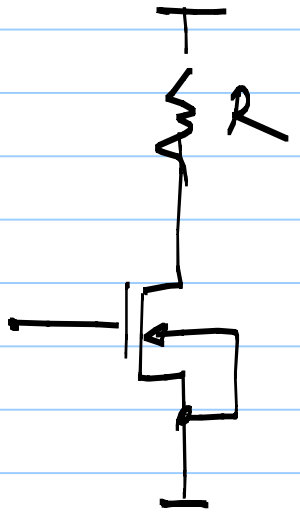
19/1/2016

Lecture 6

Body effect in a Common source amplifier

CS



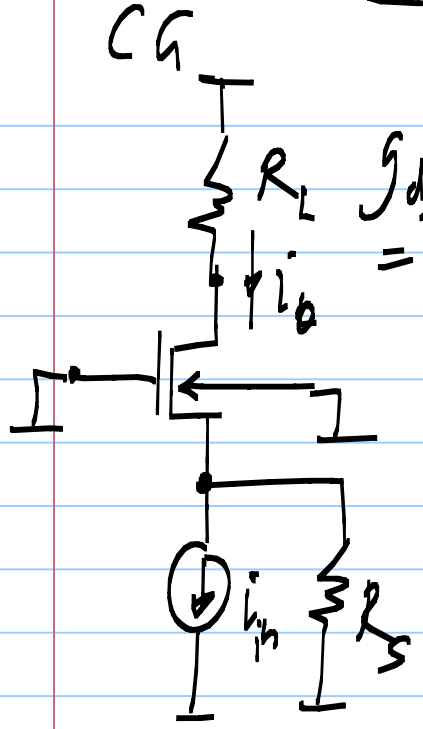
Both source & bulk are incrementally grounded, $V_{bs} = 0$

No change : gain = $-g_m R$

$g_m, g_{ds} = 0$

g_{mb}

Common gate amplifier



$g_m, g_{ds} = 0$

g_{mb}

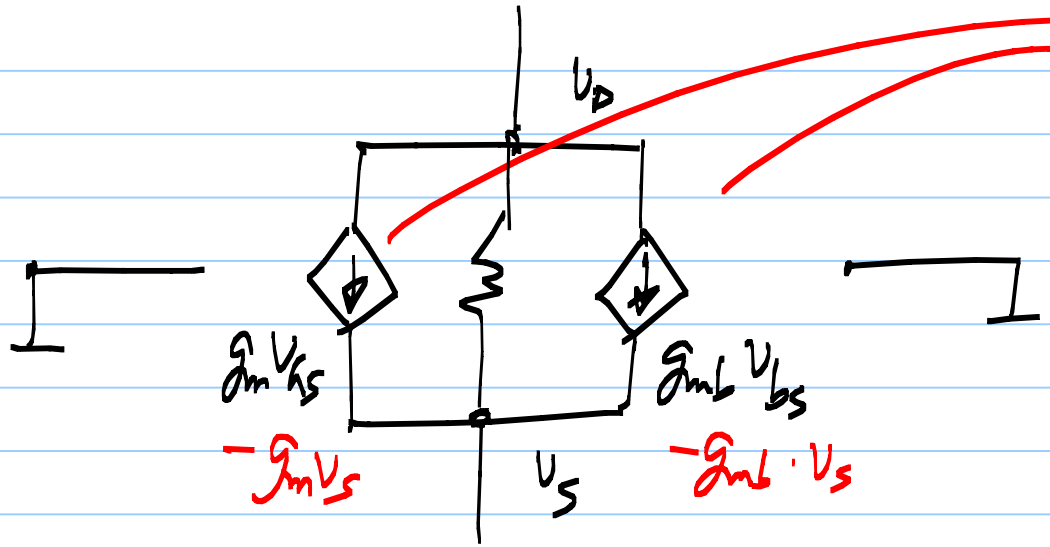
$$\text{gain } (g_{ds}=0) : \frac{i_o}{i_{in}} = \frac{(g_m + g_{mb})}{(g_m + g_{mb}) + G_s}$$

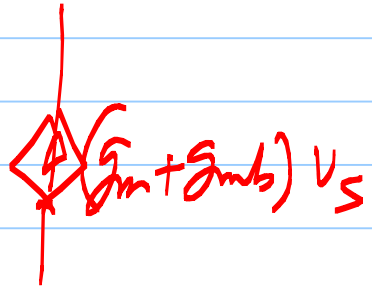
$$R_i : \frac{1}{(g_m + g_{mb})}$$

$$R_o : (g_m + g_{mb}) \cdot r_{ds} \cdot R_s + r_{ds} + R_s$$

$g_{ds} \neq 0$

Body effect improves the performance

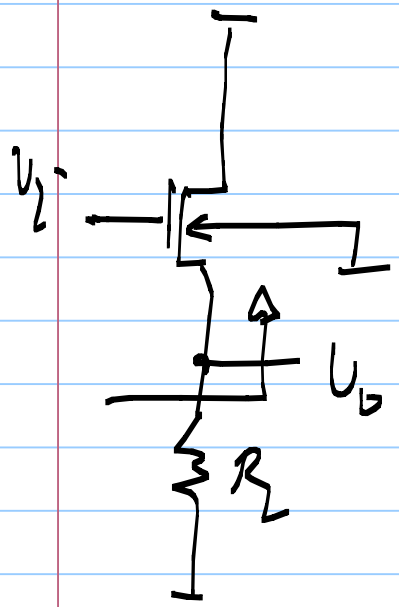

v_D
$g_m v_{gs}$
$g_{mb} v_{bs}$
$-g_m v_s$
v_s
$-g_{mb} \cdot v_s$


$(g_m + g_{mb}) v_s$

Common drain amplifier

CD

gain: $\frac{v_o}{v_i} = \frac{g_m}{g_m + g_{mb} + G_L} \approx \frac{g_m}{g_m + g_{mb}}$

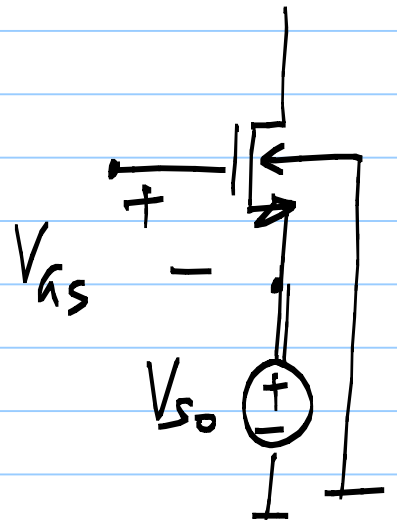


R_o : $\frac{1}{g_m + g_{mb}}$

$\frac{g_m}{g_{mb}}$: 4 – 10

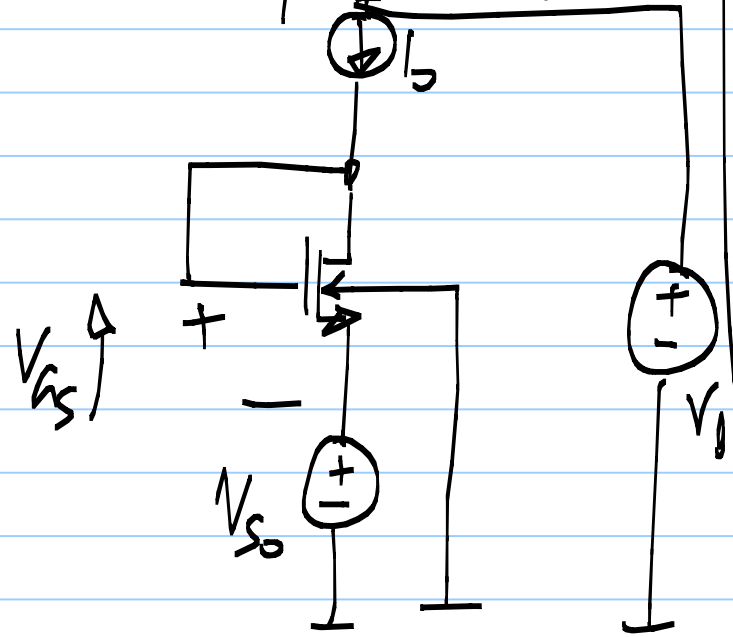
Evaluate the effect of body effect on single transistor VCCS & CC VS

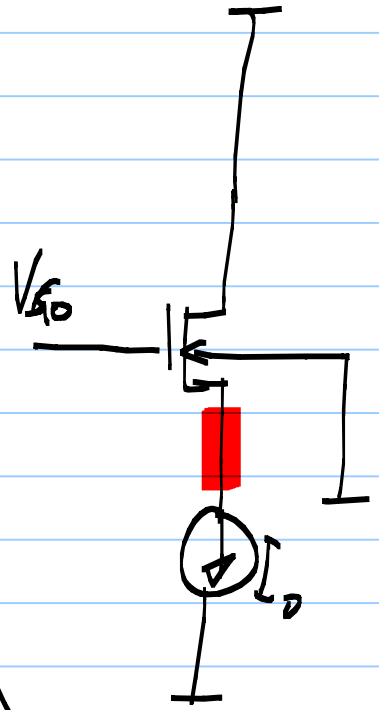
Constant V_{GS} bias



Constant I_D bias — small signal parameters: same

Drain feedback

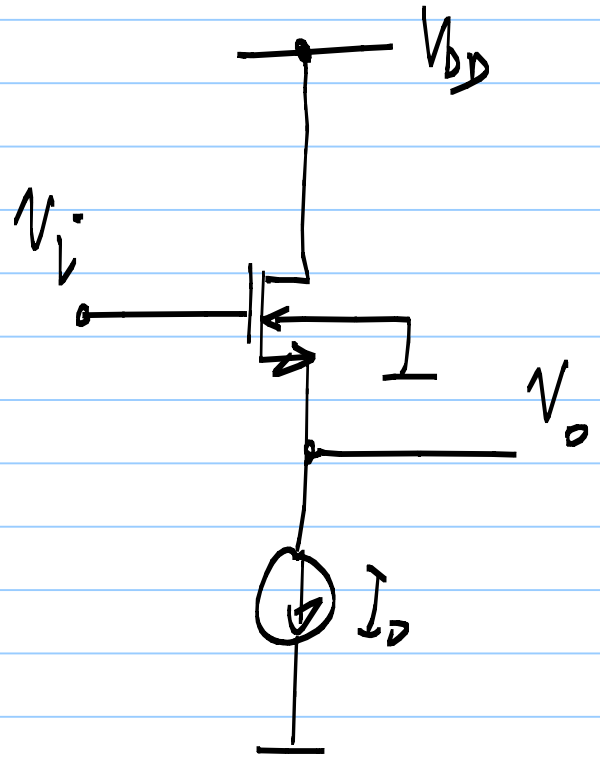


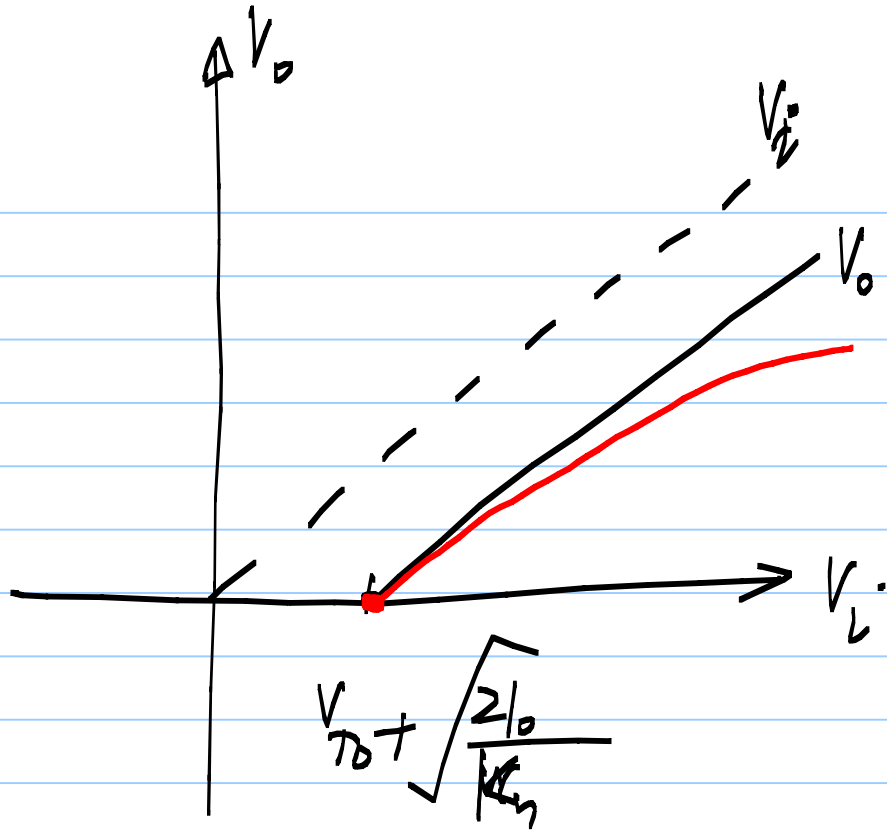


$$g_m = \sqrt{\frac{2I_D}{\mu_n C_{ox} W/L}}$$

op. point (swing limits) change

Source follower:





$$V_o = V_i - V_{GS}$$

$$= V_i - \left(V_{T_0} + \gamma\left(\sqrt{V_o + 2\phi_f} - \sqrt{2\phi_f}\right) + \sqrt{\frac{2I_D}{\mu_n C_{ox} W/L}} \right)$$