Flipping Physics Lecture Notes:
Maxwell's Equations
http://www.flippingphysics.com/maxwell-equations.html

We now have covered all four of Maxwell's equations which are a collection of equations which fully describe electromagnetism:

1) Gauss' law: $\Phi_E = \oint_{\text{surface}} \vec{E} \cdot d\vec{A} = \frac{q_{\text{enclosed}}}{\varepsilon_0}$
2) Gauss' law in magnetism: $\Phi_B = \oint_{\text{surface}} \vec{B} \cdot d\vec{A} = 0$
3) General form of Maxwell-Faraday's law of induction: $\varepsilon = \oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$
4) The Ampère-Maxwell law: $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{in}} + \varepsilon_0 \mu_0 \frac{d\Phi_E}{dt}$

Maxwell's third equation is:

- The Faraday's law of induction we previously learned: $\varepsilon = -\frac{d\Phi_B}{dt}$
  - Which shows that changing magnetic fields create an electric potential difference
- plus the more general addition: $\oint \vec{E} \cdot d\vec{s} = -\frac{d\Phi_B}{dt}$
  - Which shows that a changing magnetic field must also create a nonconservative electric field.

Maxwell's fourth equation is:

- Ampère's law: $\oint \vec{B} \cdot d\vec{s} = \mu_0 I_{\text{in}}$
  - Which shows that magnetic fields can be generated by electric currents
- plus Maxwell's addition of $\varepsilon_0 \mu_0 \frac{d\Phi_E}{dt}$
  - Which shows that a changing electric field creates a magnetic field.
    - In a similar manner to how a moving charge creates a magnetic field.