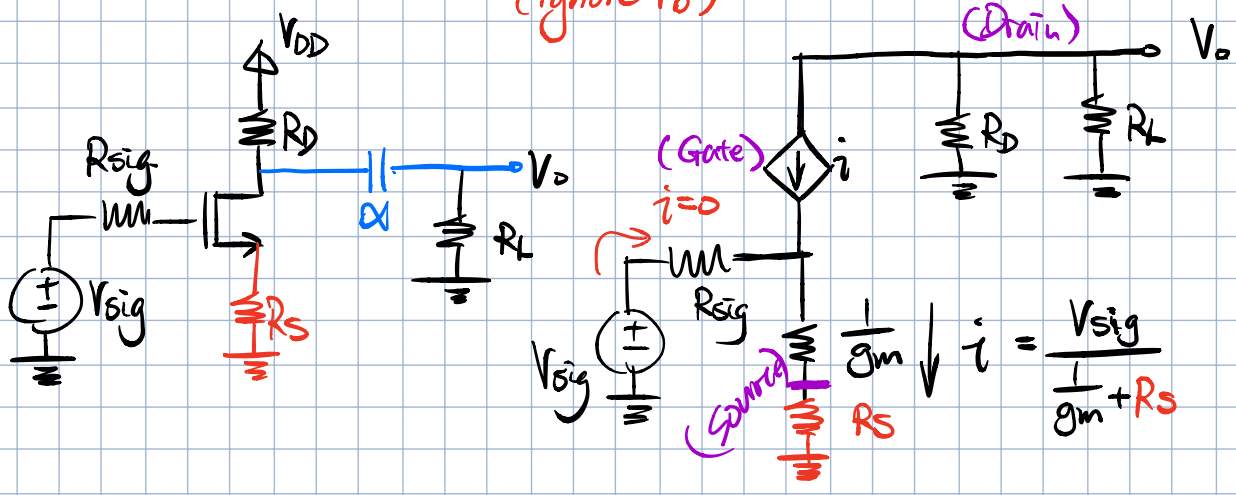
CS but with a source resistance (R_S)

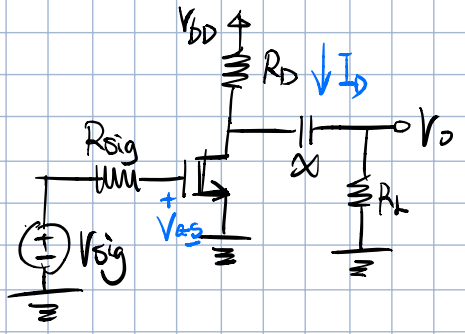
(ignore r_o)

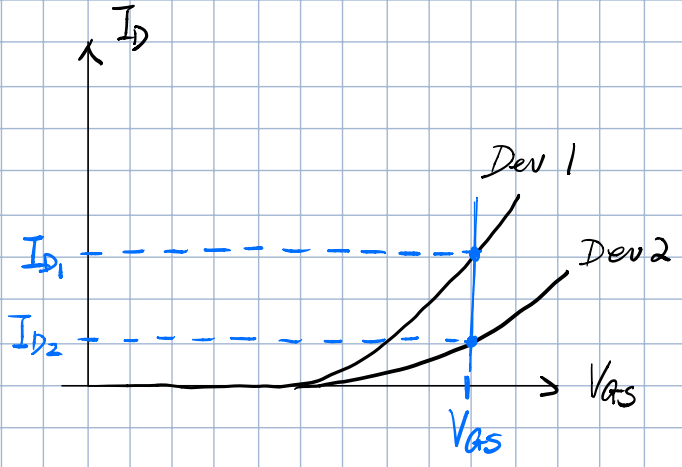


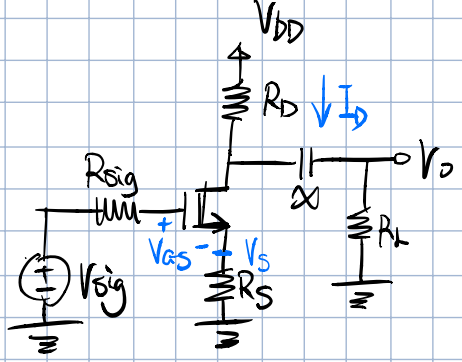
$$V_o = -i(R_D // R_L) = -\frac{V_{sig}}{\frac{1}{g_m}+R_S}(R_D // R_L)$$

$$\text{gain} = \frac{V_o}{V_{sig}} = -\frac{R_D // R_L}{\frac{1}{g_m}+R_S}$$ → reduces the voltage gain.

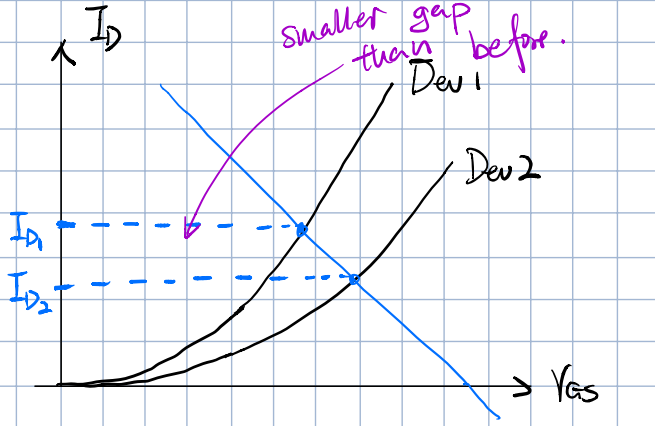
$$\text{if } R_S >> \frac{1}{g_m},\ \text{gain} \simeq -\frac{R_D // R_L}{R_S}$$





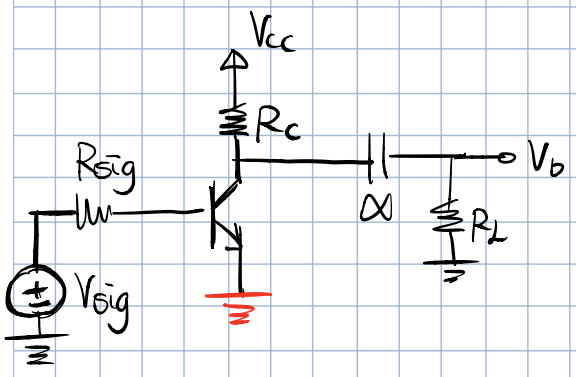


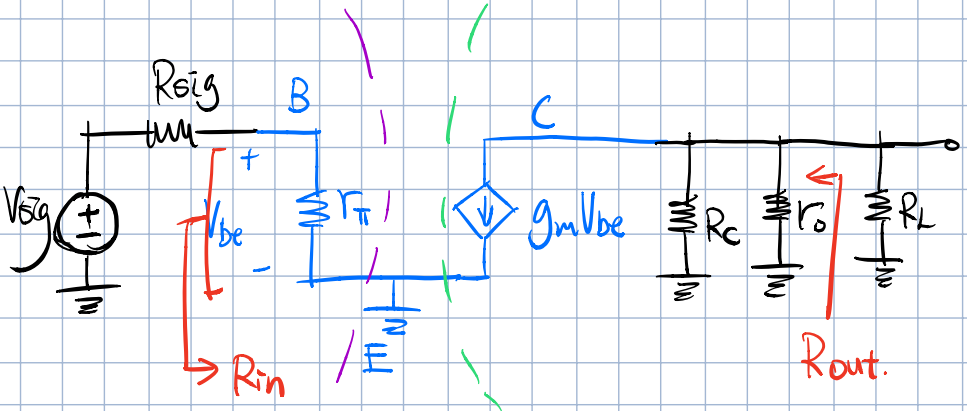
$V_S = R_S I_D$



$V_{GS} = V_{sig} - R_S I_D$, $I_D \propto (V_{GS} - V_t)^2$

Common Emitter (CE)





$V_o = -g_m V_{be} (R_c // r_o // R_L)$

$$V_{be} = \frac{r_\pi}{R_{sig} + r_\pi} V_{sig}$$

$$\frac{V_{be}}{V_{sig}} = \frac{r_\pi}{R_{sig} + r_\pi} \qquad \frac{V_o}{V_{be}} = -g_m (R_c // r_o // R_L)$$

$$\text{Voltage gain} = \frac{V_o}{V_{sig}} = -g_m \frac{r_\pi}{R_{sig} + r_\pi} (R_c // r_o // R_L)$$

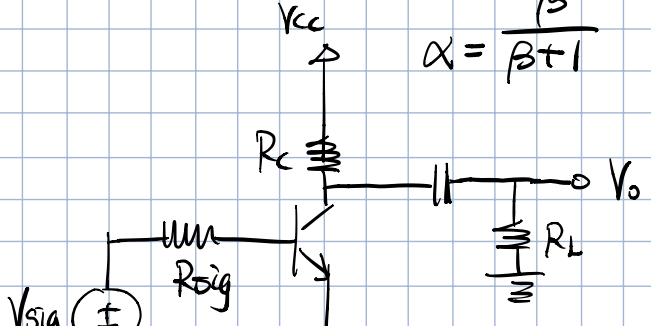
$$\frac{V_o}{V_{sig}} = -\beta \frac{R_c // r_o // R_L}{R_{sig} + r_\pi}$$ } resistance in collector / } resistance in the base.

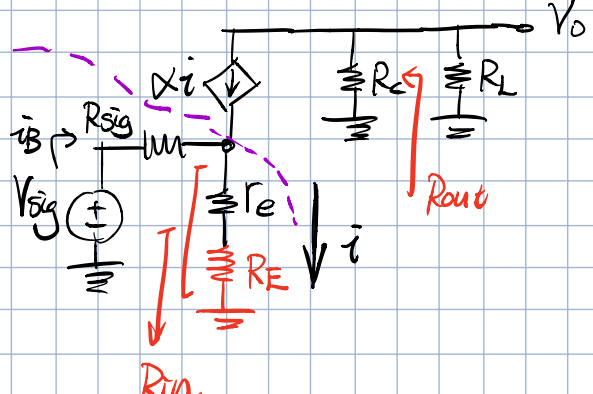
input resistance $R_{in} = r_\pi$

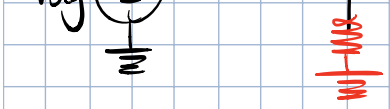
output resistance. $R_{out} = R_c // r_o$

CE with RE (ignore r_o)

$$\alpha = \frac{\beta}{\beta + 1}$$







$$R_{in} = (\beta+1)(r_e + R_E)$$

reflection rule

$$i_B = \frac{V_{sig}}{R_{sig}+R_{in}} \qquad i = (\beta+1) i_B = (\beta+1)\frac{V_{sig}}{R_{sig}+R_{in}}$$

$$V_o = -\alpha i (R_C // R_L)$$

$$= -\alpha(\beta+1)\frac{V_{sig}}{R_{sig}+R_{in}}(R_C // R_L)$$

$$gain = \frac{V_o}{V_{sig}} = -\alpha(\beta+1)\frac{R_C // R_L}{R_{sig}+R_{in}}$$

resistance in collector.

$$= -\beta \frac{R_C // R_L}{R_{sig}+(\beta+1)(r_e+R_E)}$$

resistance in base.