# Maxwell Equations

e.g. $$\vec{\nabla}\cdot\vec{E}(\vec{r}) = \frac{\rho(\vec{r})}{\epsilon_0}$$ Gauss' Law

## Divergence Theorem

$$\iiint_V \underbrace{\vec{\nabla}\cdot\vec{E}(\vec{r})}_{\text{scalar}}\, \underbrace{dV}_{\text{scalar}} = \oiint_{S=\partial V} \underbrace{\underbrace{\vec{E}(\vec{r})}_{\text{vector}} \cdot \underbrace{d\vec{A}}_{\text{vector}}}_{\text{scalar}}$$

$$= \iiint_V \frac{\rho(\vec{r})}{\epsilon_0}\, dV = \text{''}$$

$$= \frac{Q_{\text{enclosed by } S}}{\epsilon_0} = \Phi_E$$ Electric Flux

## Ampere's Law

$$\oint_C \vec{B}(\vec{r})\cdot d\vec{l} = \mu_0 I_{enc}$$ current

current density

$$= \iint_S (\vec{\nabla}\times\vec{B}(\vec{r}))\cdot d\vec{A} = \iint_S \mu_0 \vec{J}(\vec{r})\cdot d\vec{A}$$

$$\boxed{\vec{\nabla}\times\vec{B}(\vec{r}) = \mu_0 \vec{J}(\vec{r})}$$