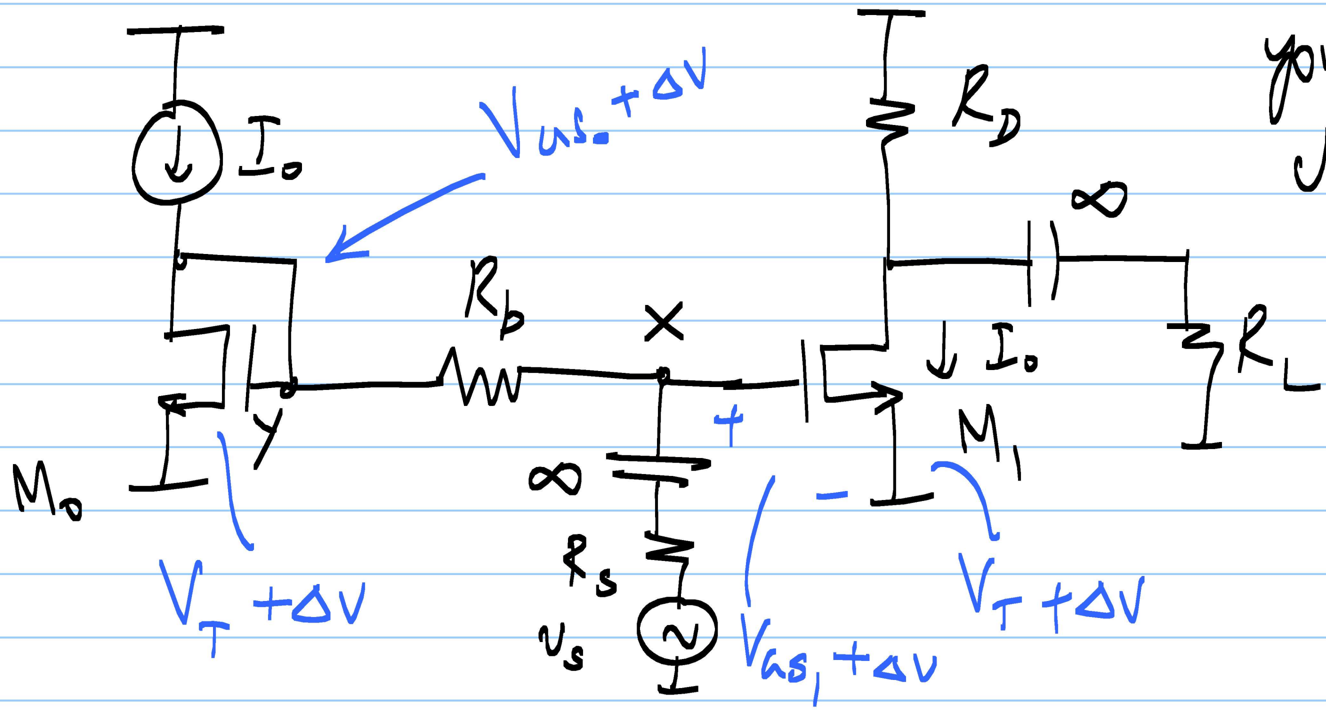
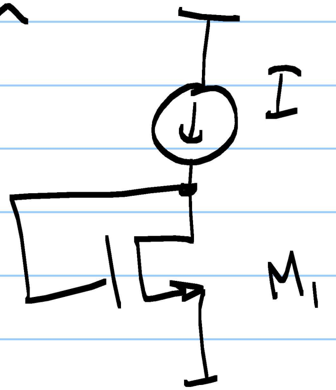
28/8/20

Lecture 15

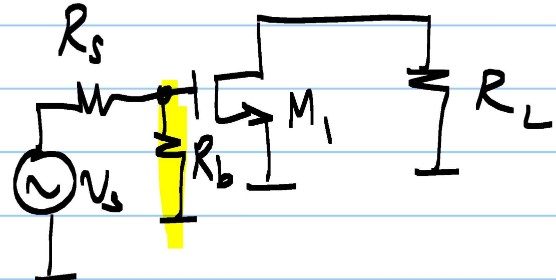
* If V_{T_1} changes by ΔV, you expect V_{T_0} to also change by ΔV



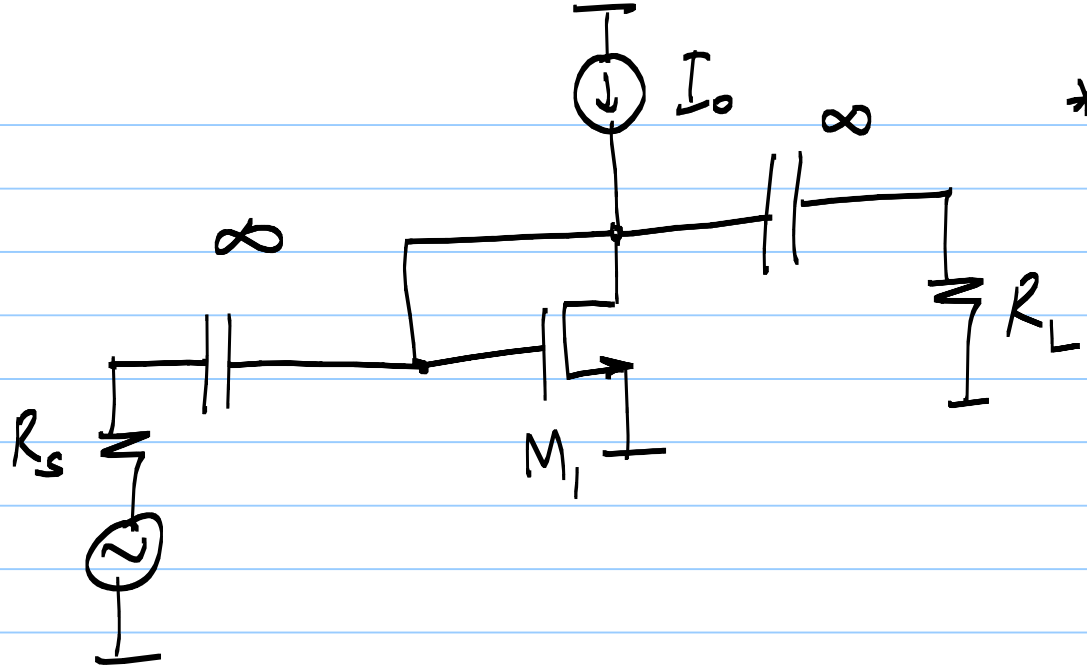
Can you do this with a single MOSFET?



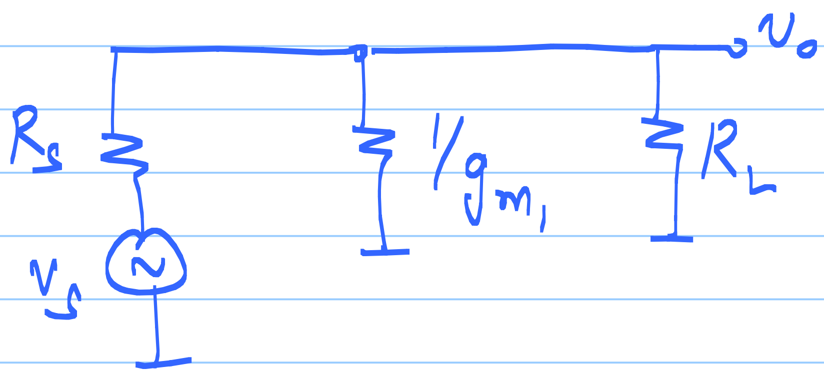
DC bias



Incremental



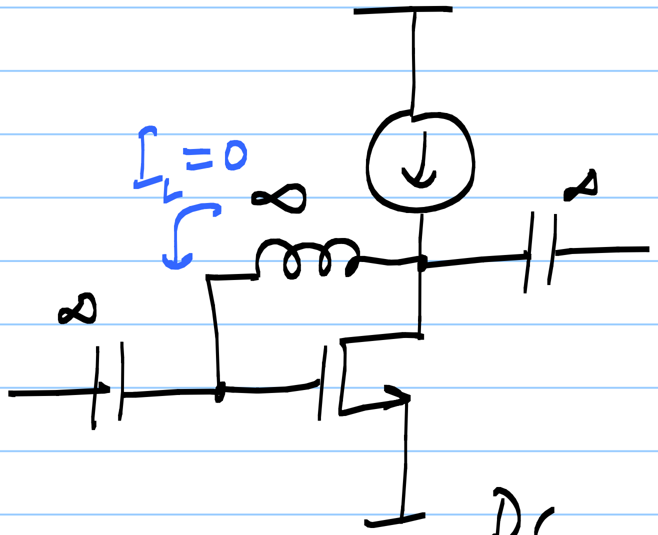
* Start with DC bias circuit
* Add source & load
* $V_{DS} = V_{GS}$
* M_1 is in sat.



$$\frac{v_o}{v_s} = \frac{R_L \| 1/g_{m1}}{R_s + R_L \| 1/g_{m1}}$$

Not what we want!

Options: 1) Add ∞ inductor between G & D

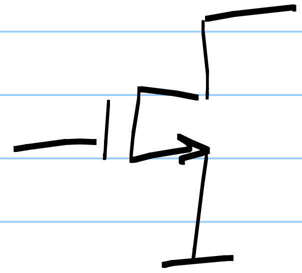


DC

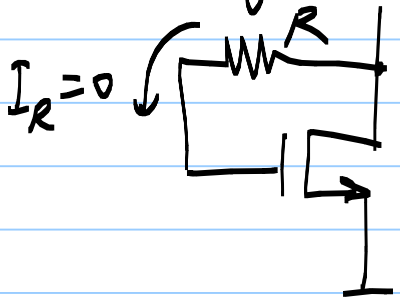
✓

works but impractical (L's are bulky)

AC



2) Use large resistor (because $I_L = 0$)

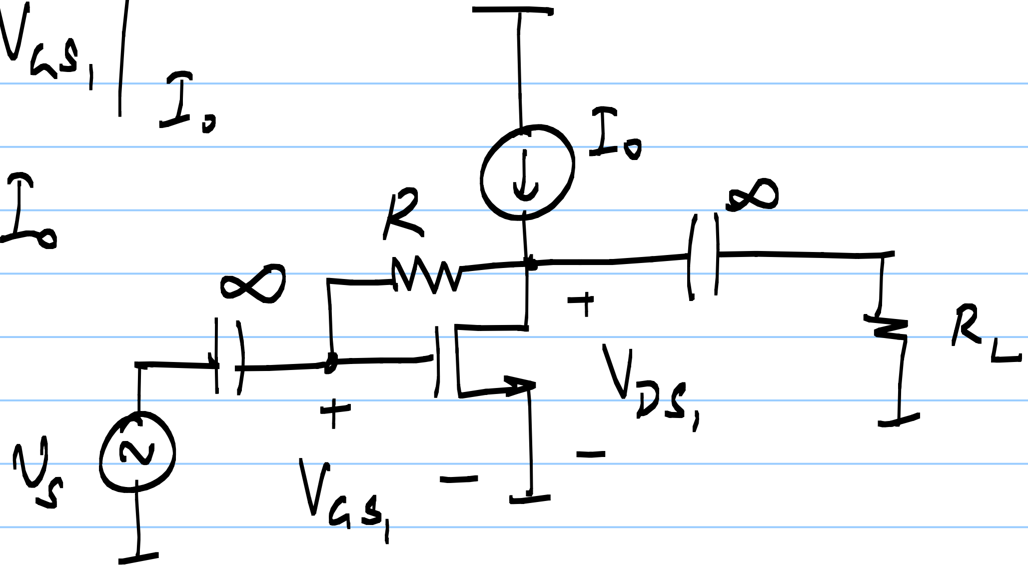


$V_{DS_1} = V_{GS_1}$, feedback maintained

$V_{DS_1} = V_{GS_1} \big|_{I_0}$

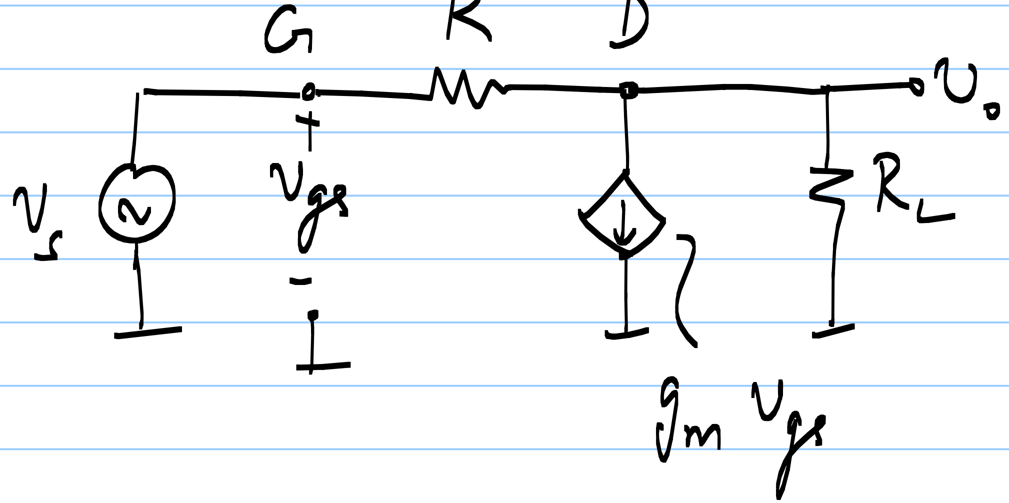
$I_{D_1} = I_0$

DC is okay



HW1 : Analyse with R_S

SS eq. :



$v_{gs} = v_s$

KCL @ drain node :

$$\frac{v_s - v_o}{R} = g_m v_s + \frac{v_o}{R_L}$$

$$\frac{1}{R} = G, \quad \frac{1}{R_L} = G_L$$

$$v_s\left[G - g_m\right] = v_o\left[G_L + G\right]$$

$$\frac{v_o}{v_s} = \frac{G - g_m}{G + G_L} = \frac{-g_m}{G_L}\underbrace{\left[\frac{1 - G/g_m}{1 + G/G_L}\right]}_{\approx 1 \text{ (desired)}}$$

We want

* $g_m >> G_L$ (large gain)
* $G << G_L \Rightarrow G << g_m$

By "large R", we mean $R >> R_L$

$$\text{gain} \approx -g_m R_L$$

Swing limits:

* Triode limit is lower because $V_{DS} = V_{GS}$
* Cutoff limit is same as before; I_D = same as before