E157 Lecture 15 Day Plan

Any questions before quiz

Quiz + Team Quiz + Talk through solution

Near field probe in a cap (C) driven by resistive voltage source (Vzp, f, Rs), what is E? Define xhat down.

- Vc = Vzp/(Rs*C*s+1)
- E = -grad(V) = V/d xhat
- Therefore: E=Vzp/d * 1/(Rs*C*s+1), beware the low pass behavior if calibrating vs. f!

Wires don't carry any power – S=0 in conductor because E=0

Handy EM laws and problem solutions:

- B around a wire – Biot-Savart – $\mu I/2\pi r$
- B in the middle of a coil – Integrate Biot-Savart – $\mu I/2\pi r$
- Helmholtz coil – two coils lined up to make uniform field in the middle -- $B = 8\mu NI/5\sqrt{5}r$
- EMF (voltage) induced in a coil by B – Faraday's / Lenz's Law – $-N\frac{d\phi}{dt}$ where $\phi = BA$
- E around a point charge – Integrate over spherical Gaussian surface – $q/4\pi r^2\epsilon$
- E around a charge line – $\lambda/2\pi r\epsilon$
- E around a charge sheet – $\sigma/2\epsilon$
- E between parallel plates w/ voltage V – σ/ϵ (or half that depending on how you define it), but we don't know sigma, instead we know V. Implies a capacitance of $\epsilon A/d$
- E in a coaxial cable with V on center pin – E is same as infinite line of charge, but we don't know lambda, we know V. Implies capacitance of $2\pi\epsilon L/\ln(b/a)$ where a and b are in/out radius.
- E around a charge hanging out over an infinite plane – figure this out by introducing an image charge and summing fields.