Lecture 25

• Last time:
  – Two-port small-signal models of amplifiers

• Today:
  – Finish methods for finding two-port model parameters
  – Start common-source amplifier
Finding the Voltage Gain $A_v$

Key idea: the output port is open-circuited and the source resistance is shorted

\[
A_v = \left. \frac{v_{out}}{v_{in}} \right|_{R_S = 0, \ R_L \to \infty}
\]
Finding the Current Gain $A_i$

Key idea: the output port is shorted and the source resistance is removed

$$A_i = \frac{i_{out}}{i_{in}} \bigg|_{R_s \to \infty, R_L = 0}$$
Finding the Transresistance $R_m$

$$R_m = \left. \frac{v_{out}}{i_{in}} \right|_{R_S \to \infty, R_L \to \infty}$$
Finding the Transconductance $G_m$

$$G_m = \left. \frac{i_{out}}{v_{in}} \right|_{R_s = 0, \ R_L = 0}$$

Two-Port Amplifier

$v_{in}$ $i_{out}$
First Example: the Common-Source Amplifier (again)

What about the load resistor?
DC Bias

Load line analysis:
Load-Line Analysis to find $Q$
DC Transfer Function

\[ V_{OUT} \]

\[ V_{BIAS} \]
Small-Signal Analysis

[Diagram of a circuit with labels: $v_{gs}$, $g_m v_{gs}$, $r_o$, $R_D$, $i_{out}$, $v_{out}$]
Two-Port Parameters:

Find $R_{in}$, $R_{out}$, $G_m$
Two-Port CS Model

Reattach source and load one-ports: