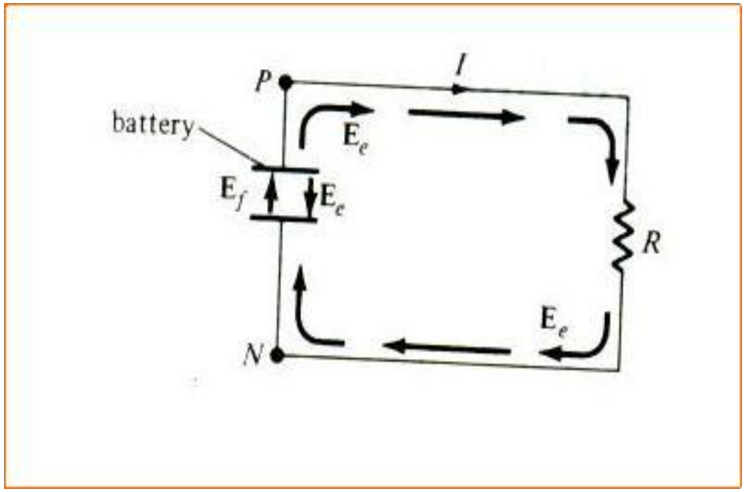
TIME VARYING MAGNETIC FIELDS AND MAXWELL’S EQUATIONS

Faraday's Law, and it can be expressed as

emf induced= -N dψ/dt



MAXWELL'S EQUATIONS FOR STATIC EM FIELDS

Differential (or Point) Form	**Integral Form**	**Remarks**
$\nabla . \mathbf{D} = \rho_v$	$\int_S D \times dS = \int_v \rho_v \, dv$	Gauss's law
$\nabla . \mathbf{B} = 0$	$\int_S B \times dS = 0$	Nonexistence of magnetic monopole
$\nabla \times \mathbf{E} = -\frac{\partial B}{\partial t}$	$\int_L E \times dl = -\frac{\partial}{\partial t}\int_s B \times dS$	Faraday’s Law
$\nabla \times \mathbf{H} = \mathbf{J} + \frac{\partial D}{\partial t}$	$\int_L H \times dl = \int_s J \times dS$	Ampere's circuit law

UNIFORM PLANE WAVES

$$\nabla^2 \vec{E} = \mu \in \frac{\partial^2 \vec{E}}{\partial t^2} \quad \text{\_\_\_\_\_\_\_\_\_\_} (2)$$

The wave equation (2) is a composition of these equations, one each component wise,
ie,

$$\frac{\partial^2 Ex}{\partial x^2} = \mu \in \frac{\partial^2 Ey}{\partial t^2} \quad \text{\_\_\_\_\_\_\_\_\_\_} (2)\ a$$

$$\frac{\partial^2 Ey}{\partial y^2} = \mu \in \frac{\partial^2 Ey}{\partial t^2} \quad \text{\_\_\_\_\_\_\_\_\_\_} (2)\ b$$

$$\frac{\partial^2 Ez}{\partial z^2} = \mu \in \frac{\partial^2 Ez}{\partial t^2} \quad \text{\_\_\_\_\_\_\_\_\_\_} (2)\ c$$

Wave equations for a conducting medium

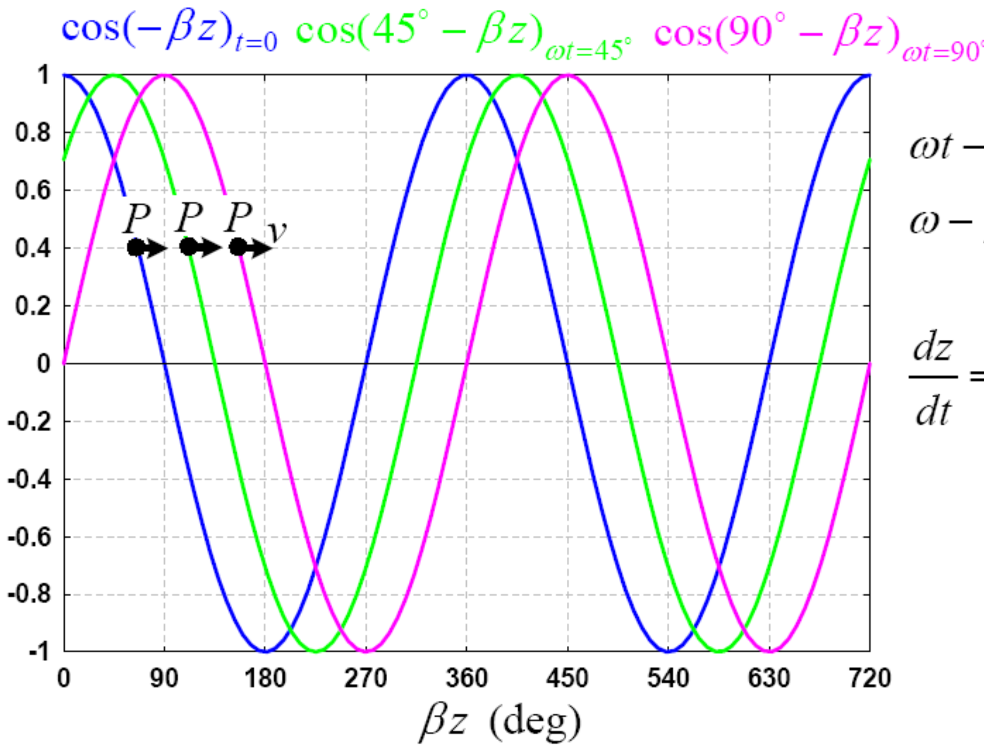
$$\nabla \times \vec{H} = \vec{J} + \in \frac{\partial \vec{E}}{\partial t} \quad \_\_\_\_\_\_\_\_\_\_\_\_ (1)$$

$$\nabla \times \vec{E} = -\mu \frac{\partial \vec{H}}{\partial t} \quad \_\_\_\_\_\_\_\_\_\_\_\_ (2)$$

$$\vec{J} = \sigma \vec{E} \qquad \sigma : Conductivity\ (\Omega / m)$$

$$\nabla \times \vec{H} = \sigma \vec{E} + \in \frac{\partial \vec{E}}{\partial t} \quad \_\_\_\_\_\_\_\_\_\_\_\_ (3)$$

Sine wave propagating in the (+z) direction



$$\omega t - \beta z = \xi_P = con$$

$$\omega - \beta \frac{dz}{dt} = 0$$

$$\frac{dz}{dt} = \boxed{v = \frac{\omega}{\beta}}, \quad \frac{\text{m}}{\text{s}}$$

Poynting's theorem

- The flow of power in the direction of wave propagation. P gives power density of the wave

$$P = E X H$$

Thank you