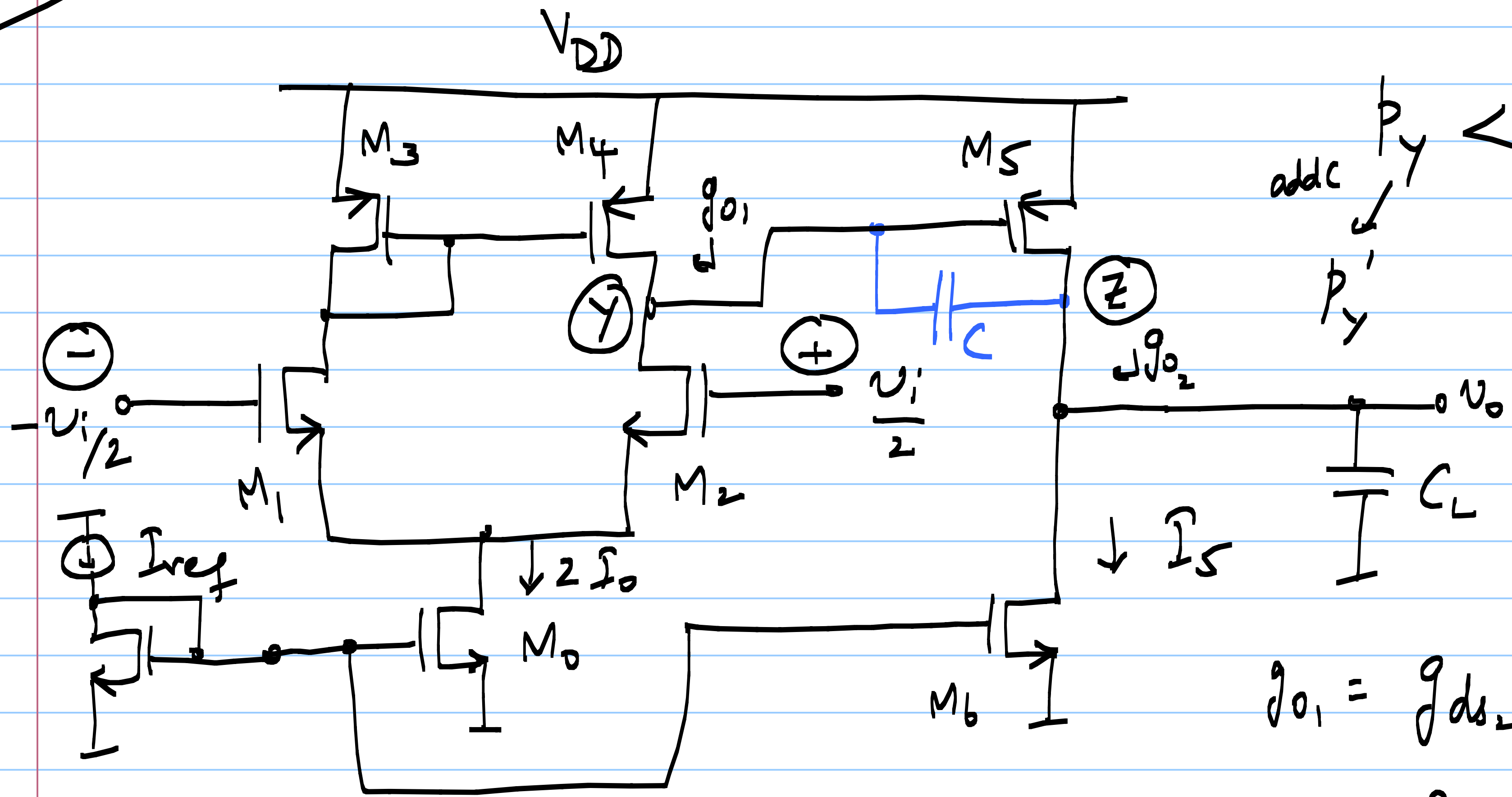
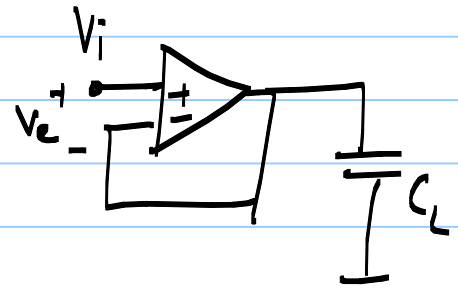
28/10/2020

Lecture 46



$p_y < p_z$

add C: $p_y \to p_y'$; add C: $p_z \to p_z'$



$g_{o_1} = g_{ds_2} + g_{ds_4}$

$g_{o_2} = g_{ds_5} + g_{ds_6}$

$$A_1 = \frac{g_{m_1}}{g_{o_1}} \; ; \quad A_2 = \frac{g_{m5}}{g_{o_2}}$$

$$p_y' \approx \frac{g_{o_1}}{A_2 \cdot C} \quad \text{dominant pole}$$

DC

$$V_y = V_{DD} - V_{SG_3}\Big|_{I_0} = V_{DD} - V_{SG_5}\Big|_{I_5}$$

$$V_{SG_3}\Big|_{I_0} = V_{SG_5}\Big|_{I_5}$$

$$V_{SG} = V_T + \underbrace{\sqrt{\frac{2 I_D}{\mu_p C_{ox}\left(\frac{W}{L}\right)}}}_{V_{D,sat}}$$

$$L_3 \equiv L_4 \equiv L_5$$

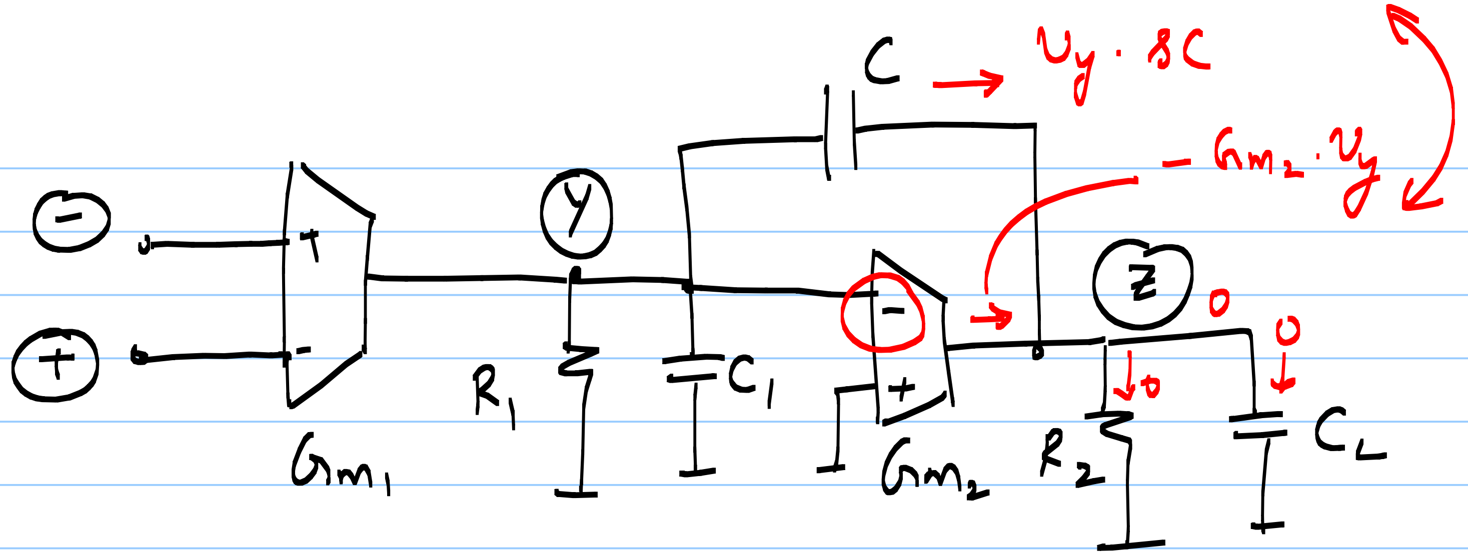
Ensure by Design:

$$V_{Dsat_3}\Big|_{I_0} = V_{Dsat_5}\Big|_{I_5}$$

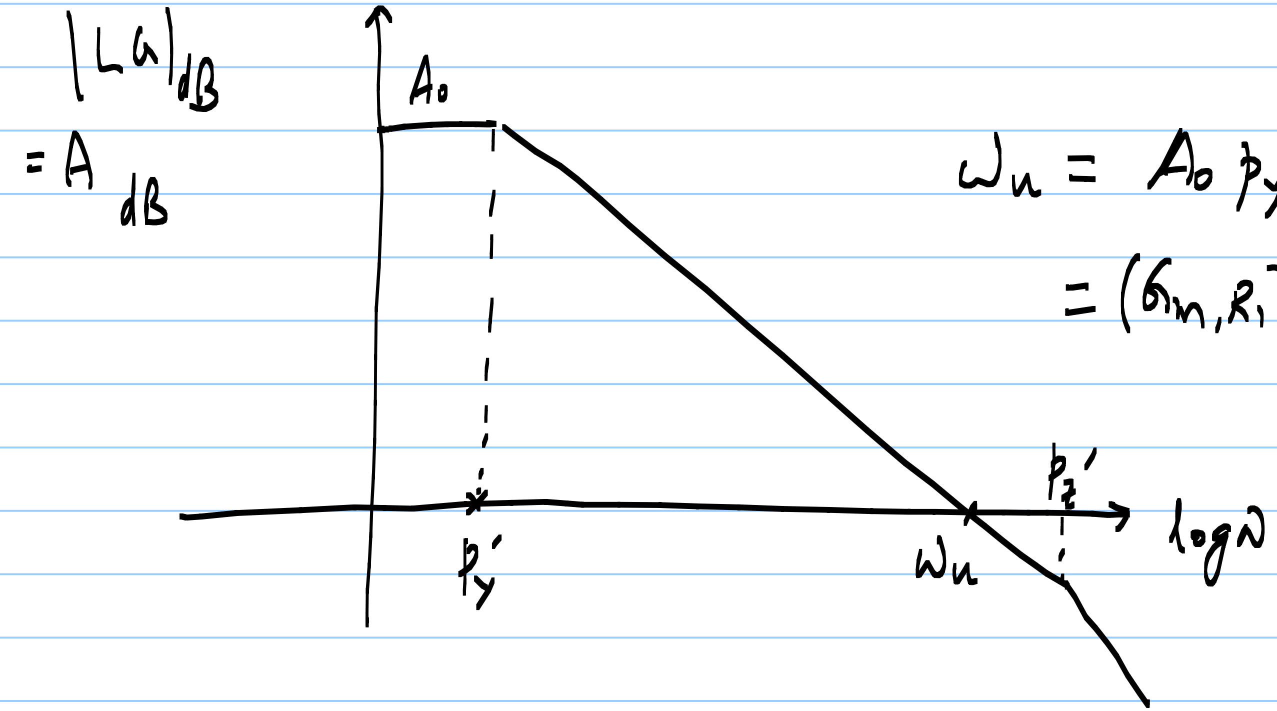
$$\sqrt{\frac{2 I_0}{\mu_p C_{ox}\left(\frac{W}{L}\right)_3}} = \sqrt{\frac{2 I_5}{\mu_p C_{ox}\left(\frac{W}{L}\right)_5}} \Rightarrow \boxed{\frac{I_{D_3}}{(W/L)_3} = \frac{I_{D5}}{(W/L)_5}}$$

Same "Current Density"

$$\omega_z = +\frac{G_{m_2}}{C}$$



$$p_y' \approx \frac{1}{R_1(G_{m_2}R_2C)} \quad ; \quad p_z' \approx \frac{(\quad)}{(\quad)}$$



$$\omega_u = A_0 p_y'$$

$$= (G_{m_1}R_1)(G_{m_2}R_2) \cdot \frac{1}{R_1 \cdot G_{m_2}R_2C}$$

$$\boxed{\omega_u \approx \frac{G_{m_1}}{C}}$$

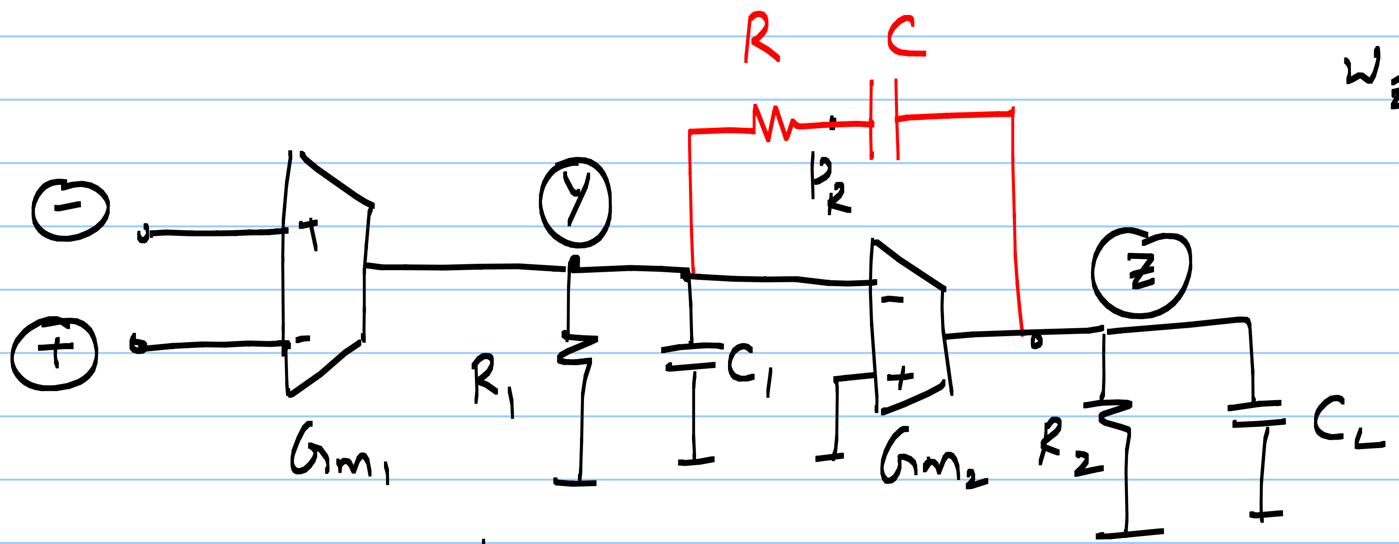
$$\omega_z = + \frac{G_{m_2}}{C} \quad (\text{RHP zero})$$

* Design condition: $G_{m_2} \gg G_{m_1}$ i.e. $g_{m5} \gg g_{m1}$

so that $\omega_z \gg \omega_u$

RC - pole splitting compensation

* want to move ω_z

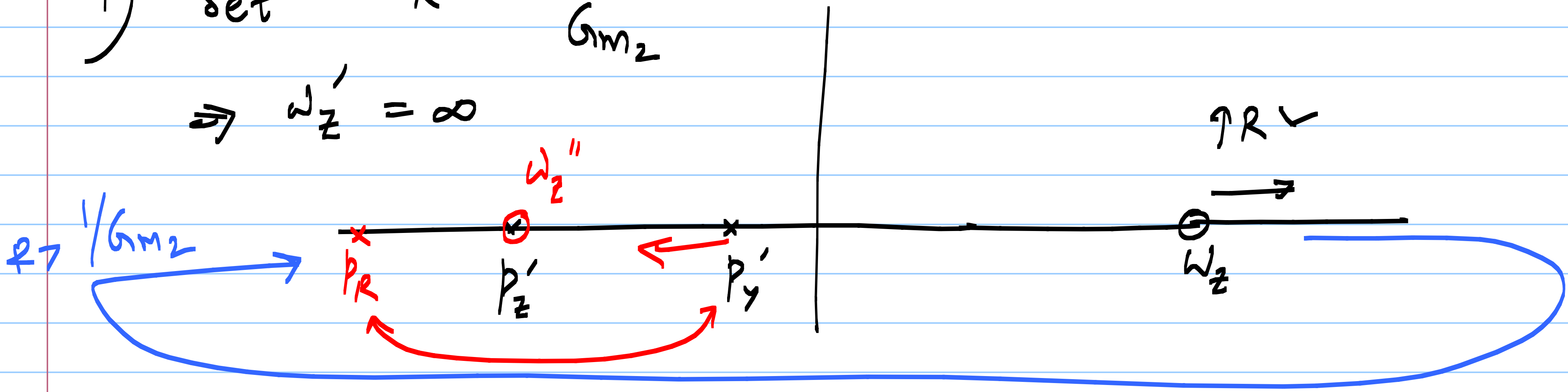


* poles will move slightly
* 3rd pole added p_R

$$\omega_z = \frac{1}{\left(\frac{C}{G_{m_2}} - RC\right)} = \frac{1}{C\left(\frac{1}{G_{m_2}} - R\right)}$$

1) set $R = \frac{1}{G_{m_2}}$

$\Rightarrow \omega_z' = \infty$



2) $R > \frac{1}{G_{m_2}} \Rightarrow$ LHP zero

choose R to set $\omega_z'' = p_z'$