MIND MAP

ELECTROMAGNETIC WAVES

Maxwell's Equation

1) $\oint \vec{E} \cdot \overrightarrow{dA} = \frac{Q}{\epsilon_0}$ Gauss's Law for electricity

2) $\oint \vec{B} \cdot \overrightarrow{dA} = 0$ Gauss's Law for magnetism

3) $\oint \vec{E} \cdot \overrightarrow{d\ell} = -\frac{d\phi_B}{dt}$ Faraday's Law

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

$c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}}$

μ_0 - Permeability of free space (vacuum)

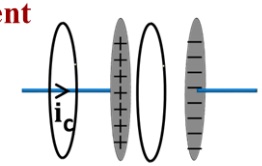
ε_0 - Permittivity of free space (vacuum)

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

μ - Permeability of medium

ε - Permittivity of medium

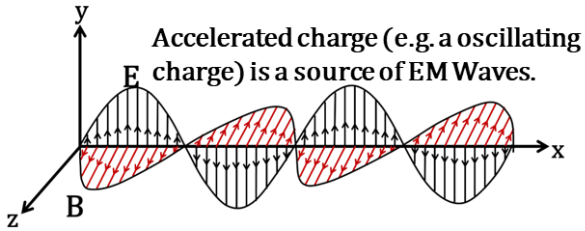
Displacement Current



Ampere-Maxwell Law

$\oint \vec{B} \cdot \overrightarrow{d\ell} = \mu_0 (i_c + i_d)$

$\oint \vec{B} \cdot \overrightarrow{d\ell} = \mu_0 i_c + \mu_0 \epsilon_0 \frac{d\phi_E}{dt}$



Accelerated charge (e.g. a oscillating charge) is a source of EM Waves.

In EM waves both electric and magnetic fields vary with time and space.

$E = BC$ $\quad \hat{E} \times \hat{B} = \hat{v}$

* $\vec{E}$ and $\vec{B}$ are perpendicular to each other and are also
* perpendicular to direction of propagation of wave.
* Electromagnetic waves can be polarized.
* Energy is equally divided in electric and magnetic field.

$$\text{Energy Density} = \frac{1}{2}\epsilon_0 E_{rms}^2 = \frac{B_{rms}^2}{2\mu_0}$$

$$\text{Total Energy Density} = \epsilon_0 E_{rms}^2 = \frac{B_{rms}^2}{\mu_0}$$

Type	Wavelength Range	Uses
Radio Waves	> 0.1 m	Radio and television communication
Microwave	0.1 m to 1 mm	Microwave Oven, Radar System
Infrared	1mm to 700nm	Remote Switches and Household electronic devices
Visible Rays	700 nm to 400nm	To see objects
Ultraviolet	400 nm to 1nm	Eye surgery, Water purifier
X-rays	1nm to 10^{-3} nm	Medical diagnosis
Gamma rays	$< 10^{-3}$ nm	Medical treatment(to destroy cancer cells)