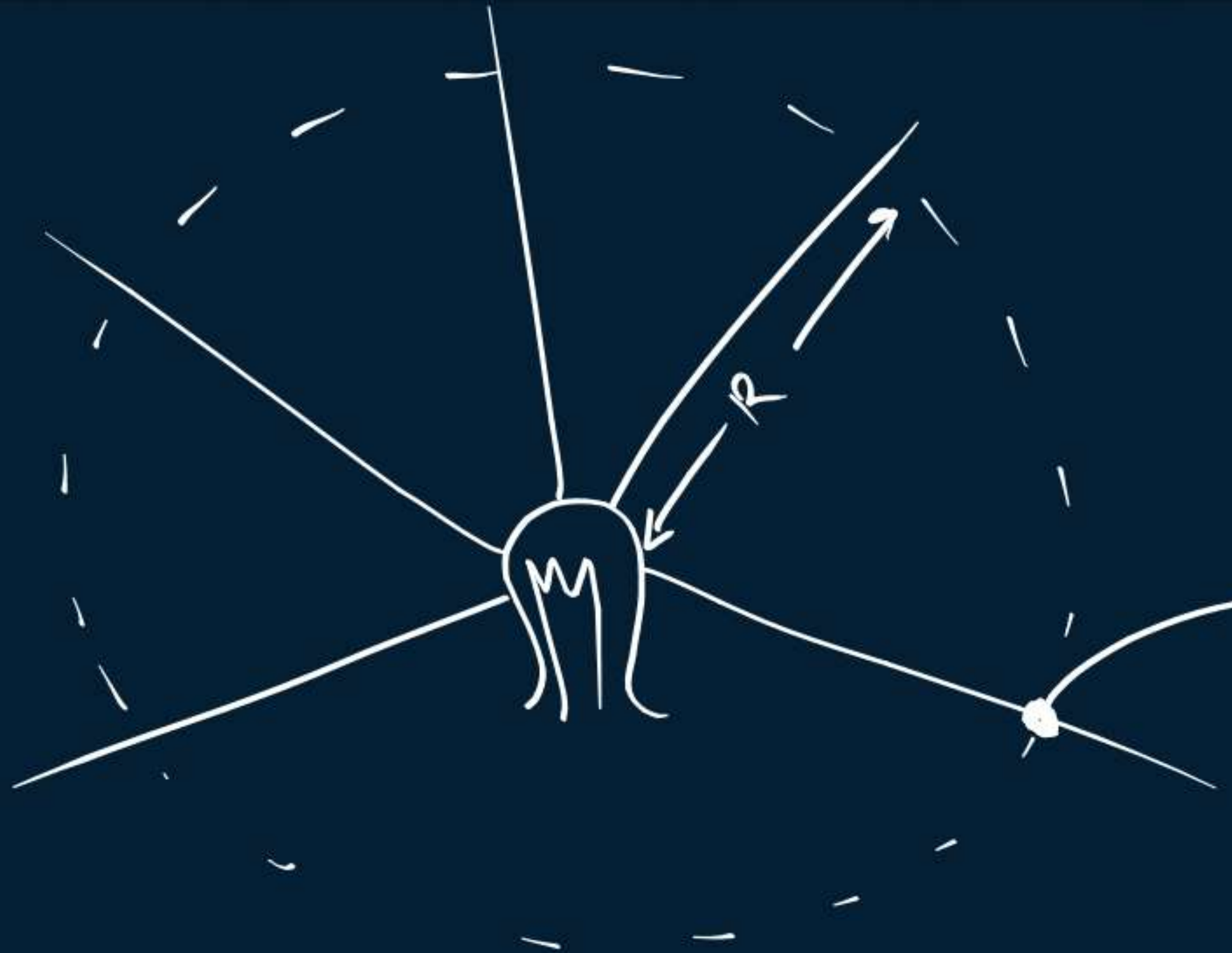
Energy density

$$u = \frac{E}{\text{Volume}}$$

$$E = u \cdot Vol$$



Intensity of a point source



$$I = \frac{\text{Power}}{\text{Area}}$$

$$\boxed{I = \frac{P}{4\pi R^2}}$$

Rashmika Mandanna is Very Unique ex of

Electromagnetic Spectrum – Detailed Overview

Gaadi X U V In My Range

Region	Frequency Range (Hz)	Wavelength Range (m)	Discoverer	Source	Applications
Radio Waves	$< 3 \times 10^{9}$	$> 10^{-1}$	Maxwell, Hertz	Antennas, Oscillators	Radio, TV, Wi-Fi, Mobile
Microwaves	$3 \times 10^{9} – 3 \times 10^{11}$	$10^{-3} – 10^{-1}$	Maxwell	Magnetrons, Cosmic	Microwave oven, Radar
Infrared (IR)	$3 \times 10^{11} – 4.3 \times 10^{14}$	$7.5 \times 10^{-7} – 10^{-3}$	W. Herschel	Thermal, IR LEDs	Night vision, Heating
Visible Light (VIBGYOR)	$4.3 \times 10^{14} – 7.5 \times 10^{14}$	$4 \times 10^{-7} – 7.5 \times 10^{-7}$	Isaac Newton	Sunlight, Lasers	Vision, Optics, Illumination
Ultraviolet (UV)	$7.5 \times 10^{14} – 3 \times 10^{17}$	$10^{-8} – 4 \times 10^{-7}$	J. W. Ritter	Sun, Mercury lamps	Sterilization, Forensics
X-Rays	$3 \times 10^{17} – 3 \times 10^{19}$	$10^{-12} – 10^{-8}$	W. Roentgen	X-ray tubes	Medical imaging, Security
Gamma Rays	$> 3 \times 10^{19}$	$< 10^{-12}$	Paul Villard	Nuclear, Cosmic	Cancer therapy, Astronomy

$\nu \uparrow$ $\lambda \downarrow$

1. Radio Waves

It is produced by the accelerated motion of charges in conducting wires. (i.e., by oscillating electric charge).

Used in radio and T.V. communication.

2. Microwaves

It is produced by special vacuum tubes (called Klystrons, Magnetrons and Gunn diodes)

(1) It is used to detect speed of tennis ball, cricket ball, automobile.

(2) It is used in microwave ovens.

3. Infrared

- It is produced by hot bodies i.e. vibrations of atoms and molecules. (Hence also called heatwaves).
- It is not detected by human eye but snake can detect it.

- Used to see through fog and smoke, muscular pain
- It is responsible for keeping average temperature through green-house effect.

4. Visible

It is a narrow range of electromagnetic spectrum

It is produced when electrons jump to lower level.

5. Ultra-Violet

- It is produced by sun, special lamps and very hot bodies.
- It is produced when electrons jump to lower level
- Most of the ultraviolet radiations coming from the sun are absorbed by the ozone layer in the earth's atmosphere.
- The UV rays in large quantity produce harmful effect on human being, it causes production of melanin, tanning of the skin.
- It is used in water purifiers..

6. X-Ray

It is produced in a tube called modern X-ray tube and electronic transition.

X-ray are used as a diagnostic tool in medicine

In engineering it is used for detecting faults, cracks, flaws and holes.

7. Gamma Rays

- It is high frequency radiation which is produced in nuclear reactions they are emitted by radioactive nuclei.
- They are used for cancer therapy.
- They provide important information regarding nuclear structure.

Homework

Notes

Book - I complete (Sameta Jaye)