Final exam details
- Out Monday, I'll leave in office mailbox
- Take home exam, 3 hours, seal w/ tape when done, hand to Sydney & get answer
- 2x 8.5"x11" sheets front & back + writing utensils
- 3-4 questions - starts w/ match/short answer + 2 num problems
  - middle is design exercise close to class
  - end is synthesis/application
- Back ½ focused, but cumulative, esp. in sense from a lot in terms back
  - Comm system w/ mismatch

Topics from back ½

- Antennas & propagation
- Near/far field
- Gain/directivity
- Path loss
- Types
- Ckt model

- Noise
- noise temp of components
- spec. on.

- Linearity
- 2HD, 3HD
- 2IM, 3IM
- calculating values from
  - SIP3, P-1dB

- Comm. System
- modulation/demodulation
- common architectures
- analysis & freq. planning

- Study resources: quizzes, I'll post handouts by Monday, midterm, lab qs
Stability -

- Recall S-parameters
- We've speculated S_{12} can let a reflection get back to the input (instability)

\[ g_2 = \frac{G_2}{L} = \frac{G_2}{L} (S_{21} a_1 + S_{22} a_2) \]

\[ b_1 = S_{11} a_1 + S_{12} a_2 = S_{11} a_1 + \frac{G_2 S_{21} S_{12}}{1 - G_2 S_{22}} \]

- Similar derivation will give us
  \[ \Gamma_{in} = S_{11} + \frac{G_2 S_{21} S_{12}}{1 - G_2 S_{22}} \]

- If \(|\Gamma_{in}| > |\Gamma_{out}|\) always < 1 then stable, > 1 unstable
- Need to eval both, but \(\Gamma_{in}\) usually easier
- Test @ all frequencies - mix in, clip amps, etc. - \(\Gamma/\) varies
- Beware! \(\Gamma_{in}\) can vary w/ f. distance (stability)

- Test stability in a few ways, often read in \(\gamma\)-params

\[ \mu = \frac{1 - |S_{11}|^2}{|S_{11} (S_{11} s_{21} - S_{12} s_{22}) - S_{21} (1 + S_{12} S_{21})|} \]

\[ k = \frac{1 - (|S_{11}|^2 - |S_{22}|^2 + |S_{21} S_{12} - S_{12} S_{21}|^2)}{2 |S_{12} S_{21}|} \]

- Can also indicate boundary between stable + unstable \(\Gamma_{in}\) on Smith

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- One way determines specify stable loads

- Beware of excess BW + Gain
These stability factors capture load instability.

- Can still have regular old supply instability.
- Exp. 6/6 6/9 to power plane has high Z @ high f.
- Bypass like crazy and follow recommended layouts closely.

Ties into PCB layout:

- Short straight wiring runs
- Side launch SMA
- Taps separated by 0.52 resistor
- Wires are microstrip t-line.
  - Care about stackup & metal weight.

- Vertical SMA don't look like 50Ω corner if uneven.
  - Loading.
  - Can extend grid plane to lead 2 taper to account for L.
  - Extra loading keep this separation big.

- Custom footprints to taper into 0 or 6 PCB pins.
  - 45° linear taper of @ low f.
  - Exponential taper looks like wideband match.

- Filet corners 16 need to be.

- FR4 creeps out above 2GHz, but adhesion bad on other PCB.
  - Loss vector \( \alpha = 0.03 \text{ dB/cm/1GHz} \)
  - Nearby ground plane contains fields - less radiation.
Consider 1st day

- Is high speed design important → cell phones → comm. tech
  → back planes

- And we'll cover
  - T lines
  - S parameters
  - Antennas
  - Comm. Systems

- Can use this to build modern cell phone

![Diagram](attachment://diagram.png)