Electromagnetics:

Electromagnetic Field Theory

Conditions for Magnetostatics

Maxwell's Equations at DC

Maxwell's Equations

$$\nabla \times \vec{E} = -\cancel{\frac{\partial \vec{B}}{\partial t}}$$

$$\nabla \times \vec{H} = \vec{J} - \cancel{\frac{\partial \vec{D}}{\partial t}}$$

$$\nabla \bullet \vec{D} = \rho_v$$

$$\nabla \bullet \vec{B} = 0$$

Constitutive Relations

$$\vec{D} = [\varepsilon]\vec{E}$$

$$\vec{B} = [\mu]\vec{H}$$

Electrostatic Equations

$$\nabla \times \vec{E} = 0$$

$$\nabla \bullet \vec{D} = \rho_v$$

$$\vec{D} = [\varepsilon]\vec{E}$$

Magnetostatic Equations

$$\nabla \times \vec{H} = \vec{J}$$

$$\nabla \bullet \vec{B} = 0$$

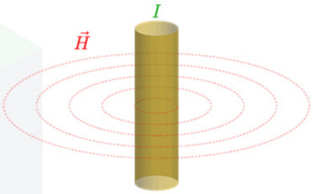
$$\vec{B} = [\mu]\vec{H}$$

Maxwell’s Equations for Magnetostatics

Ampere’s Circuit Law

$\nabla \times \vec{H} = \vec{J}$ Magnetic fields circulate around currents.

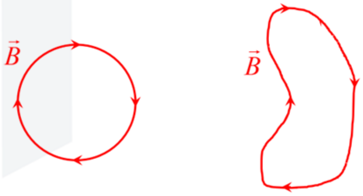
Magnetic fields only exist when there is electric current.



Gauss’ Law for Magnetic Fields

$\nabla \bullet \vec{B} = 0$ Magnetic flux $\vec{B}$ cannot have divergence.

Magnetic fields cannot begin or end, yet they must exist.
Magnetic fields always form loops.



Constitutive Relation

$\vec{B} = [\mu]\vec{H}$ $\vec{B}$ is proportional to $\vec{H}$ scaled by $[\mu]$.

Static magnetic fields do not see permittivity so they are not affected by permittivity.