The Maxwell Equations

Fundamental form

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

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

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}$$

Macroscopic form

$$\nabla \cdot \mathbf{D} = \rho_{\rm f}$$

$$\nabla \cdot \mathbf{B} = 0$$

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

$$\nabla \times \mathbf{H} = \mathbf{J}_{\rm f} + \frac{\partial \mathbf{D}}{\partial t}$$

Definitions

$$\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$$

$$\mathbf{H} = \frac{1}{\mu_0}\mathbf{B} - \mathbf{M}$$

Linear media

$$\mathbf{P} = \epsilon_0 \chi_e \mathbf{E}\ , \qquad \mathbf{D} = \epsilon \mathbf{E}$$

$$\mathbf{M} = \chi_m \mathbf{H}\ , \qquad \mathbf{B} = \mu \mathbf{H}$$

Energy: $$U = \frac{1}{2}\int_V \left(\epsilon_0 E^2 + \frac{1}{\mu_0} B^2 \right) dV$$

Poynting Vector: $$\mathbf{S} = \frac{1}{\mu_0}\, \mathbf{E} \times \mathbf{B}$$

Coulomb's Law: $$d\mathbf{E}(\mathbf{x}) = \frac{dq\ (\mathbf{x} - \mathbf{x}')}{4\pi\epsilon_0 \left| \mathbf{x} - \mathbf{x}' \right|^3}$$

Biot-Savart Law: $$d\mathbf{B}(\mathbf{x}) = \frac{\mu_0 I d\boldsymbol{\ell} \times (\mathbf{x} - \mathbf{x}')}{4\pi \left| \mathbf{x} - \mathbf{x}' \right|^3}$$