# Engineering Electromagnetism (EENG 386) Course Redesign

## Fostering conceptual change and modeling abilities in electrical engineering students

### WHY CHANGE

Students struggle with electromagnetism (EM) because:

1. It can seem very abstract, involving fields which we cannot see interacting in strange ways.
2. It relies heavily on vector calculus.
3. They have difficulty seeing applications of EM in EE and daily life.
4. It invalidates concepts learned in prior courses (e.g., lump circuit analysis).

### INTENDED OUTCOMES

1. **Improve students’ conceptual understanding**
   - Course **flipped**: Content delivered out-of-class via textbook readings and daily reading guides
   - In-class time focused on the **hard stuff**: solving problems, wrestling with challenging concepts, developing skills like model-building and working in teams

2. **Improve students’ modeling skills**
   - Course split into five units, each focused on a single application
   - Unit tests assess modeling skills in addition to problem-solving abilities
   - Final project completely replaces final exam
   - Better support of final project via peer evaluation and intermediate checkpoints

### WHAT IS CHANGING

- Re-organization of concepts using a course map
- Better alignment of course outcomes, assessments, and in-class time
- Incorporate prereqs via an initial assignment and PHYS 200 review videos
- Activities and assessments focused on developing modeling abilities
- Final project completely replaces final exam
- Better support of final project via peer evaluation and intermediate checkpoints

### EENG 386 Highlights

- **Required** core course for all Electrical Engineering undergraduates
- **70-90** junior and senior students enrolled/year
- **Offered 2x/year**
- **Prerequisites**: Physics II, Calculus III

### Recent history of EENG 386

**Prior anecdotal student feedback:**

- Overwhelmed by many equations and seemingly-disjointed concepts → poor retention
- Difficulty recalling knowledge from their prerequisite courses
- Challenged by modeling a self-defined EM problem using course concepts

### In-class small group problem solving

### Step-by-step Redesign:

- **Prior to 2013**: EENG 386 taught in lecture format
- **2013-2015**: Active learning incorporated
- **2013**: Initial redesign with S. Spiegel
- **2014**: Summer 2015: First taught in flipped format
- **2015**: Spring 2016: Second cycle of redesign
- **2016**: Summer 2016: Second cycle of redesign

### EENG 386 course concept map

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