

Chapter -8  
Electromagnetic Waves  
Concept Map

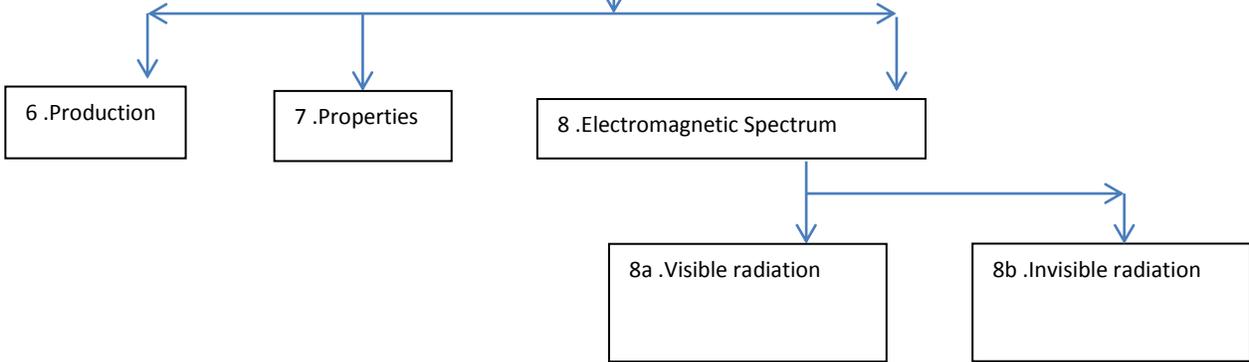
1 . Ampere's circuital law

2 .Inconsistency of Ampere's circuital law

3 .Maxwell's Displacement current  
Or Modified Amperes circuital law  
Or Ampere-Maxwell Law  
$$\oint B \cdot dl = \mu_0 I + (\mu_0)(\epsilon_0)d\Phi/dt$$

4. Maxwell's Equations

5 .Electromagnetic  
Waves



6 .Production

7 .Properties

8 .Electromagnetic Spectrum

8a .Visible radiation

8b .Invisible radiation

## GIST FROM ELECTROMAGNETIC WAVES

1) If an open surface  $S$  is bounded by a loop  $C$ , then Ampere's circuital law says

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I$$

2). Inconsistency of Ampere's circuital law;

Ampere could not explain the continuity of flow of current between the two plates of a capacitor which is connected to a battery which was later explained by Maxwell with his idea of displacement current.

3). Displacement current:

It is that current which comes into play in the region whenever the electric field and hence the electric flux is changing with time. The displacement current is given by the equation

$$I_d = \epsilon_0 (d\Phi_E/dt)$$

4) Maxwell's equations:

$$\oint \vec{E} \cdot d\vec{A} = Q/\epsilon_0 \text{ (Gauss's theorem in electrostatics)}$$

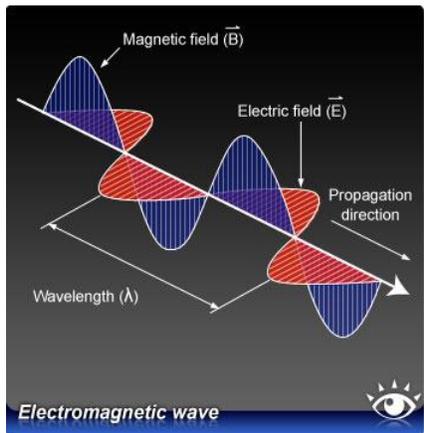
$$\oint \vec{B} \cdot d\vec{A} = 0 \text{ (Gauss's theorem in magnetostatics)}$$

$$\oint \vec{E} \cdot d\vec{l} = d\Phi_B/dt \text{ (Faraday's law of em induction)}$$

$$\oint \vec{B} \cdot d\vec{l} = \mu_0 I + \mu_0 \epsilon_0 (d\Phi_E/dt) \text{ (Ampere Maxwell Law)}$$

5) Electromagnetic waves:

A wave produced by the acceleration of an electric charge and propagated by the periodic variation of intensities of, usually, perpendicular electric and magnetic fields.



6) Production of EM waves:

EM waves are normally produced accelerated charged particles.

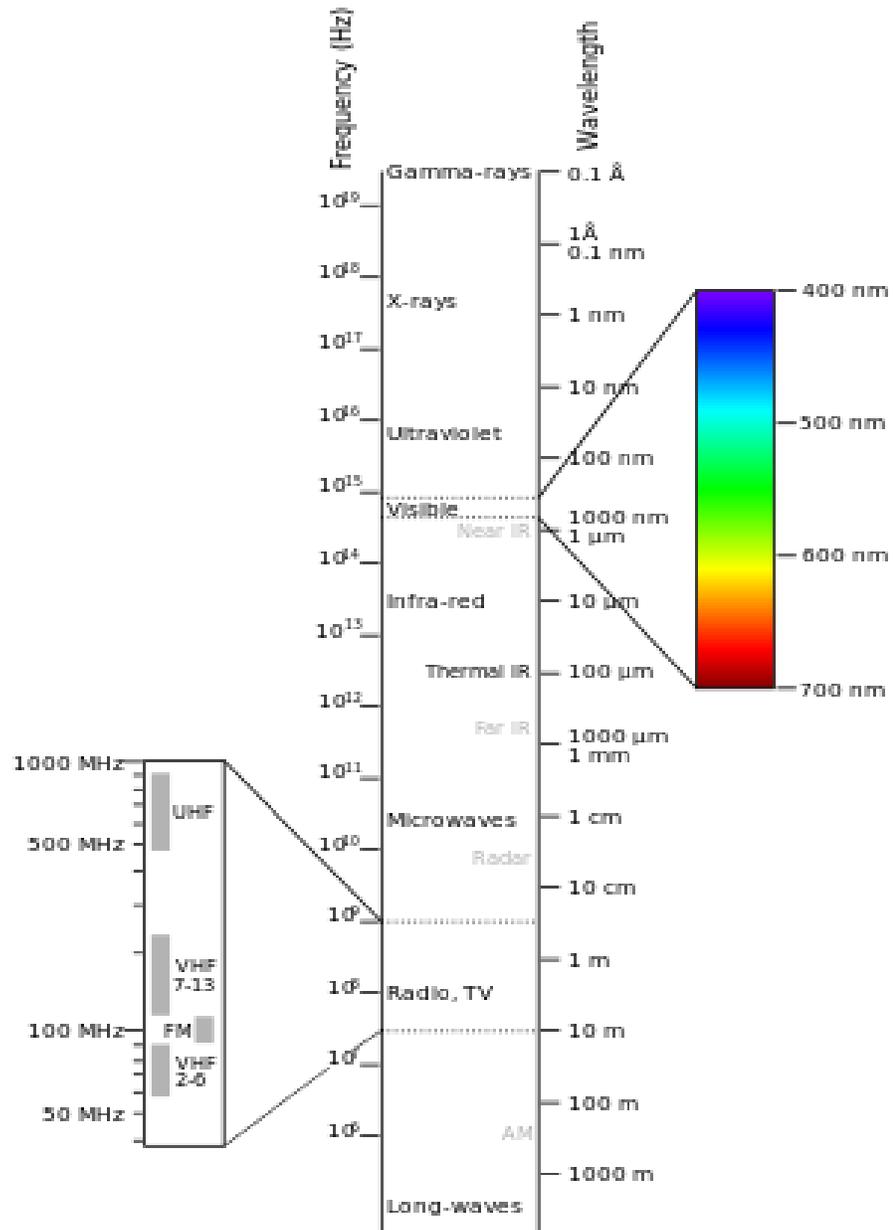
7) Properties of EM waves:

1) Show properties of rectilinear propagation and all other properties of waves including polarization

- 2) Travels with the velocity of light in vacuum and exert radiation pressure.
- 3) They travel in the form of transverse waves.
- 4) Contain mutually perpendicular electric & magnetic fields which share the em energy.
- 5) They exert radiation pressure.
- 6) They obey principle of superposition.
- 7) The speed of em waves in a material medium is given by  $v=1/(\mu\epsilon)^{1/2}$
- 8)  $c=E_0/B_0=E/B$

Where  $c$  is velocity of em wave in vacuum.

$E$  &  $B$  are magnitudes of electric and magnetic fields.



ELECTROMAGNETIC SPECTRUM

### Parts of Invisible radiation with application

1. Radio waves (used in Radio communication)
2. Micro waves (Used in Radar operation)
3. Infra-red (IR)Rays(Used in IR photography)
4. Ultra violet (UV)Rays(Used to kill germs in water purifiers)
5. X-Rays (Used to take photograph of internal body parts)
6. Gamma Rays(Used in medicine to destroy cancer cells)

### Parts of visible radiation

Visible radiation contains seven colours from Violet to Red familiarly called as VIBGYOR and is used to visualize objects.