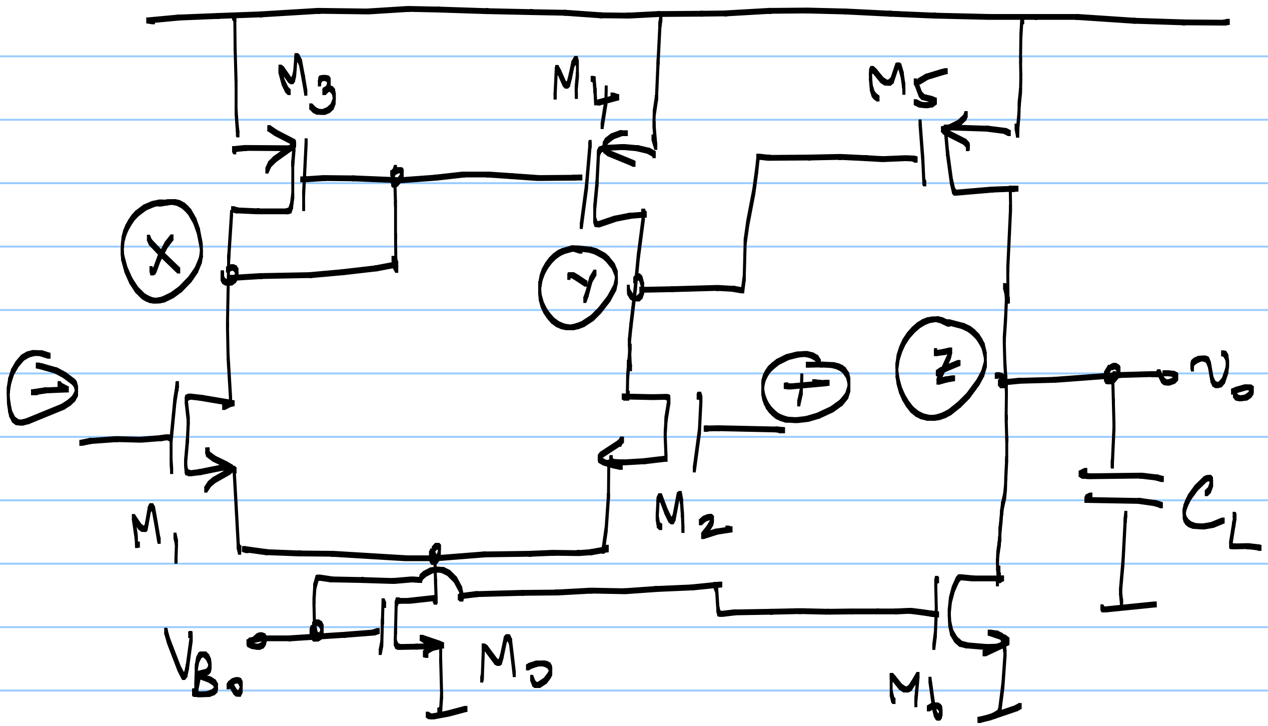
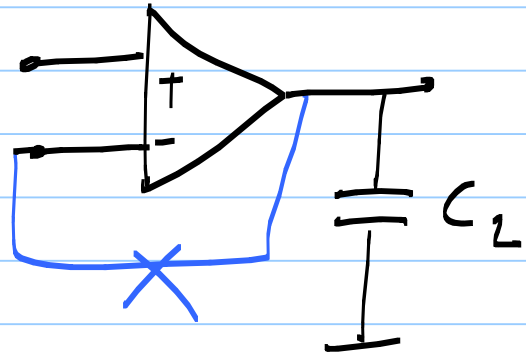
27|10|2020

Lecture 45





3 poles @ X, Y, Z

1 zero @ $2p_x$ (z_x)

$C_x \approx 2C_{gs_3}$; $C_y \approx C_{gs_5}$; $C_z \approx C_L$

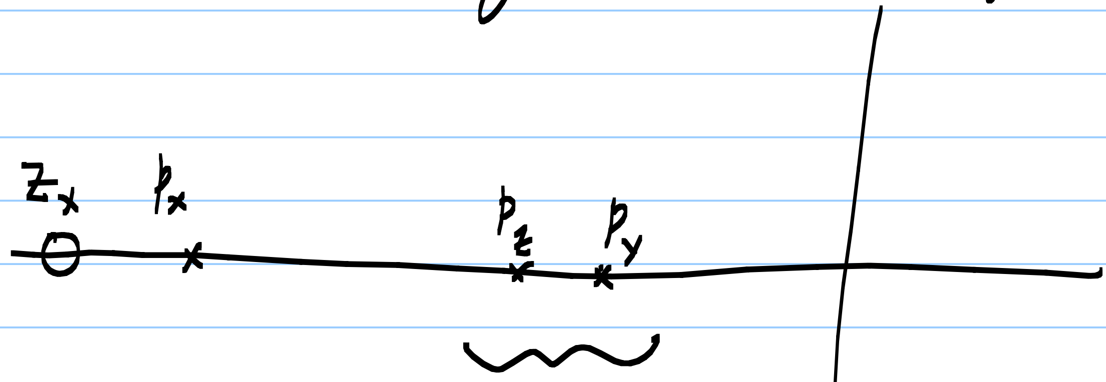
$G_x \approx g_{m_3}$; $G_y = g_{ds_2} + g_{ds_4}$; $G_z = g_{ds_5} + g_{ds_1}$

H/W

$p_x \approx \dfrac{g_{m_3}}{2C_{gs_3}}$; $p_y \approx \dfrac{g_{ds_2} + g_{ds_4}}{C_{gs_5}}$; $p_z \approx \dfrac{g_{ds_5} + g_{ds_1}}{C_L}$

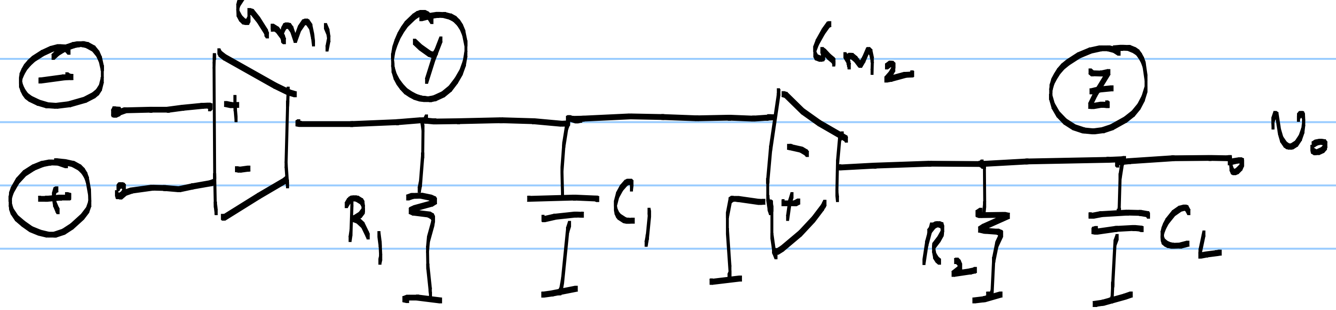
$p_x >> p_y, p_z$; so, ignore p_x & $z_x = 2p_x$

So → effectively a 2-pole system (p_y & p_z) with high DC gain



→ high Q, low ζ, ringing in step response

<u>problem</u>

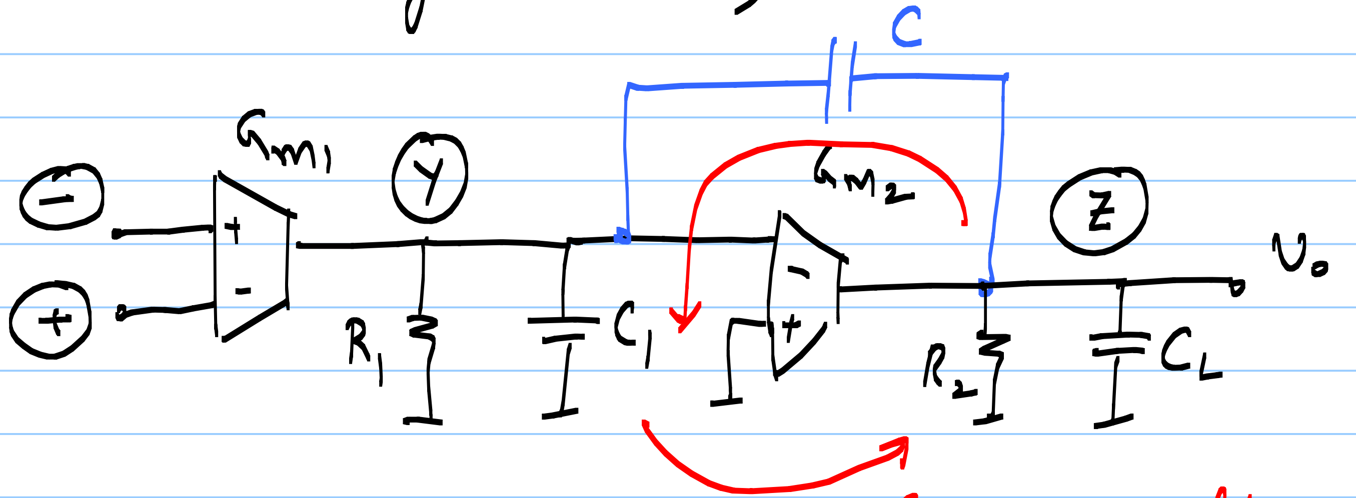


Block level view of 2-stage opamp

$G_{m_1} = g_{m_1}$; $G_{m_2} = g_{m5}$

$R_1 = \frac{1}{g_{ds2} + g_{ds4}}$; $R_2 = \frac{1}{g_{ds5} + g_{ds6}}$

$C_1 = C_{gs5}$; $C_2 = C_L$



G_Z reduces due to AC feedback through C_f

gain = $G_{m_2} R_2$ (high)

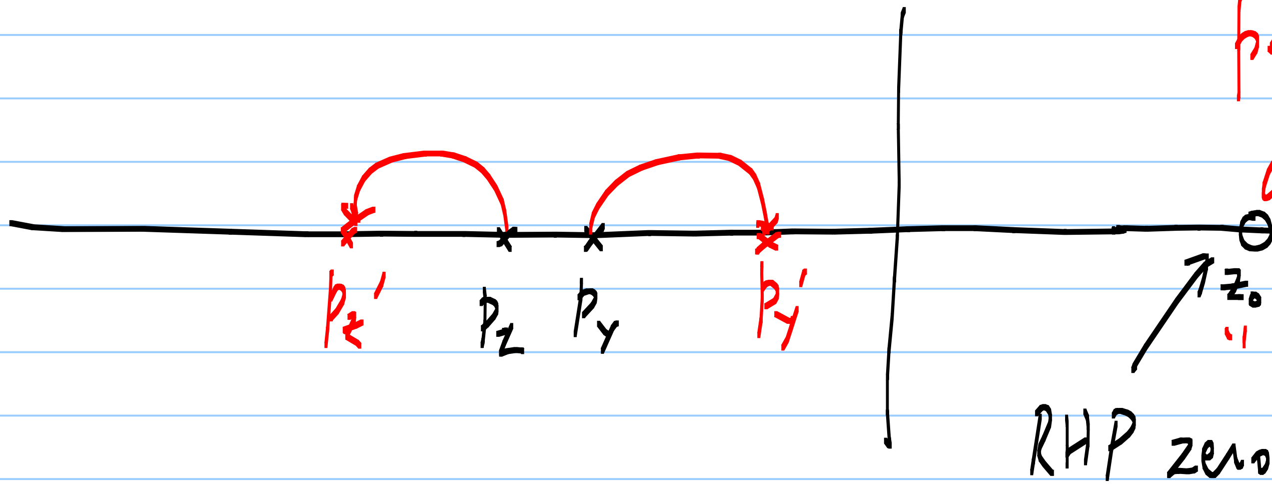
C_1

$C_1' \approx C_1 + G_{m_2} R_2 C$ → "Miller Capacitance"

$$p_y' \approx \frac{1}{R_1 C_1'} << p_y$$

↓

Dominant pole



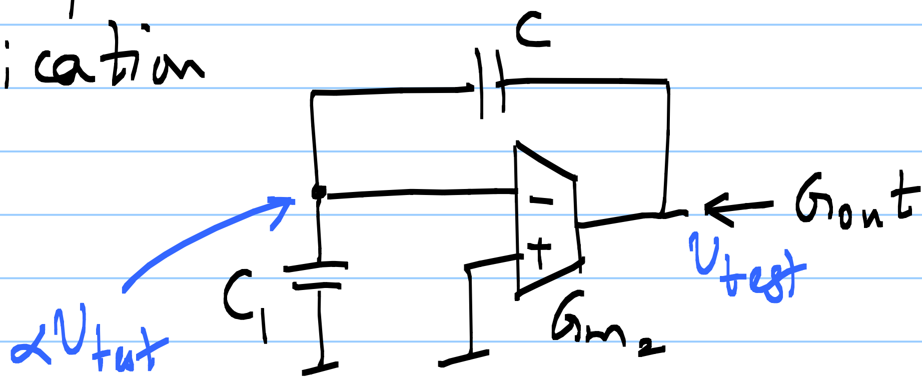
"pole splitting" compensation

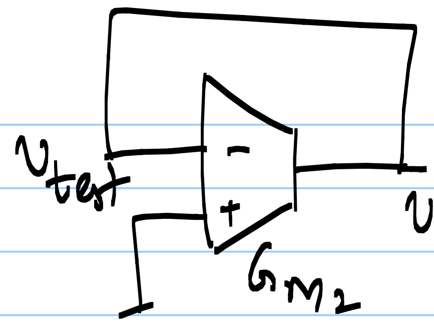
or

"Miller" Compensation

required value of C is small due to Miller multiplication

(HW) G_{out} of →





$\leftarrow G_{out} = G_{m_2}$