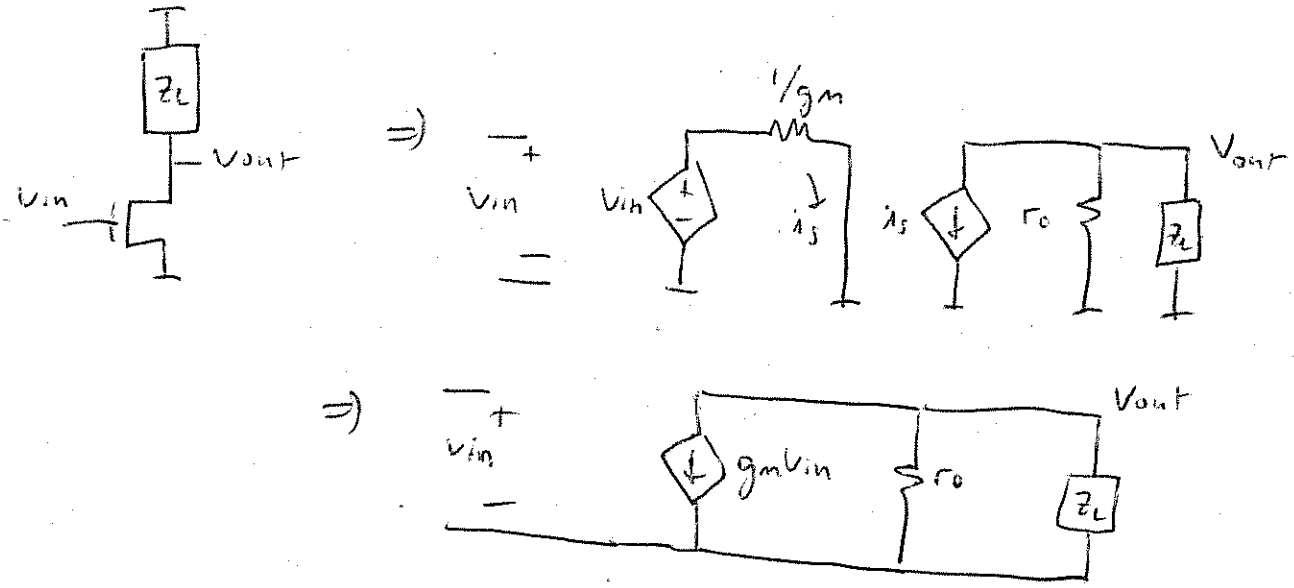
SLIDE 3) EXAMPLE GAIN CALCULATION FOR COMMON SOURCE AMPLIFIER



$\Rightarrow V_{out} = -(r_o \| Z_L) g_m V_{in}$

$\Rightarrow$ **DC GAIN $= (-r_o \| Z_L) g_m$**

AS $Z_L \to \infty \Rightarrow$ DC GAIN $\to -g_m r_o$

SLIDE 6) BASED ON ANALYSIS ABOVE, SINCE CURRENT SOURCE IBIAS HAS INFINITE OUTPUT IMPEDANCE

$\Rightarrow Z_L = \infty$

$\Rightarrow$ DC GAIN $\to$ **$-g_m r_o$**

SLIDE 8) BASED ON SLIDE 3 ANALYSIS ABOVE, FINITE Z_L ACTS TO REDUCE GAIN SINCE

DC GAIN $= (-r_o \| Z_L) g_m$

$\Rightarrow$ WANT $|Z_L| >> r_o$ TO AVOID GAIN REDUCTION

SLIDE 10:

FOR M_3: $I_{BIAS} = \frac{1}{2}\mu_p C_{ox}\frac{W_3}{L}\left(V_{SG}-|V_{THp}|\right)^2\left(1+\lambda V_{SD_3}\right)$

$\Rightarrow$ THIS FORMULA HOLDS SINCE $V_{SD} = V_{SG} = |V_{THp}| + \Delta V$

$\Rightarrow V_{SD} > \Delta V$

$\Rightarrow$ SATURATION

FOR M_2: $I_D = \frac{1}{2}\mu_p C_{ox}\frac{W_2}{L}\left(V_{SG}-|V_{THp}|\right)^2\left(1+\lambda V_{SD_2}\right)$

$\Rightarrow$ THIS FORMULA HOLDS SINCE V

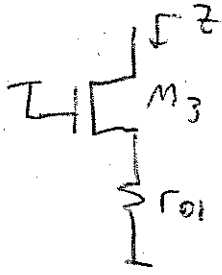
$$\Rightarrow \frac{I_D}{I_{BIAS}} = \frac{\frac{1}{2}\mu_p C_{ox}\frac{W_2}{L}\left(V_{SG}-|V_{THp}|\right)^2\left(1+\lambda V_{SD_2}\right)}{\frac{1}{2}\mu_p C_{ox}\frac{W_3}{L}\left(V_{SG}-|V_{THp}|\right)^2\left(1+\lambda V_{SD_3}\right)}$$

$$\boxed{\frac{I_D}{I_{BIAS}} = \left(\frac{W_2}{W_3}\right)\frac{1+\lambda V_{SD_2}}{1+\lambda V_{SD_3}}}$$

IF THE V_{DS} OF EACH PMOS DEVICE IS MATCHED, THEN

$$\boxed{\frac{I_D}{I_{BIAS}} = \frac{W_2}{W_3}}$$

SLIDE 17:



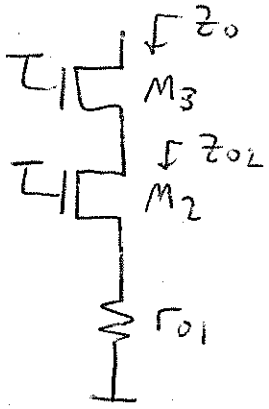
$Z_o: R_{TH}|_{M_3} = r_{o3}\left(1+(g_{m3}+g_{mb_3})r_{o1}\right)+r_{o1}$

$\simeq r_{o3}\,g_{m3}\,r_{o1}$

$\Rightarrow$ OUTPUT IMPEDANCE IS BOOSTED BY APPROXIMATELY $r_{o3}\,g_{m3}$ USING CASCODE TECHNIQUE

~~SLIDE 17~~:

SLIDE 18:



$$Z_{o2} \simeq (g_{m2} r_{o2})\, r_{o1}$$

$$\Rightarrow \boxed{Z_o \simeq (g_{m3} r_{o3})(g_{m2} r_{o2})\, r_{o1}}$$