Welcome to E190AK (E190 RF!)

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 wires...
- You can apply E84 knowledge locally,

But fast signals are very small, so they see endless tunnels rather than nodes. Nature of VoI in 84 approx.

- Wave equation, T lines, in wave design;
- And signals are much smaller than E84
- Careful design, lots of gain, noise, (Com & Systems)
How are we going to learn this?

- Continuing effort in transparent teaching, you should know what you're learning or how.
- Start w/ goals, end w/ methods + logistics

Goals

Big: do a RF clinic

Skills:
- Do I need RF?
- Use common RF equipment
- Link budgets for communication systems
- Design lab setups w/ fast signals (including PCBs)

Getting there

- Transmission lines
- Midterm + DP1
- 5 parameters
- Antennas + propagation
- Link budgets
- Final + DP2

Assignments

Quizzes - Every Tuesday (including this one)
- Frequent low stakes testing
- Probably drop lowest 1 or 2, but no makeups
Labs - Hands-on
- Exponential Learning Theory (Lab)
- Mostly training, not design
- Every other week
- Due Fri. 5pm, PDF, Solns as Lab notebook (example)

Homeworks - Quiz practice & test practice
- Work through harder problems
- Individual work, but you may chat
- Due Fri., 5pm, PDF, solns as scanned

Design Projects - Filter & Radar
- Big labs
- 5-page report, no notebook
- Fri. 5pm

Midterm in class, final as take home — may modify
- I write hard tests
- Nothing in 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 3hr slot starting next week
- Sign up sheet w/ partner, times negotiable

Less formal supervision & don't go back to lab
Cert — see slides

In groups of 3, go to board and write up Maxwell's eq's

- Both diff + integral, pref. mks form

\[ \nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} \]
\[ \nabla \cdot \mathbf{B} = 0 \]
\[ \nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \]
\[ \nabla \times \mathbf{B} = \mu_0 \left( \mathbf{J} + \varepsilon_0 \frac{\partial \mathbf{E}}{\partial t} \right) \]

\[ \int \mathbf{E} \cdot d\mathbf{A} = \iiint \rho dV \]

\[ \int \mathbf{B} \cdot d\mathbf{A} = \oint \mathbf{E} \cdot d\mathbf{l} = -\frac{d}{dt} \int \mathbf{B} \cdot d\mathbf{A} \]

- Implications

  - Electric charge exists, magnetic doesn't
  - Magnetic fields are loops
  - Q \rightarrow \mathbf{E} fields
  - J \rightarrow \mathbf{B} fields (c virtual, opposite \( J \))
  - Conductors care about \( d\mathbf{B}/dt \) — they are loops of wire or lines

Example:
- field around a wire