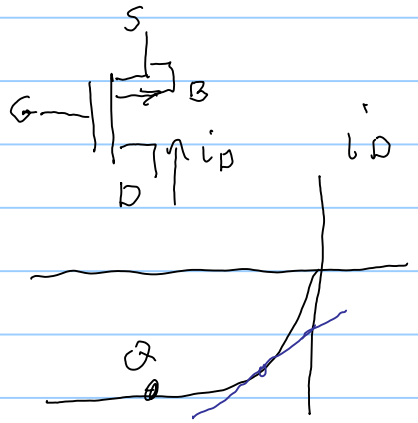
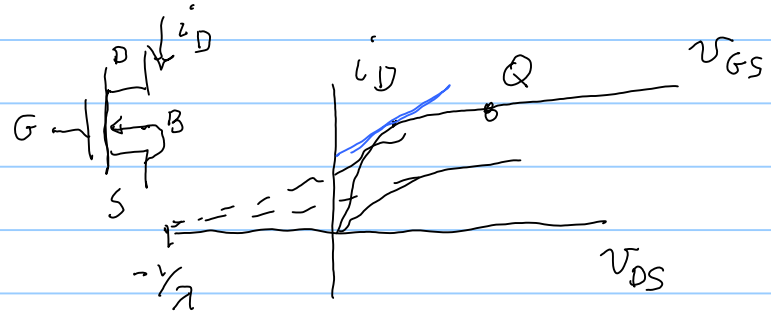
EE3034
12/08/15

Note Title 12/8/2015

Final: PMOS & NMOS equivalent circuits
inverter CMOS
current mirrors BJT & CMOS
amplifier; grounded source & source & emitter follower
" " emitter

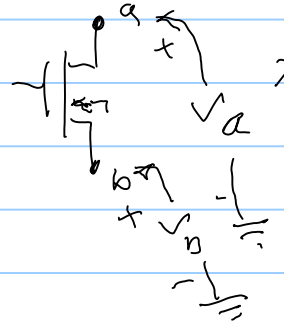
$v_{GS} = V_{GS} + v_{gs}$



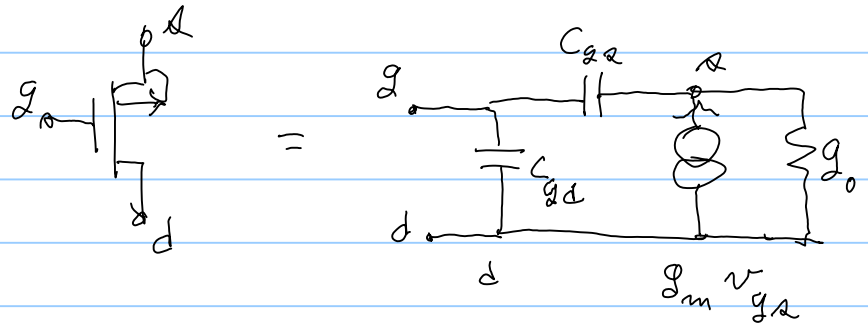


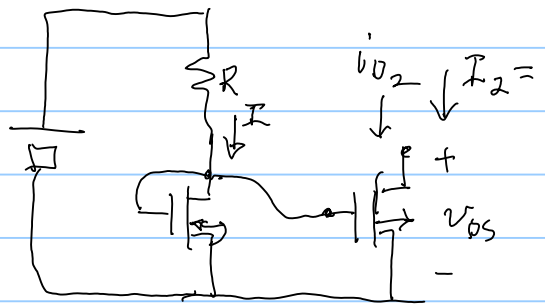
For NMOS: the Source is at a lower potential than the Drain

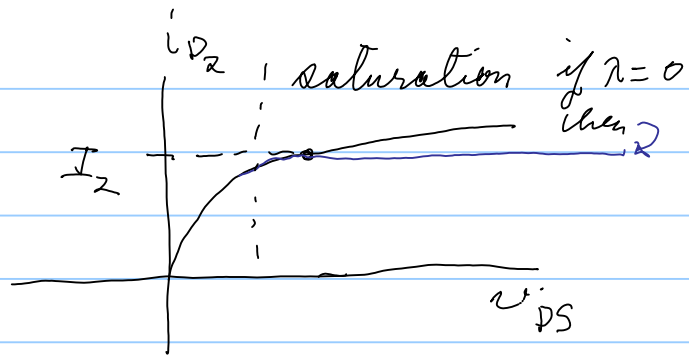
PMOS: " " " " " higher " " " "



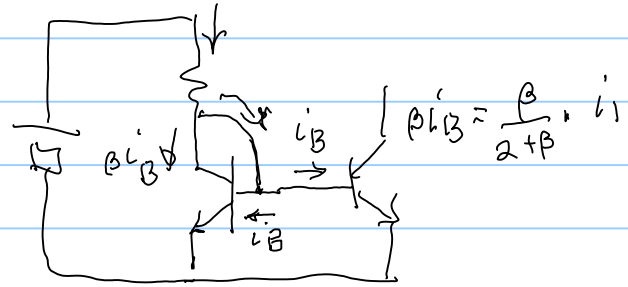
then a = S if $V_a \leq V_b$



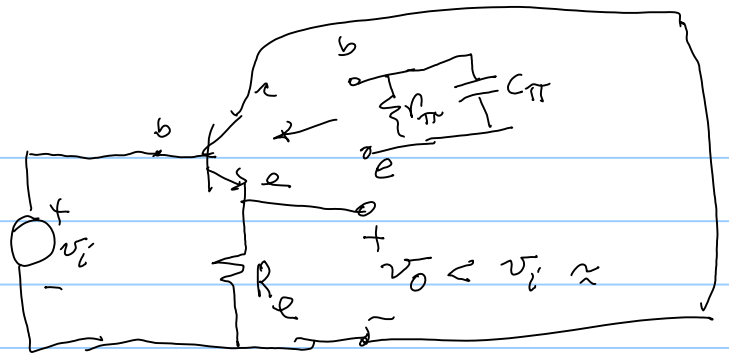


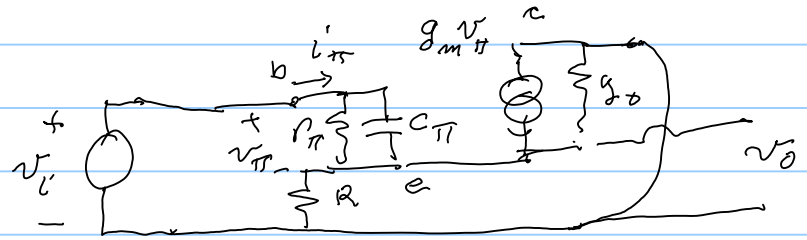


$$i_1 = \beta i_B + 2 i_B \Rightarrow i_B = i_1 / [2+\beta]$$



Emitter follower.





$$v_\pi = v_i - v_o \quad \Rightarrow \quad g_\pi v_\pi \approx i'_\pi = i'_b \approx (g_\pi + sC_\pi) v_\pi$$

KCL@e : $i'_b + i'_c = i'_e = (g_\pi + sC_\pi) v_\pi + g_m v_\pi - g_o v_o$

$= G v_o$

$$(g_o + G) v_o = [g_m + g_\pi + sC_\pi] v_\pi$$

$$v_o = v_i - v_\pi = v_i - \frac{(g_o+G)}{g_m + g_\pi + sC_\pi} \times v_o \Rightarrow \left[1 + \frac{g_o+G}{g_m + g_\pi + sC_\pi}\right] v_o = v_i$$

$$\frac{v_o}{v_i} = \text{voltage gain} = \frac{1}{1 + \dfrac{g_o + G}{g_m + g_\pi + s C_\pi}} \approx 1$$

$$\simeq \frac{\dfrac{g_m + g_\pi}{C_\pi} + s}{s + \dfrac{1}{C_\pi}\left[g_o + G + g_m + g_\pi\right]} = \frac{s - s_0}{s - p_0}$$

$$s_0 \simeq -\left(\frac{g_m + g_\pi}{C_\pi}\right) = \text{zero}$$

$$s_p \simeq -\left(\frac{g_o + G + g_m + g_\pi}{C_\pi}\right)$$