

# Transformed E&M I materials

## Gauss' Law, divergence and curl of E (Griffiths Chapter 2)

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### TIMELINE

Prof A covers this in lectures 6.

Prof B. covers this in lecture 3-5.

Transformed course covered in lectures 4-6.

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### LEARNING GOALS

#### Divergence and Curl of E; Gauss' Law

1. Students should recognize when Gauss' Law is the appropriate way to solve a problem (by recognizing cases of symmetry; and by recognizing limiting cases, such as being very close to a charged body).
  2. Students should be able to recognize that E comes out of the Gaussian integral only if it is constant along the Gaussian surface.
  3. Students should be able to recognize Gauss' Law in differential form and use it to solve for the charge density  $\rho$  given an electric field  $E$ .
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### CLASS ACTIVITIES

#### **Discussion**

##### **Gauss vs Coulomb**

Discussion re "which is more fundamental, Gauss or Coulomb" (and, why) Let them discuss. (Pointed out the Coulomb came first, historically. And that from one, you can show the other, in statics. But also pointed out Coulomb is \*wrong\*, but Gauss is always true, in non-static cases. Also pointed out Gauss is always true but not always \*helpful\* to solve for E in a given problem...)

## **Whiteboard**

### **Charge distribution from E field**

Whiteboard to compute the charge distribution from  $E=c r(\text{vector})$  (which is also a clicker question) and then to compute  $Q(\text{enclosed})$  of the resulting  $\rho$ .

## **Tutorials**

### **Divergence**

***Paul van Kampen – Dublin University (Tutorials 1-8, page 32)***

In document "Tutorials 1-8"

Two students try to calculate the charge density, one uses Cartesian and one uses cylindrical. They calculate the divergence of the E field in both coordinate systems. They derive the divergence formula in cylindrical coordinates. Very nice tutorial.

## **Tutorials**

### **Boundary condition activity**

***Oregon State University – Boundary E***

Groups investigate how components of electric field change as you cross a boundary.

## **Tutorials**

### **Gauss' Law**

***Oregon State University***

Students working in small groups practice using Gauss' Law to determine the electric field due to several charge distributions.

Students practice using the symmetry arguments necessary to use Gauss' Law.