Summary of Discrete MOS Amplifiers

Common Drain (Source Follower):
\[ \frac{v_o}{v_i} = \frac{g_m(r_o \parallel R_S \parallel R_L)}{1 + g_m(r_o \parallel R_S \parallel R_L)} \]
\[ R_i = R_G \]
\[ R_o \approx \frac{1}{g_m} \parallel R_S \]

Common Source:
\[ \frac{v_o}{v_i} = -g_m(r_o \parallel R_D \parallel R_L) \]
\[ R_i = R_G \]
\[ R_o = R_D \parallel r_o \]
\[ f_{p3} = \frac{1}{2\pi C_s[R_S \parallel (r_o + R_D \parallel R_L)/(1 + g_m r_o)]} \]

Common Source with Source Resistance:
\[ \frac{v_o}{v_i} = -\frac{g_m(R_D \parallel R_L)}{1 + g_m R_S + (R_D \parallel R_L)/r_o} \]
\[ R_i = R_G \]
\[ R_o = R_D \parallel [r_o(1 + g_m R_S)] \]

Common Gate:
\[ \frac{v_o}{v_i} = g_m(r_o \parallel R_D \parallel R_L) \]
\[ R_i = R_S \parallel \frac{1 + (R_D \parallel R_L)/r_o}{g_m} \]
\[ R_o = R_D \parallel [r_o(1 + g_m(R_S \parallel R_{sig})]] \]

\[ f_1 = \Sigma_j f_{p_j} \text{ and } f_{p1} = 1/[2\pi C_{c1}(R_i + R_{sig})] \text{ and } f_{p2} = 1/[2\pi C_{c2}(R_L + R_o)] \]
Summary of Discrete BJT Amplifiers

Common Collector (Emitter Follower):

\[ \frac{v_o}{v_i} = \frac{g_m(r_o \parallel R_E \parallel R_L)}{1 + g_m(r_o \parallel R_E \parallel R_L)} \]
\[ R_i = R_B \parallel [r_\pi + \beta(r_o \parallel R_E \parallel R_L)] \]
\[ R_o = R_E \parallel \frac{r_\pi + R_B \parallel R_{sig}}{1 + \beta} \]

Common Emitter:

\[ \frac{v_o}{v_i} = -g_m(r_o \parallel R_C \parallel R_L) \]
\[ R_i = R_B \parallel r_\pi \]
\[ R_o = R_C \parallel r_o \]
\[ f_{p3} = \frac{1}{2\pi C_e[R_E \parallel (1/g_m + (R_B \parallel R_{sig})/\beta)]} \]

Common Emitter with Emitter Resistor:

\[ \frac{v_o}{v_i} \approx -g_m(R_C \parallel R_L)/r_o \]
\[ R_i = R_B \parallel [r_\pi + R_E + \frac{\beta R_E}{1 + (R_C \parallel R_L)/r_o}] \]
\[ R_o = R_C \parallel \left[ r_o \left( 1 + \frac{\beta R_E}{r_\pi + R_E + R_B \parallel R_{sig}} \right) \right] \]

Common Base:

\[ \frac{v_o}{v_i} = g_m(r_o \parallel R_C \parallel R_L) \]
\[ R_i = R_E \parallel r_\pi \parallel \frac{1 + (R_C \parallel R_L)/r_o}{g_m} \]
\[ R_o = R_C \parallel [r_o(1 + g_m(R_E \parallel r_\pi \parallel R_{sig})/g_m)] \]
\[ f_{p3} = 1/[2\pi C_B R_{CB}] \quad R_{CB} \equiv R_B \parallel [r_\pi + (1 + \beta)(R_{sig} \parallel R_E)] \]

- \[ f_i = \Sigma_j f_{pj} \text{ and } f_{p1} = 1/[2\pi C_{c1}(R_i + R_{sig})] \text{ and } f_{p2} = 1/[2\pi C_{c2}(R_L + R_o)] \]