Electrostatics:

$$\vec{E} = \sum_{i=1}^{N} \frac{Q_i \vec{R}_i}{4\pi\varepsilon R_i^3} + \int_l \frac{\rho_L \vec{R}}{4\pi\varepsilon R^3} + \int_s \frac{\rho_s \vec{R}}{4\pi\varepsilon R^3} + \int_v \frac{\rho_v \vec{R}}{4\pi\varepsilon R^3} \quad , \quad V = \sum_{i=1}^{N} \frac{Q_i}{4\pi\varepsilon R_i} + \int_l \frac{\rho_L}{4\pi\varepsilon R} + \int_s \frac{\rho_s}{4\pi\varepsilon R} + \int_v \frac{\rho_v}{4\pi\varepsilon R}$$

$$\oint_s \vec{D}.d\vec{s} = Q \ , \quad \oint_l \vec{E}.d\vec{l} = 0 \, , \quad \nabla\vec{D} = \rho_v \, , \quad \nabla\times\vec{E} = 0 \quad , \quad \vec{D} = \varepsilon\vec{E} \quad , \quad V_P = -\int_{\infty}^{P} \vec{E}.d\vec{l} \quad , \quad V_{AB} = V_B - V_A = -\int_{A}^{B} \vec{E}.d\vec{l} \, ,$$

$$\vec{E} = -\nabla V \ , \quad w_e = \frac{1}{2}\varepsilon E^2 \ , \quad \vec{E} = \frac{\rho_L}{2\pi\varepsilon\rho}\vec{a}_\rho \quad , \quad \vec{E} = \frac{\rho_s}{2\varepsilon}\vec{a}_N \quad , \quad D_{1n} - D_{2n} = \rho_s \quad , \quad E_{1t} = E_{2t} \ , \quad C = \frac{Q}{V_o} \ , \quad \nabla^2 V = -\frac{\rho_v}{\varepsilon}$$

Magnetostatics:

$$\oint_s \vec{B}.d\vec{s} = 0 \ , \quad \oint_l \vec{H}.d\vec{l} = I \quad , \quad \nabla\vec{B} = 0, \quad \nabla\times\vec{H} = \vec{J} \quad , \quad \vec{B} = \mu\vec{H} \ , \quad \vec{B} = \nabla\times\vec{A} \, , \quad \vec{A} = \frac{I}{4\pi}\int_l \frac{d\vec{l}\times\vec{R}}{R} \quad , \quad \nabla\vec{A} = 0 \, ,$$

$$\nabla^2\vec{A} = -\mu\vec{J} \ , \quad \psi_m = \int_s \vec{B}.d\vec{s} = \oint_l \vec{A}.d\vec{l} \ , \quad M_{21} = \frac{\Lambda_{21}}{I_1} = \frac{N_2\psi_{21}}{I_1} , \quad L = \frac{\Lambda}{I} \ , \quad d\vec{H} = \frac{I}{4\pi}\frac{d\vec{l}\times\vec{R}}{R^3} , \quad w_m = \frac{1}{2}\mu H^2$$

$$\vec{H} = \vec{a}_\phi \frac{I}{4\pi\rho}[\cos\alpha_2 - \cos\alpha_1] , \ \vec{H} = \vec{a}_\phi \frac{I}{2\pi\rho} \quad , \quad \vec{F}_m = I\int_l d\vec{l}\times\vec{B} \quad , \ B_{1n} = B_{2n} \ , \quad (\vec{H}_1 - \vec{H}_2)\times\vec{a}_{n12} = \vec{K}$$

EMF: $emf = -\int_s \frac{\partial\vec{B}}{\partial t}d\vec{s} + \oint_l (\vec{u}\times\vec{B})d\vec{l} = -\frac{d\psi_m}{dt}$

Maxwell's Equations (General Form):

$$\nabla\times\vec{E} = -\frac{\partial\vec{B}}{\partial t} \quad , \quad \nabla\times\vec{H} = \vec{J} + \frac{\partial\vec{D}}{\partial t} \ , \quad \nabla\vec{D} = \rho_v \quad , \quad \nabla\vec{B} = 0$$

Plane TEM Waves:

$$u_p = \frac{\omega}{\beta} \ , \ u_g = \frac{d\omega}{d\beta} \quad , \ u_p = \frac{c}{\sqrt{\mu_r\varepsilon_r}} \ , \quad \eta = \sqrt{\frac{\mu}{\varepsilon}} \ , \quad \lambda = \frac{2\pi}{\beta} \ , \quad \eta = \frac{\sqrt{\mu/\varepsilon}}{[1+(\sigma/\omega\varepsilon)^2]^{1/4}}\exp[j\,\frac{1}{2}\tan^{-1}(\sigma/\omega\varepsilon)] \quad ,$$

$$\gamma = \alpha + j\beta = j\omega\sqrt{\mu\varepsilon(1-j\sigma/\omega\varepsilon)} \, , \quad \alpha = \omega\sqrt{\frac{\mu\varepsilon}{2}[\sqrt{1+(\sigma/\omega\varepsilon)^2}-1]} \quad , \quad \beta = \omega\sqrt{\frac{\mu\varepsilon}{2}[\sqrt{1+(\sigma/\omega\varepsilon)^2}+1]} \quad , \delta = 1/\alpha \quad ,$$

$$\Gamma_\perp = \frac{\eta_2\cos\theta_i - \eta_1\cos\theta_t}{\eta_2\cos\theta_i + \eta_1\cos\theta_t} \quad , \quad \tau_\perp = \frac{2\eta_2\cos\theta_i}{\eta_2\cos\theta_i + \eta_1\cos\theta_t} \quad , \quad 1+\Gamma_\perp = \tau_\perp$$

$$\Gamma_{//} = \frac{\eta_2\cos\theta_t - \eta_1\cos\theta_i}{\eta_2\cos\theta_t + \eta_1\cos\theta_i} \quad , \quad \tau_{//} = \frac{2\eta_2\cos\theta_i}{\eta_2\cos\theta_t + \eta_1\cos\theta_i} \quad , \ 1+\Gamma_{//} = \tau_{//}(\frac{\cos\theta_t}{\cos\theta_i}) \quad , \quad \beta_1\sin\theta_i = \beta_2\sin\theta_t \ , \ \theta_r = \theta_i$$

For normal incidence, $\theta_i = 0$

Poynting's Vector = $\vec{E}\times\vec{H}$, Average Poynting's Vector = $\frac{1}{2}\text{Re}(\vec{E}_s\times\vec{H}_s^*)$

Differentials:

$$d\vec{l} = \vec{a}_\rho d\rho + \vec{a}_\phi \rho d\phi + \vec{a}_z dz \quad , \quad d\vec{s} = \vec{a}_\rho \rho d\phi dz + \vec{a}_\phi d\rho dz + \vec{a}_z \rho d\rho d\phi \ , \quad dv = \rho d\rho d\phi dz$$

$$d\vec{l} = \vec{a}_r dr + \vec{a}_\theta r d\theta + \vec{a}_\phi r\sin\theta d\phi \ , \quad d\vec{s} = \vec{a}_r r^2\sin\theta d\theta d\phi + \vec{a}_\theta r\sin\theta dr d\phi + \vec{a}_\phi r dr d\theta \ , \quad dv = r^2\sin\theta dr d\theta d\phi$$