

## Motivator

## syllabus

## Maxwell

↳ Is high speed design important?

↙ cell phones      ↘ back planes

↳ why aren't  $B_{TE}$  models ok?

↳ units ~ time, snth

antenn, comm

↳ write down equations

↳ what does each equation do?

↳ Quizzes ~ frequent testing

↳ HW ~ 1 prob/lec, 5pm Fri.

↳ Labs ~ Experimental Learning

↳ DP ~ flex design muscles, cool

↳ Lab access

↳ Final

— Welcome to E190AK (E190RF!)

— Why take this class

↳ RF is important

↳ cell phones & radios

↳ The internet & backplanes

— Why can't I just use my E84 knowledge

↳ RF design is mostly waves ...

↳ You can apply E84 knowledge locally,

↳ But fast signals are very small, so they see end-to-end tunnels rather than nodes. Nature of V+I in 84 approx.

→ wave equations, T lines, in-wave design

↳ And signals are much smaller than E84

→ careful design, lots of gain, noise, common systems

How are we going to learn this?

- ~ Continuing effort in transparent teaching, you should know what you're learning & how.
- ~ start w/ goals, end w/ methods & logistics

## Goals

BIG: do a RF clinic

STEPS:

- Do I need RF? → interpret all the outputs
- Use common RF equipment → theory of operation
- Link budgets for communication systems
- Design lab setups w/ fast signals (including PCBs)

## Getting there

- Transmission Lines
  - S parameters
  - Antennas & propagation
  - Link budgets
- for curts
- Midterm + DP1
- Final + DP2

## Assignments

Quizzes - Every Tuesday (including this one)

- Frequent low stakes testing
- Probably drop lowest for 2, but no makeups

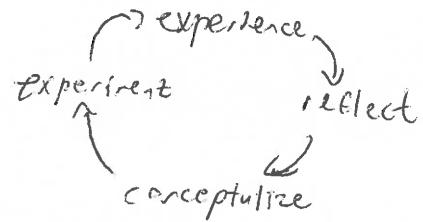
Labs - Hands-on

- = Experiential Learning Theory (Loalb)

- Mostly training & not design

- Every other week

- due Fri. 5PM, PDF, Sakai as lab notebook (example)



Homeworks - Quiz practice & test practice

less formal

- work through harder problems

supervised Q

- individual work, but you may chat

don't go back to lab

- due Fri., 5 PM, PDF, Sakai, scanned

- partners

Design Projects - filter & radar

- big labs

- 5 page report, no notebook

- Fri. 5 PM

- midterm in class, final as take home or may modify

- I write hard tests

- nothing on finals week but DP2 after final

- keep up with work! - 12 hours

Lab access - requires cert, doing today

- RF lab is small, so guarantee 1x 3 hr slot starting

- next week

- sign up sheet w/ partner, times negotiable

- Cert - see slides

- In groups of 3, go to board & write up Maxwell's eq<sup>1</sup>
  - Both diff & integral, pref. mks form

$$\nabla \cdot E = \rho / \epsilon_0$$

surface  $\oint E \cdot dA = \iiint \rho dV$

$$\nabla \cdot B = 0$$

$$\nabla \times E = - \frac{\partial B}{\partial t}$$

$$\nabla \times B = \mu_0 \left( J + \epsilon_0 \frac{\partial E}{\partial t} \right)$$

$$\oint B \cdot dA = 0$$

loop  $\frac{\text{Voltage}}{\oint E \cdot dl} = - \frac{d}{dt} \iint B \cdot dA$

$$\oint B \cdot dl = \mu_0 \iint J \cdot dA + \mu_0 \epsilon_0 \frac{d}{dt} \iint E \cdot dl$$

### - Implications

↳ electric charge exists, magnetic doesn't

↳ magnetic fields are loops

↳  $q \rightarrow \vec{E}$  fields

↳  $J \rightarrow \vec{B}$  fields (or virtual, capacitive  $\vec{J}$ )

↳ antennas care about  $d/dt$  ~ they are loops of wire or lines  
~ not  $q$  meters

Example:

- field around a wire