# Lecture 36

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## 1 Ampère's Law

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

or

$$\oint_C \vec{H} \cdot d\vec{l} = I_{\text{enc}}$$

Consider an AC voltage source connected to a capacitor. Then

$$\oint_C \vec{H} \cdot d\vec{l} = I_{\text{enc}} = \iint_S \vec{J} \cdot d\vec{S} = i(t) = -\frac{V_0}{|z_L|} \sin \omega t$$

However, there should be no current, as a capacitor is essentially an open circuit. Maxwell suggested that we need to consider a new "displacement" current

$$\vec{J}_d = \frac{\partial \vec{D}}{\partial t}$$

Now Ampère's Law becomes

$$\vec{\nabla} \times \vec{H} = \vec{J} + \vec{J}_d = \vec{J} + \varepsilon \frac{\partial \vec{E}}{\partial t}$$