E157 Lecture 11 Day Plan

Any questions before quiz

Quiz + Team Quiz + Talk through solution

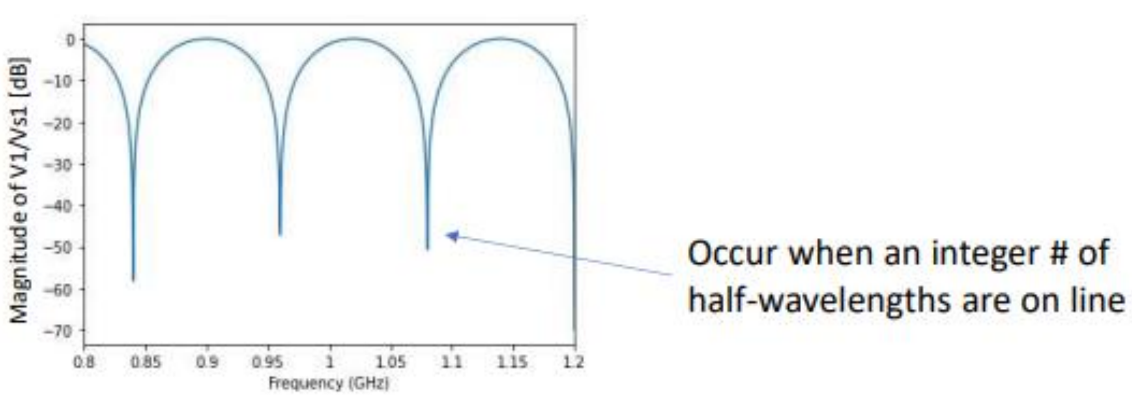
Leftover from last lecture: S21 is voltage gain if input is matched

- Call out an intermediate formula: S21 = V2/V1*(1+S11), S11 is zero if matched, port 2 Z0 term
- Reminder, Calculate S11 as Gamma w/ Z0 term.
- Note that reflection Gamma_in won't necessarily be just S11 b/c of S21*S12 round trip
- Calculate S11 and S21 for amp w/ gain of A, Rin=50, Rout=50 // gain A, Rin=inf, Rout=50

Linear network matrix properties

- Linear vs. Affine – difference from Thevenin, (calculate Thevenin for 2 port w/ a Vsource)
  - Let system be f(x) = ax+b, matches Thevenin model, note Rth=-Voc/Isc by port defn
  - Linearity requires f(x+y)=f(x)+f(y)
- Passive – implies passive components, no power added
  - Try w/ A= [2, 1+I ; 1-I, 1]
  - & lossless → unitary: $S^{T*}S = I$, eg: |S11|^2+|S21|^2=1 for 2 port
  - & lossy → $S^{T*}S < I$, eg: |S11|^2+|S21|^2<1 for 2 port
- Reciprocal – implies made of uniform, reciprocal ("non-directional") material,
  - $S^T = S$ → Sij=Sji
  - Not true for circulators (b/c of magnetically biased core), amplifiers, diodes
- Symmetric – can plug in backwards, reciprocal and all Sii=Sjj (same match at input and output)
- Matched, lossless, reciprocal 3 port is impossible:
  - Matched → S11=S22=S33=0,
  - Reciprocal → S12=S21, S13=S31, S32=S23
  - Lossless → S unitary, so |S1x|^2 + |S2x|^2 + |S3x|^2 = 1 for x in {1,2,3} and Swx* Syz = 0 w wx={21,21,31}, yz={31,32,32}
  - 9 equations in only 6 unknowns, overconstrained

Finding length from a short cal



- Pick out f1 of null 1 and f2 of null 2.
- 2*k1*S = 2n*pi, 2*k2*S=2(n+1)*pi ← Every VSWR lambda, or every half wave lambda