

DC Current

Current Density

$$I = \int \mathbf{J} \cdot \mathbf{e}_n dS$$

Conservation Equation

$$\Delta \cdot \mathbf{J} + \frac{\partial \rho}{\partial t} = 0$$

$$\oint \mathbf{J} \cdot \mathbf{e}_n dS = -\frac{dQ}{dt}$$

Conductivity

$$\mathbf{J} = \sigma \mathbf{E}$$

Effect

$$P = \int \mathbf{J} \cdot \mathbf{E} dv$$

Boundary Conditions

$$\begin{cases} \mathbf{e}_{n2} \cdot (\mathbf{J}_1 - \mathbf{J}_2) = 0 & \text{(no surface current)} \\ \mathbf{E}_{t1} = \mathbf{E}_{t2} \end{cases}$$

Time Constant

$$RC = \frac{\epsilon_r \epsilon_0}{\sigma}$$

Analogy Electrostatics - DC Current

\mathbf{E}, V	\mathbf{E}, V
\mathbf{D}	\mathbf{J}
$\epsilon_r \epsilon_0$	σ
Q	I
C	G