E157 Lecture 17 Day Plan

Any questions before quiz

Quiz + Team Quiz + Talk through solution

Design spec roundup

- $R_{rad}(\omega)$. [Ohms] TX can’t tell difference between radiation and dissipation, so resistor.
- $X_{rad}(\omega) = C_{rad}(\omega) + L_{rad}(\omega)$. [Ohms]
  - $C_{rad}$ and $L_{rad}$ can be approximated const sometimes.
  - All second order systems appear capacitive below resonance, inductive above
- $R_{loss}(\omega)$. [Ohms] Frequency dependence is from skin effect.
- Efficiency$(\omega) = R_{rad}/R_{loss}$ (b/c share same current). [Dimensionless]
- Bandwidth. [Hz] -3dB _in frequency_. Measure w/ VNA (S21 off peak, S11 off 0dB.)
- Radiation Pattern
  - Displayed as 3x polar plots in each antenna plane (xy, xz, yz)
  - Directivity and Gain [dBi]. Max of radiation pattern. Directivity theoretical.
  - Beam Width. [degrees]. -3dB _in angle_ off rad pattern max.
  - Note that “broadside” is the direction that an antenna is pointing.
  - Azimuth and
- Polarization [degrees].
  - Which way E field comes out of antenna
  - Note that superposition allows diagonal and circular polarizations
- Area / Dimension [m]. Matters for near/far field.

Discuss phased array beamforming and radiation patterns

Chu limit – $Q >= (1/(ka)^3+1/ka)$ for linear polarized, where a radius of containing sphere & $k$ is wave #

Why is path loss frequency dependent? → isotropic antenna gets smaller. So does yours probably.

Review receive antenna in a circuit and LC model for $X_{rad}$