PHYS 301
Electricity and Magnetism

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Today!

- Electric fields
  - ➤ Coulomb's law
  - ➤ Gauss' law

ELECTROSTATICS
[Source charges at rest]

- **Basic problem**:
  Find forces on test charge due to source charges

- Superposition Principle holds for forces and vector fields

THE ELECTRIC FIELD:

For a single point charge:
$$\vec{E} = \frac{1}{4\pi\varepsilon_o}\frac{q}{\imath^2}\hat{\imath}$$

For a differentially small point charge:
$$d\vec{E} = \frac{1}{4\pi\varepsilon_o}\frac{dq}{\imath^2}\hat{\imath}$$

For continuous charge distribution:
$$\vec{E} = \int d\vec{E} = \frac{1}{4\pi\varepsilon_o}\int\frac{dq}{\imath^2}\hat{\imath}$$

where $\varepsilon_o = 8.85 \times 10^{-12} C^2/Nm^2$

GAUSS' LAW:

INTEGRAL FORM:
$$\oint_{surf} \vec{E}\cdot d\vec{a} = \frac{q_{encl}}{\varepsilon_o}$$

DIFFERENTIAL FORM:
$$\vec{\nabla}\cdot\vec{E} = \frac{\rho}{\varepsilon_o}$$

NOTE:
$$q = \int_{vol}\rho(\vec{r}')d\tau$$