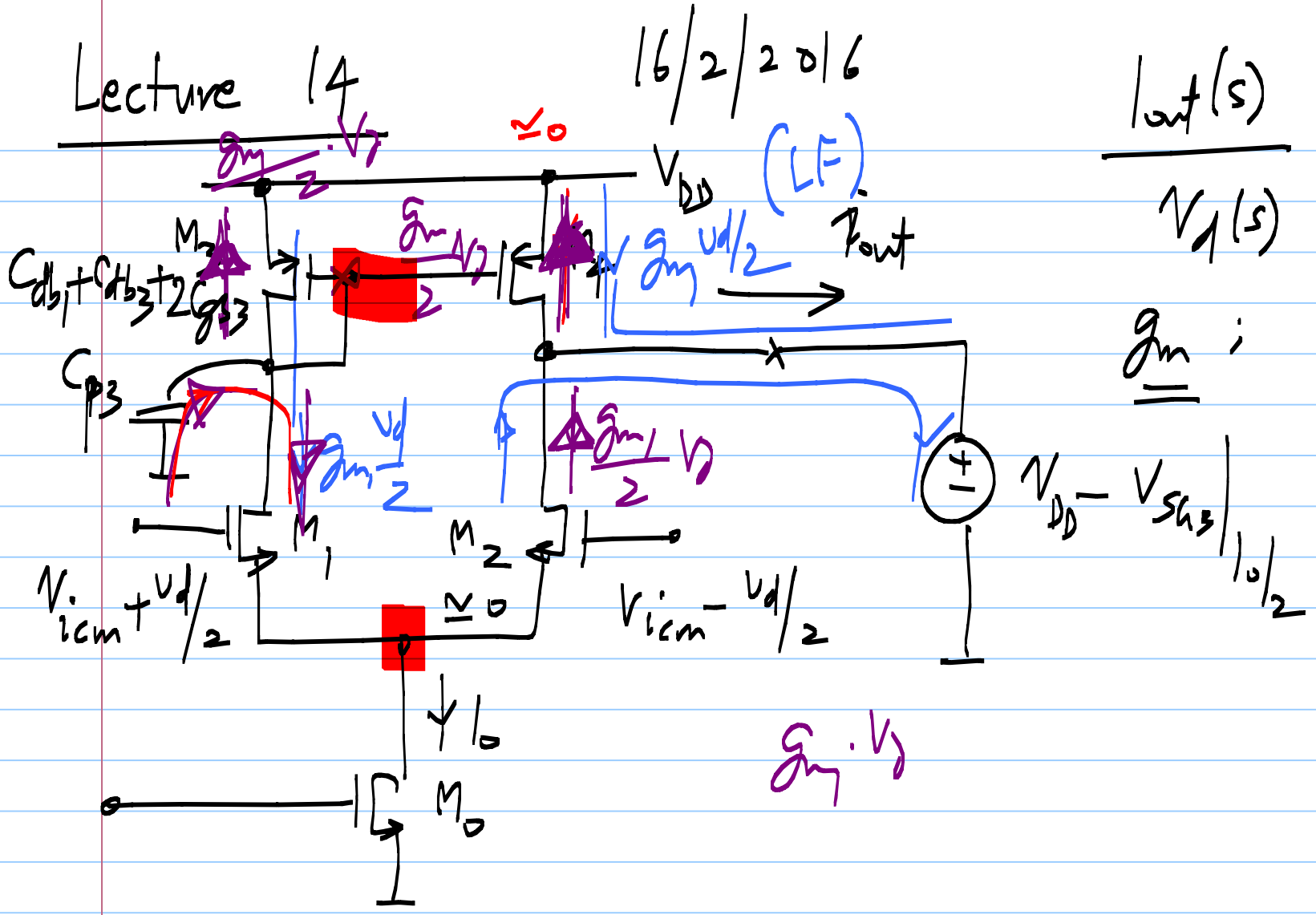
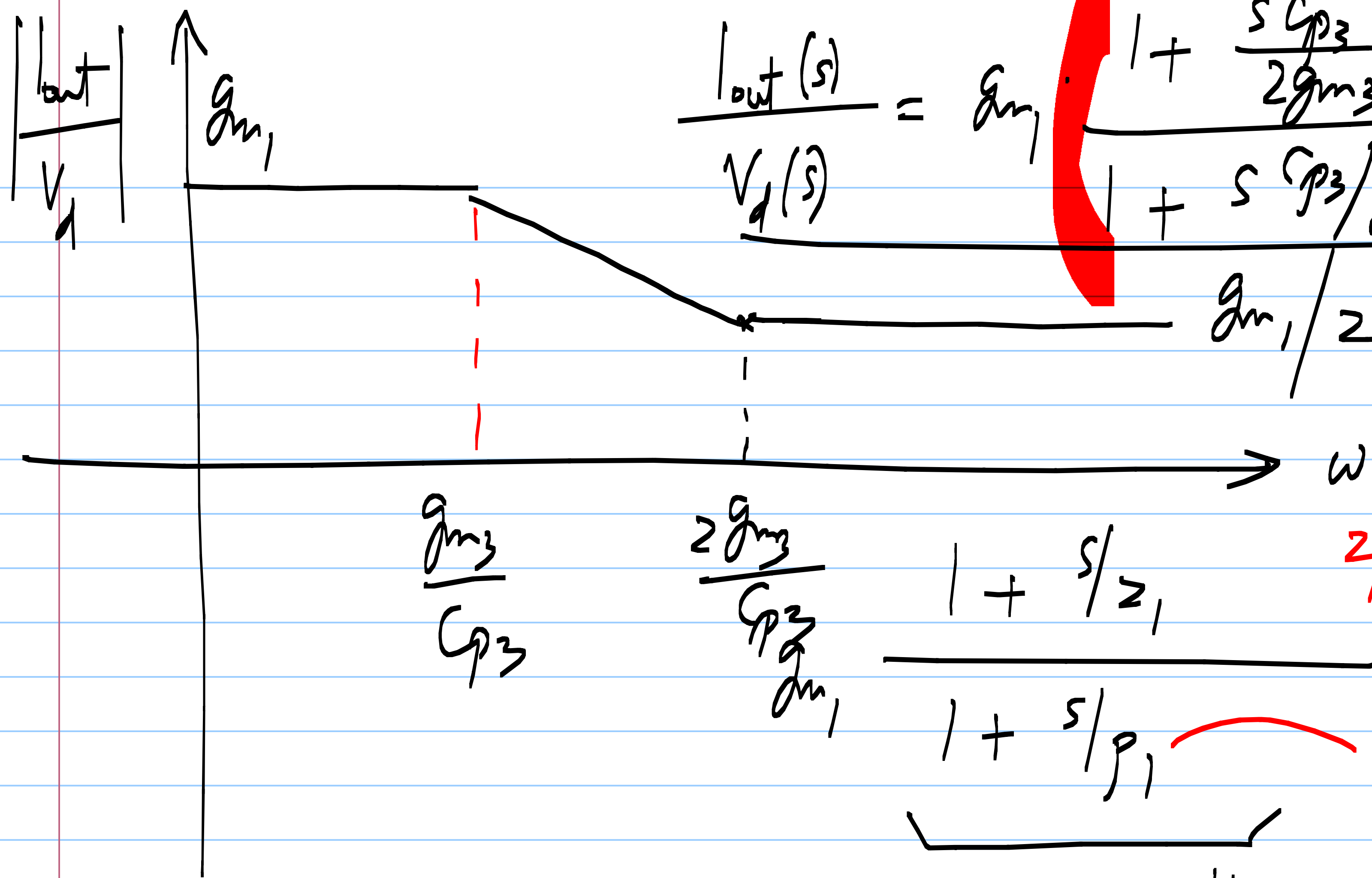
Lecture 14

16/2/2016



$$\frac{I_{out}(s)}{V_1(s)}$$

g_m :



$$\frac{I_{out}(s)}{V_d(s)} = g_{m1}\left(\frac{1+\frac{sC_{p3}}{2g_{m3}}}{1+sC_{p3}/g_{m3}}\right)$$

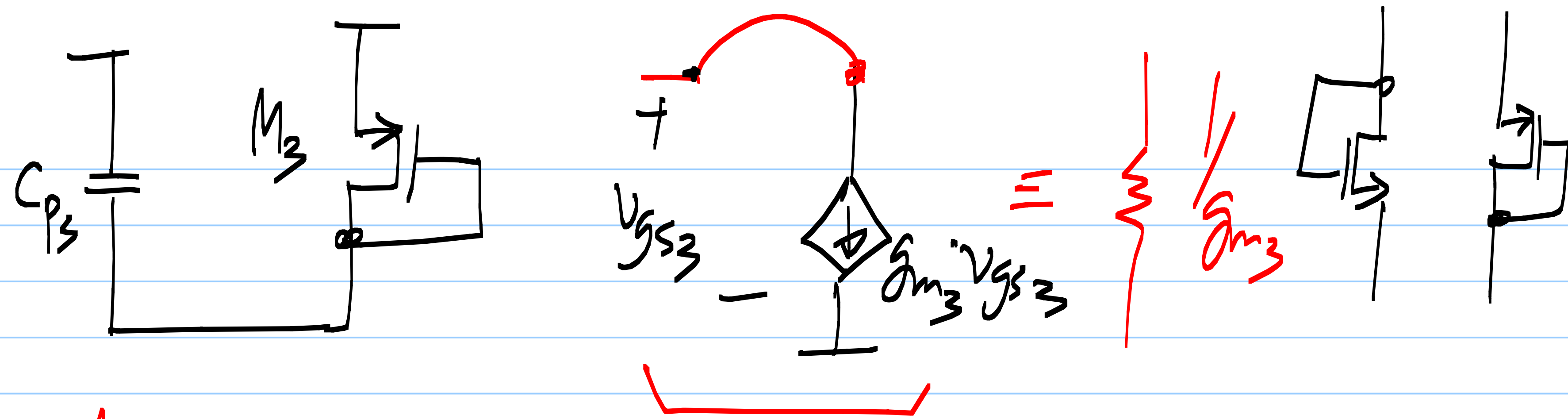
pole zero doublet

$$\frac{1+s/z_1}{1+s/p_1}$$

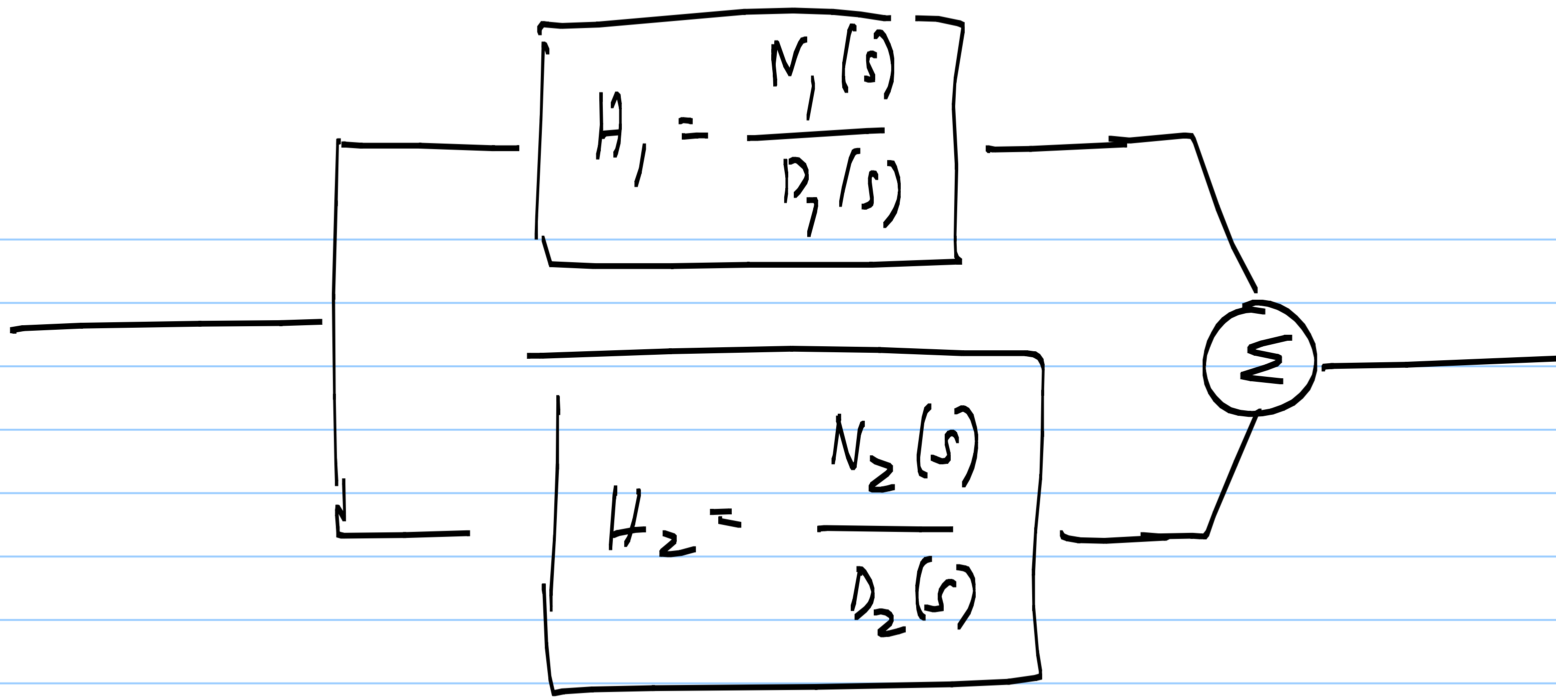
$z_1 = 2 \cdot \frac{g_{m3}}{C_{p3}}$

$p_1 = \frac{g_{m3}}{C_{p3}}$

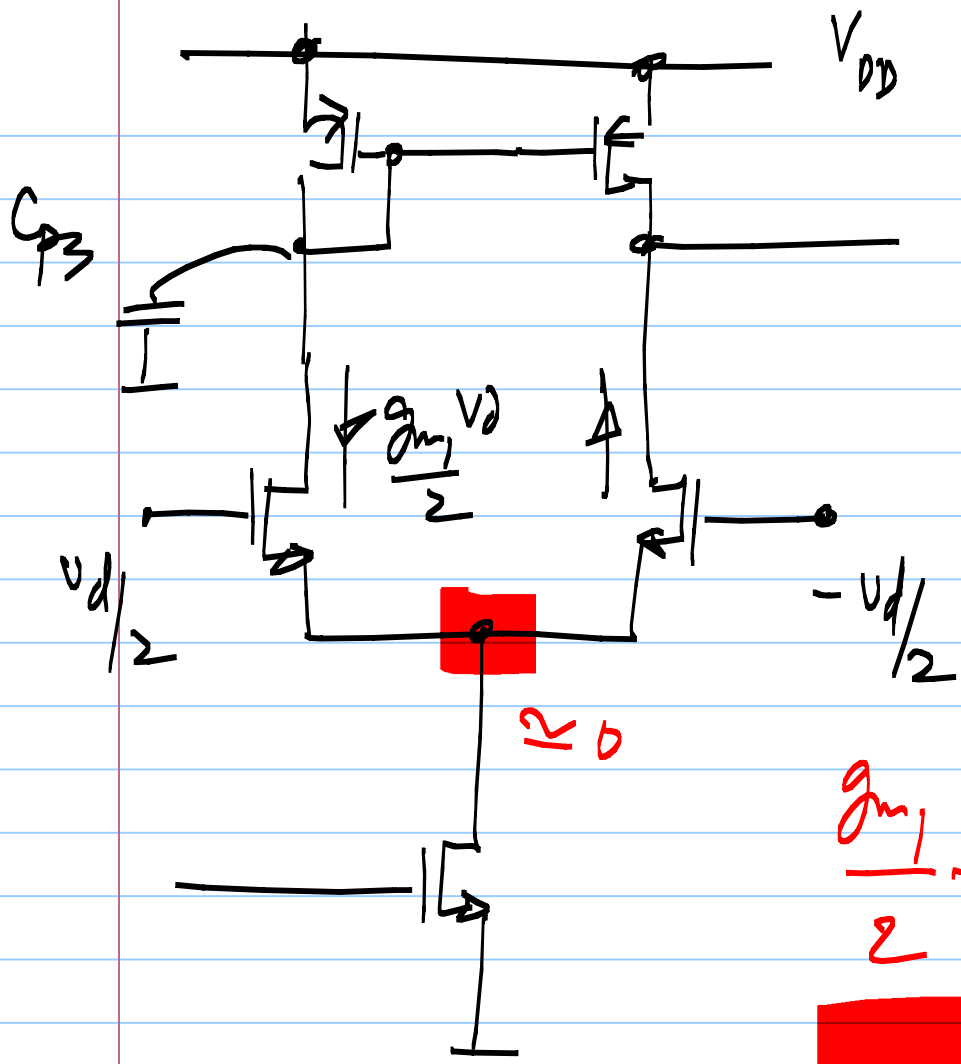
$s \to \infty$: $1/2$

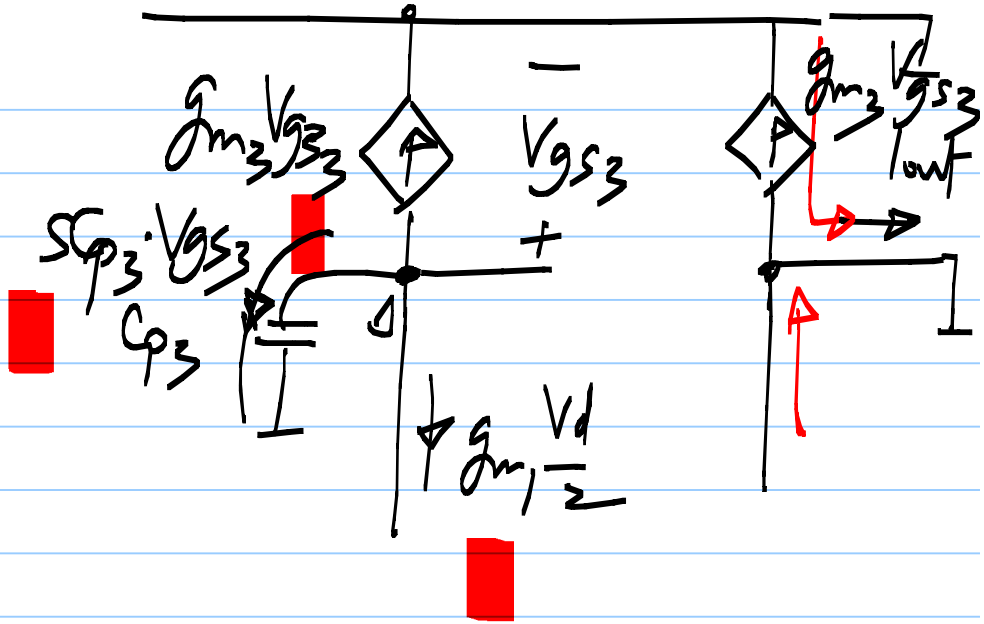


$$\frac{1}{\frac{1}{g_{m_3}} \cdot C_{p_3}} = \frac{g_{m_3}}{C_{p_3}}$$

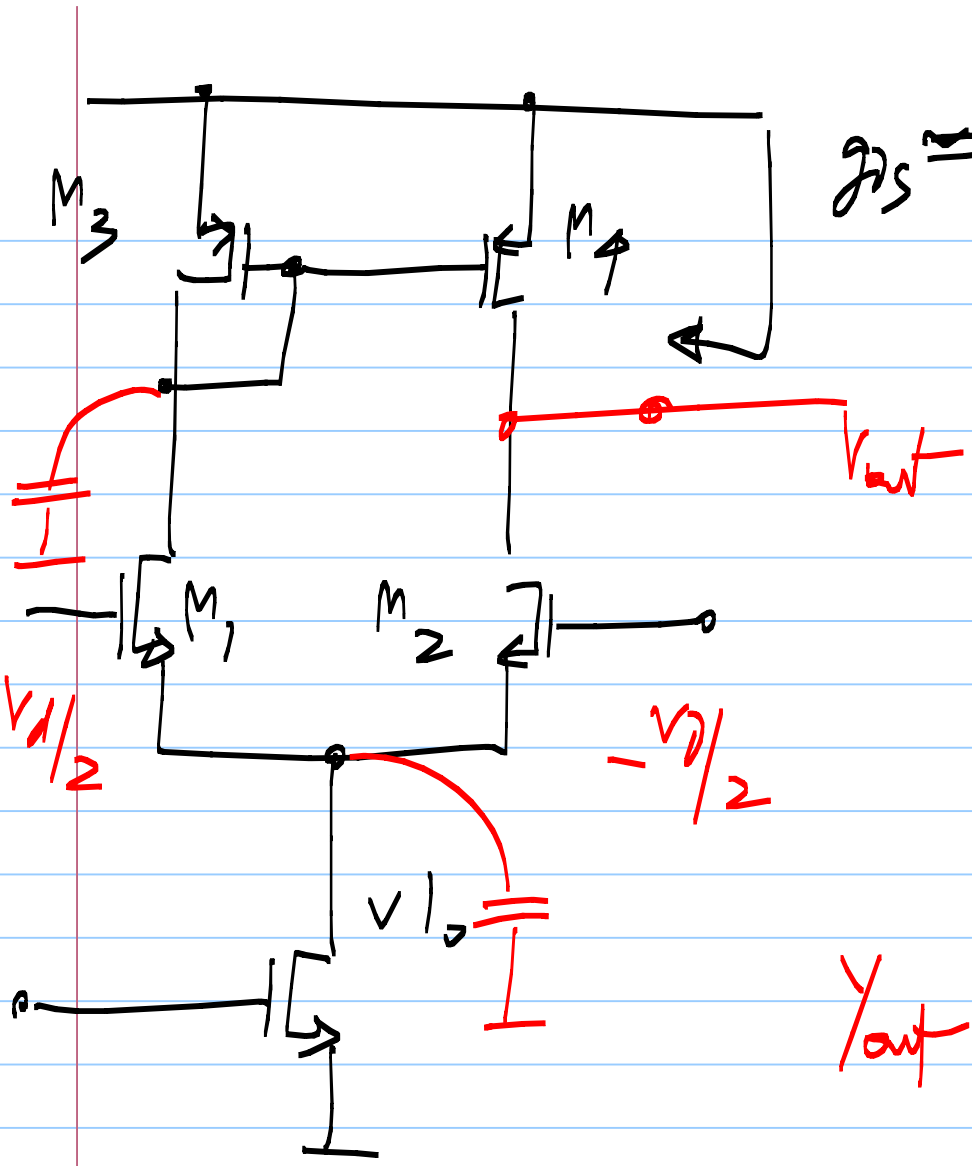


$$\frac{N_1(s)}{D_1(s)} + \frac{N_2(s)}{D_2(s)} = \frac{N_1 D_2 + N_2 D_1}{\quad}$$





$$\frac{g_{m1}}{2} \cdot V_d + \frac{g_{m3} \cdot g_{m1} V_d/2}{g_{m3} + sC_{p3}}$$



$g_{DS} \simeq 0$

* with a shorted output,

$$\frac{I_{out}}{V_d} = g_{m1} \cdot \frac{1 + s/2p_1}{1 + s/p_1}$$

$$p_1 = g_{m3}/C_{p3}$$

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* $G_{out} = g_{DS1} + g_{DS3}$

(no parasitic caps)

$Y_{out} = g_{DS1} + g_{DS3}$ @ LF & HF

poles & zeros

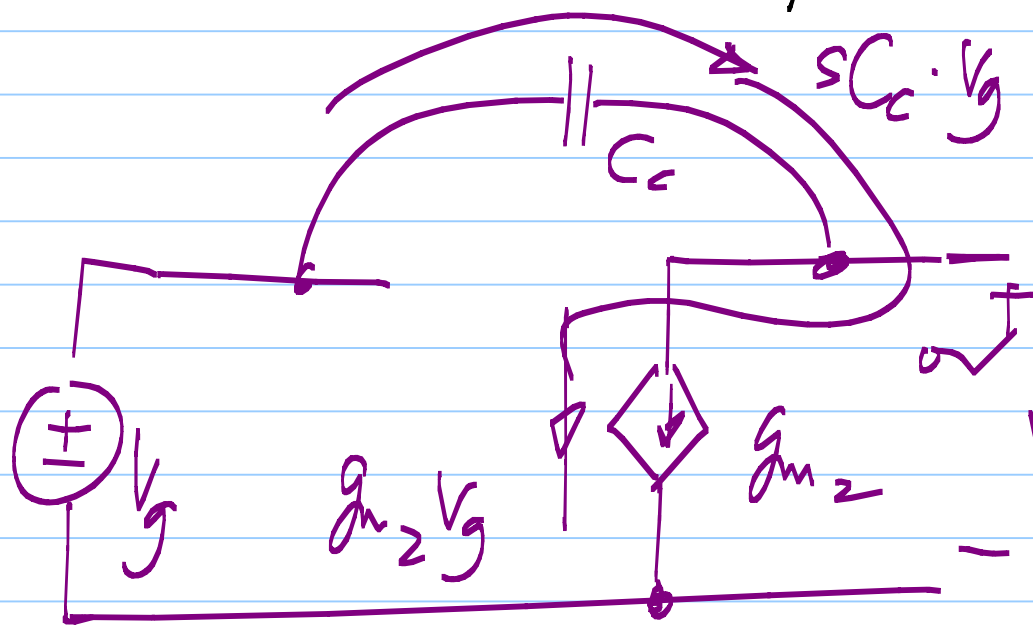
$$\frac{V_{out}}{V_2} = \underbrace{Y_m(s)} \cdot \underbrace{Z_{out}(s)}$$

$$Z_{out}(s) \approx \frac{1}{g_{ds_1} + g_{ds_3}} \quad \text{@ LF \& HF}$$

$$g_{m_1} \cdot \frac{1 + s/2p_1}{1 + s/p_1} \cdot \frac{1}{g_{ds_1} + g_{ds_3}}$$

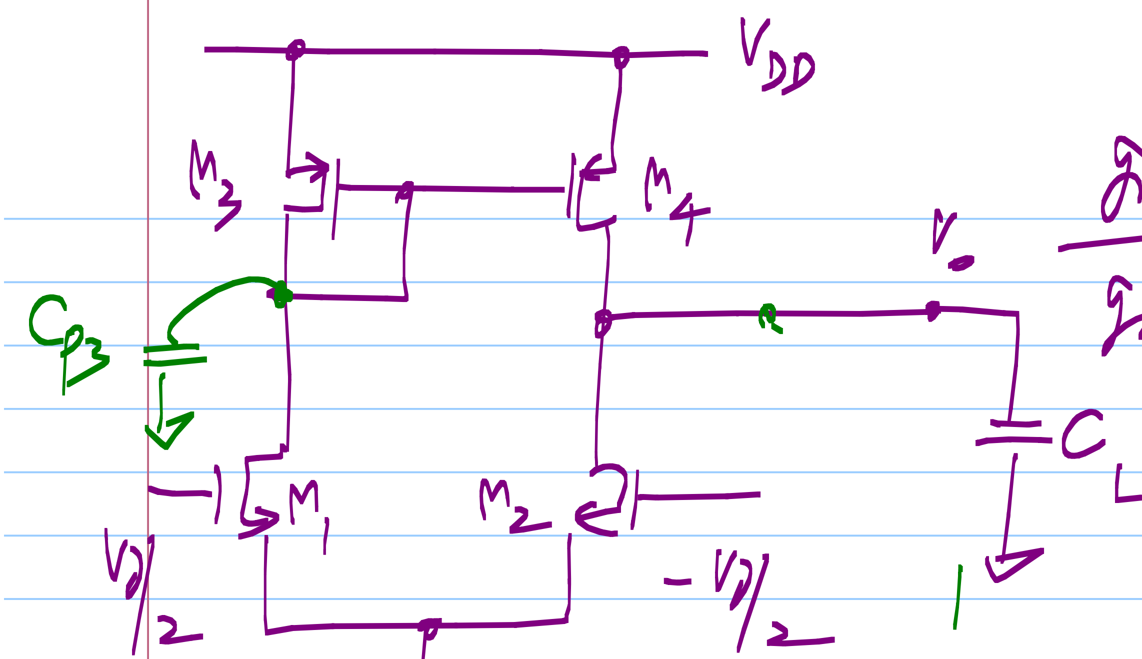
$$p_1 = g_{m_3}/C_{g_3}$$

@ zero freq. $o/p = 0$

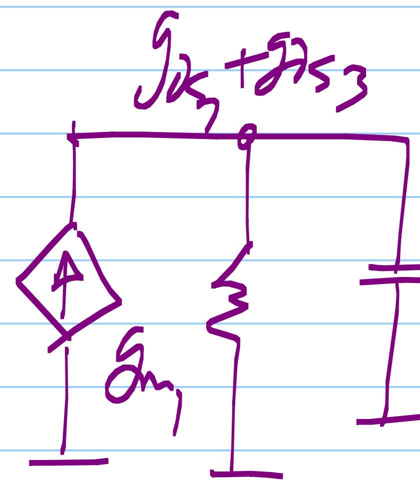


$\frac{V_o}{V_g} = 0$ @ zero freq.

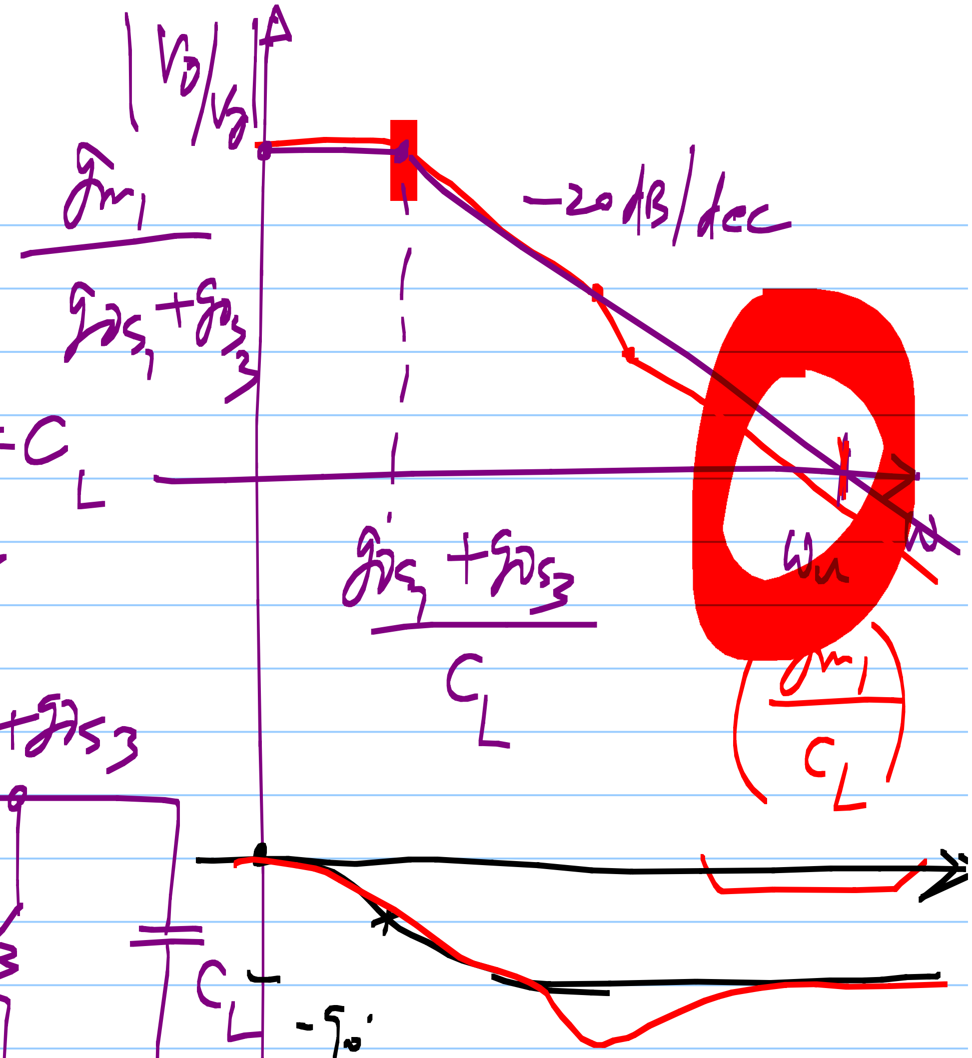
$$s = \frac{g_{m_2}}{C_c}$$



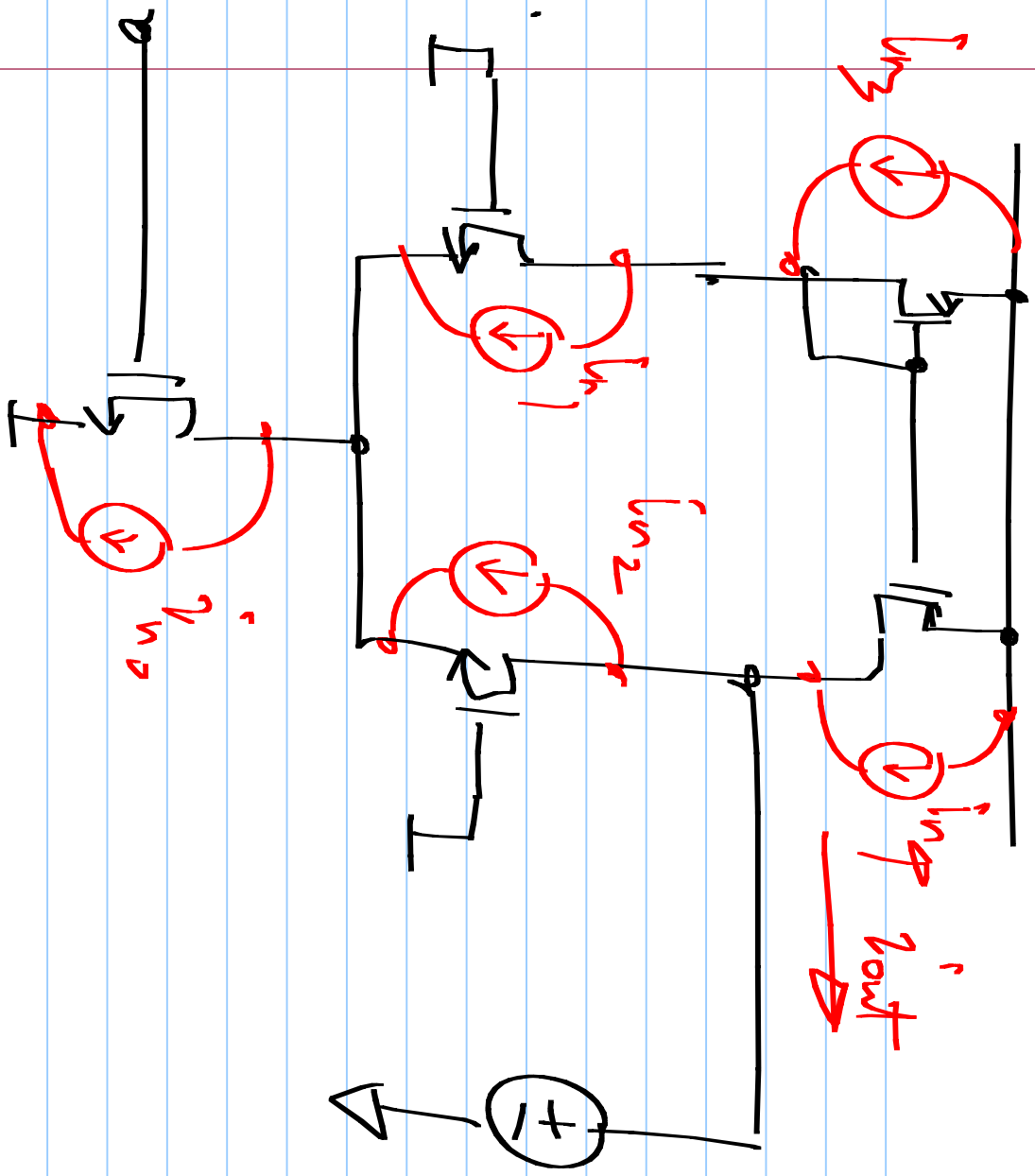
V_{DD}
M_3
M_4
M_1
M_2
C_{p3}
V_o
C_L
$V_d/2$
$-V_d/2$
+



$g_{ds_1}+g_{ds_3}$
g_{m_1}
C_L



$|V_o/V_d|$
$\frac{g_{m_1}}{g_{ds_1}+g_{ds_3}}$
$-20\,dB/dec$
$\frac{g_{ds_1}+g_{ds_3}}{C_L}$
ω_u
ω
$\left(\frac{g_{m_1}}{C_L}\right)$
$-90°$


v_{in2}
v_{in1}
v_{out}