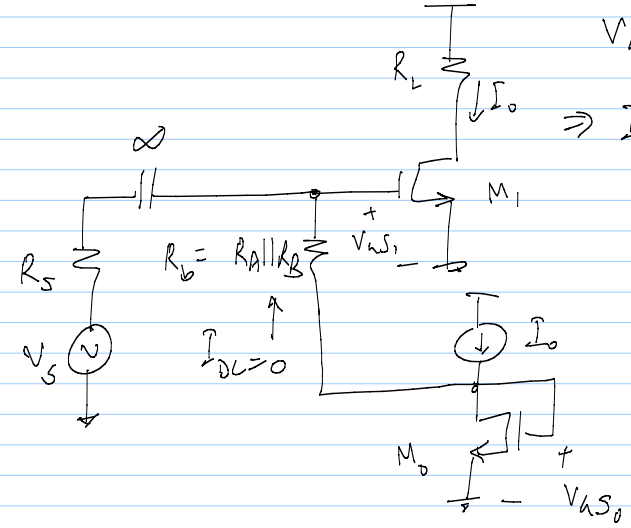
10/9/14

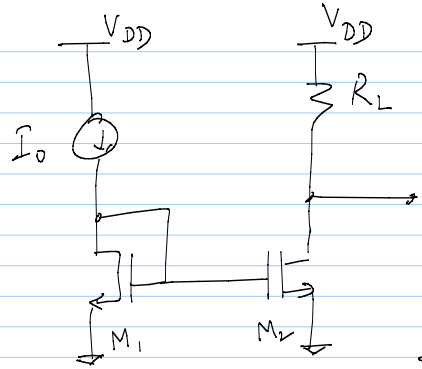
# lec 20




$V_{GS_0} = V_{GS_1}$

$\Rightarrow I_{D_1} = I_{D_0} = I_0$

"Current Mirror"



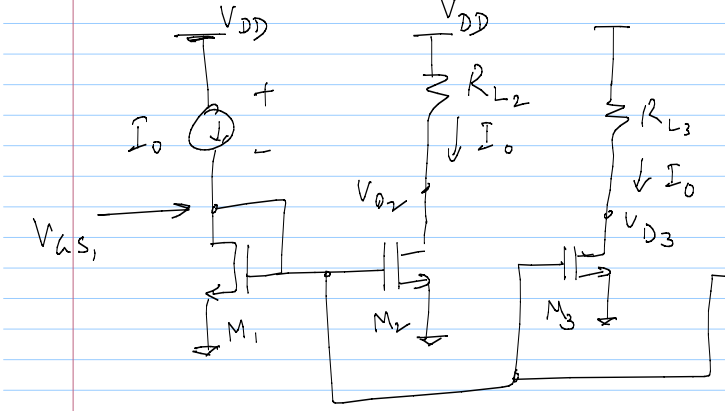

$V_{D_2} = V_{DD} - I_0 R_L$

$M_2$ = Sat.

$$V_{DD} - I_0 R_L > V_{GS_1} - V_T$$

$V_{GS_1} = V_{GS_2}$

$\Rightarrow I_{D_1} = I_{D_2} = I_0$



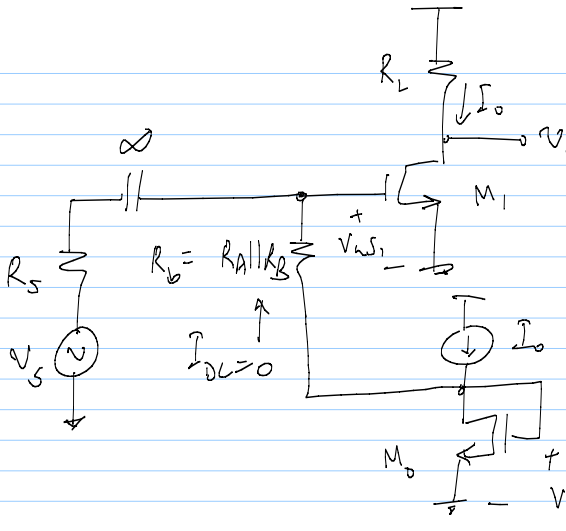

$V_{D_i} > V_{GS_1} - V_T$

$M_1, M_2, M_3 \ldots$ are identical ...

If we want to generate $2I_0$, make

$$\left(\frac{W}{L}\right)_{M_2} = 2\left(\frac{W}{L}\right)_{M_1}$$

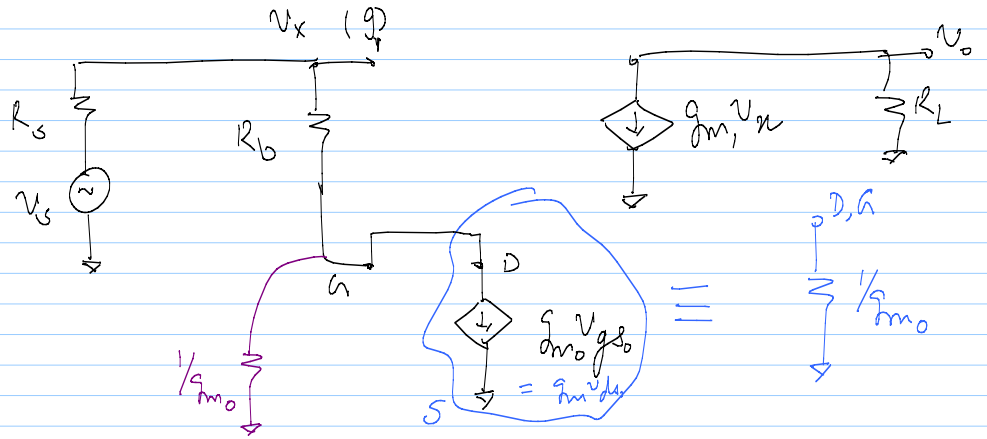
$$L_1 = L_2$$




$V_{GS_{DC}} = V_{GS_1}$

$V_{DS_{DC}} = V_{DS_1} = V_{DD} - I_0 R_L$

$$g_m = \frac{2I_0}{V_{GS_1} - V_T}$$




$$V_x = \frac{R_b + 1/g_{m_0}}{R_s + R_b + 1/g_{m_0}} V_s \approx V_s \quad \text{if} \quad R_b + 1/g_{m_0} \gg R_s$$

$$\frac{V_o}{V_s} = -g_m R_L$$

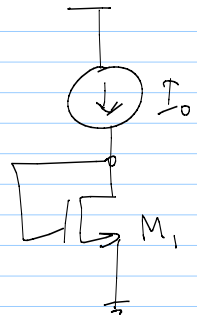
$V_{as_1}$ = same as before

$I_D$ = "

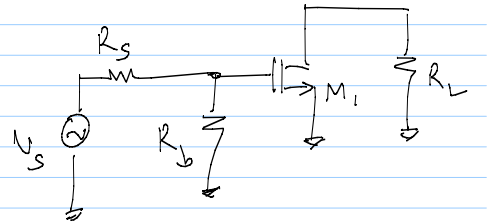
$V_{DS_1}$ = "

G = "

$\therefore$ Swing limits } = Same as before

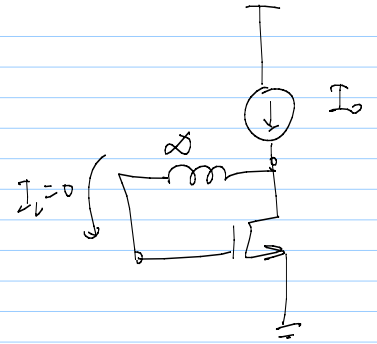



DC

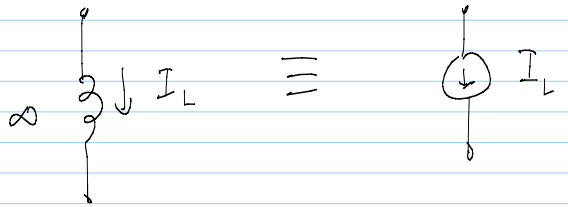


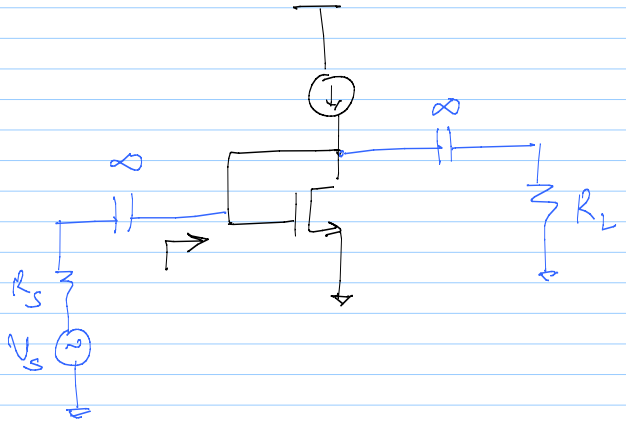

AC

1)



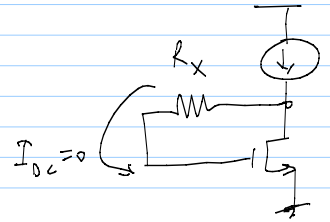

+ inductors are bulky ✗



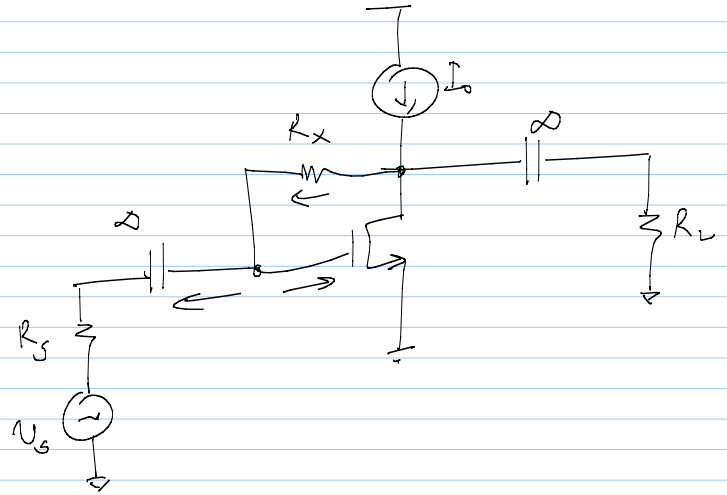



$$\frac{v_o}{v_s} = \frac{R_L \| 1/g_m}{R_L \| 1/g_m + R_S}$$

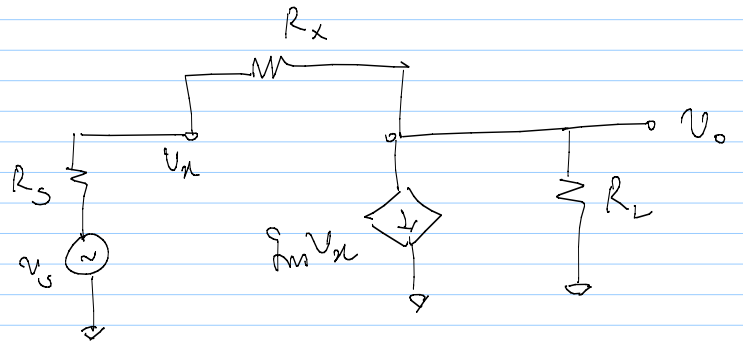
2)




$$V_{GS_{DC}} = V_{DS_{DC}}$$




Small-signal:




$v_s$