HW #6 Due Today

HW #7 assigned; Due Fri Feb 19 (Solution posted)

Graded HW #5 handed back

Quiz 2 Monday Feb 15 (15 minutes)
Sample on class webpage
Reference notesheet
BJT Small-signal analysis
+ CE Amplifier

Amplifier configurations: CE
CB
CC (emitter follower)

CC Amplifier

\[ R_i = r_K + (\beta + 1) R_L \]
\[ R_o = R_L || R_i \]
\[ R_i = \frac{r_K}{\beta + 1} = \frac{1}{g_m} \approx \frac{1}{g_m} \]

With a large \( R_L \); \( R_o \approx \frac{1}{g_m} \) small

\[ \frac{v_o}{v_i} = \frac{R_L}{r_K + R_L} \]
\[ = \frac{1}{\beta + 1} \frac{1}{g_m} \approx 1 \quad (\text{less } < 1) \]
Buffer amplifiers

- \( R_i \) large
- \( R_o \) Small
- \( Gain \approx 1 \)

Small-signal models

Hybrid-\( \alpha \) model

T-model

CE, CB, CC; NPN/PNP Versions

- \( I_c = 1 \text{mA}, \beta = 100 \)
- \( R_c/R_e = 2 \text{k}\Omega \)
- \( q_m = 40 \text{mA/V} \)
- \( R_e = 2.5 \text{k}\Omega \)

CE

CB

- \( R_i = R_e = 2.5 \text{k}\Omega \)
- \( R_o = R_c = 2 \text{k}\Omega \)
- \( A_v = -q_m R_c = -80 \% \)
- \( A_i = \beta = 100 \)

- \( R_i = \frac{R_f}{\beta + 1} \approx 1 \text{k}\Omega \)
- \( R_o = R_c = 2 \text{k}\Omega \)
- \( A_v = q_m R_c \approx 80 \% \)
- \( A_i = \approx 1 \)
### Summary

<table>
<thead>
<tr>
<th></th>
<th>CE</th>
<th>CB</th>
<th>CC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ai</strong></td>
<td>high</td>
<td>low (~1)</td>
<td>high (β+1)</td>
</tr>
<tr>
<td><strong>Av</strong></td>
<td>high</td>
<td>high</td>
<td>low ( ~1)</td>
</tr>
<tr>
<td><strong>Ri</strong></td>
<td>Medium</td>
<td>Low</td>
<td>high</td>
</tr>
<tr>
<td><strong>Ro</strong></td>
<td>Medium</td>
<td>Low</td>
<td>low</td>
</tr>
</tbody>
</table>

\[ Ri = r_k + (\beta + 1) R_L = 204.5 \, \text{kΩ} \]
\[ R_o = \frac{1}{g_m} = 25.5 \]
\[ A_v = \frac{g_m R_L}{g_m R_L + 1} = 0.99 \]
\[ A_i = (\beta + 1) = 101 \]