

Lecture 1

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January 9, 2023

1 Maxwell's Equations

$$\vec{\nabla} \times \vec{E} = -\mu \frac{\partial \vec{H}}{\partial t} \quad (1)$$

$$\vec{\nabla} \times \vec{H} = \vec{J} + \varepsilon \frac{\partial \vec{E}}{\partial t} \quad (2)$$

$$\vec{\nabla} \cdot \vec{E} = \frac{\rho_v}{\varepsilon} \quad (3)$$

$$\vec{\nabla} \cdot \vec{H} = 0 \quad (4)$$

Which are called Faraday's Law (1), Ampere's Law (2), Gauss's Law (Electric) (3) and Gauss's Law (Magnetic) (4).

2 Coulomb's Law

Charles de Coulomb discovered that a charge in the presence of another charge experiences a force, which exhibits the following properties

1. Force is proportional to product of charges
2. Force is inversely proportional to distance (or radius) squared
3. Force acts in the direction along the line joining the two charges
4. Like charges repulse, opposite charges attract

$$\begin{aligned}
|\vec{F}_e| &\propto \frac{Q_1 Q_2}{R^2} \\
&= k \frac{Q_1 Q_2}{R^2} \\
&= \frac{Q_1 Q_2}{4\pi\epsilon_0 R^2}
\end{aligned}$$