Lecture 29

• Last time:
  – Bipolar single-stage amplifiers: biasing, common-emitter, common-base, common-collector

• Today:
  – Overview of single-stage amplifiers
  – Frequency response of CS stage operated as a current amplifier
Common-Collector Summary

• Typo in Fig. 8.47 in text … $R_{in}$ can’t depend upon $R_S$!

• Input and output resistances depend on load and source resistances, respectively

• See Appendix to Chapter 8 for limits to using this model with very low values of $R_L$
# Summary of Two-Port Parameters for CE/CS, CB/CG, CC/CD Amplifiers

<table>
<thead>
<tr>
<th>Amplifier Type</th>
<th>Controlled Source</th>
<th>Input Resistance $R_{in}$</th>
<th>Output Resistance $R_{out}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Emitter</td>
<td>$G_m = g_m$</td>
<td>$r_n$</td>
<td>$r_o \parallel r_{oc}$</td>
</tr>
<tr>
<td>Common Source</td>
<td>$G_m = g_m$</td>
<td>infinity</td>
<td>$r_o \parallel r_{oc}$</td>
</tr>
<tr>
<td>Common Base</td>
<td>$A_i = -1$</td>
<td>$1/g_m$</td>
<td>$r_{oc} \parallel [(1+g_m(r_n \parallel R_S))\ r_o]$, for $g_m r_o \gg 1$</td>
</tr>
<tr>
<td>Common Gate</td>
<td>$A_i = -1$</td>
<td>$1/g_m, (\nu_{sb} = 0)$</td>
<td>$r_{oc} \parallel [(1+g_m R_S) r_o], (\nu_{sb} = 0)$, -otherwise- $r_{oc} \parallel [(1+ (g_m + g_{mb}) R_S) r_o]$, both for $r_o \gg R_S$</td>
</tr>
<tr>
<td>Common Collector</td>
<td>$A_v = 1$</td>
<td>$r_n + \beta_o (r_o \parallel r_{oc} \parallel R_L)$</td>
<td>$(1/g_m) + R_S/\beta_o$</td>
</tr>
<tr>
<td>Common Drain</td>
<td>$A_v = 1$ if $\nu_{sb} = 0$, -otherwise- $g_m/(g_m + g_{mb})$</td>
<td>infinity</td>
<td>$1/g_m$ if $\nu_{sb} = 0$, -otherwise- $1/(g_m + g_{mb})$</td>
</tr>
</tbody>
</table>
The “Chapter 8” Method for Single-Stage Amplifier Analysis

1. What is it?
2. DC Bias
3. Small-signal 2-port model
4. Output swing
DC Bias for $CE_{deg}$
Two-Port Model for $C_{E_{\text{deg}}}$

- Input looks like CC $\rightarrow R_{in} =$
- Output looks like CB (see p. 504 for details) $\rightarrow R_{out} =$
- Transconductance: $G_m =$
Two-Port Model for CE_{deg} (cont.)

• Find $G_m$

• Voltage Gain:

• Is it a good voltage amplifier (vs. CE)?
Output “Swing”

- Maximum $v_{OUT} = V_{OUT} + v_{out} = v_{out}$

- Minimum $v_{OUT}$