EEL782: Analog Integrated Circuits

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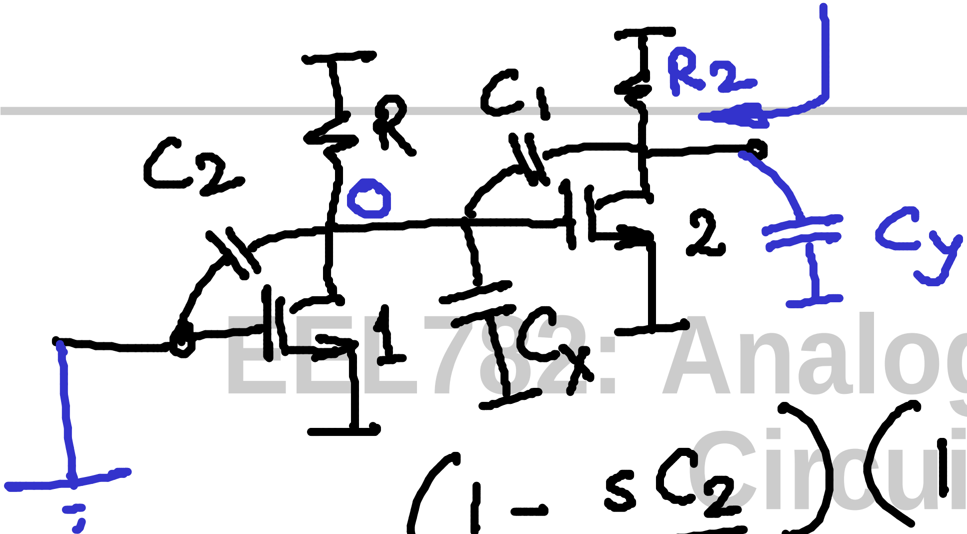

$$G_m = \frac{\left(1 - \frac{sC_2}{g_{m_1}}\right)\left(1 - \frac{sC_1}{g_{m_2}}\right) g_{m_2}\, g_{m_1}\left(r_{ds_1} \| R\right)}{\left(1 + \underbrace{s\left(R \| r_{ds_1}\right)\left(C_x + C_1 + C_2\right)}_{p_1}\right)}$$

$$R_{out} = \frac{\left(r_{ds_2} \| R_2\right)}{1 + \underbrace{s\left(r_{ds_2} \| R_2\right)\left(C_1 + C_y\right)}_{p_2}}$$

2 poles, 2 RHP zeros → deep trouble!

ϕ → desired phase margin

$p_2 = A p_1 \tan\phi$

$z_1, z_2 \gg p_2 \gg p_1$

$z_1 = A p_1 \tan\phi$

$z_2, p_2 \gg z_1 \gg p_1$

"Dominant pole" compensation

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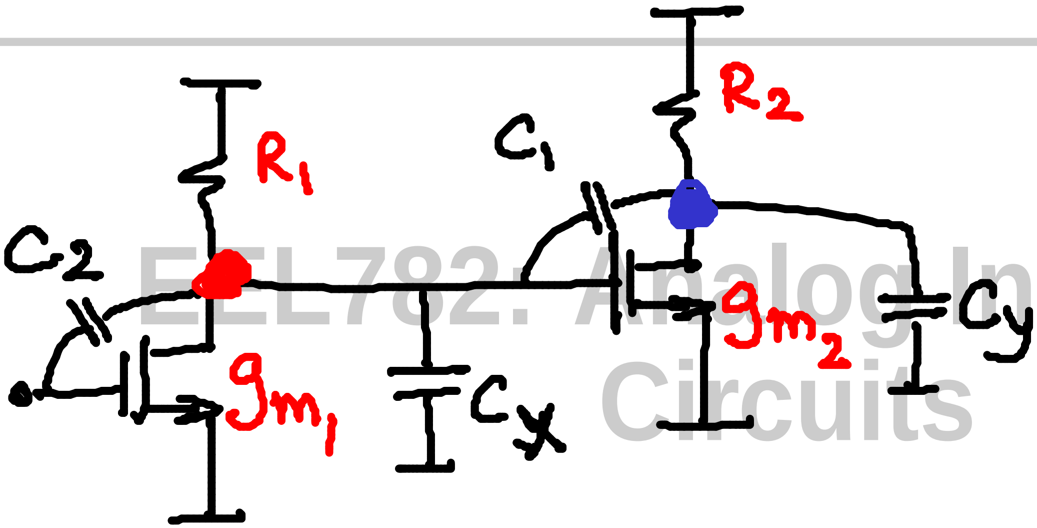

"pole splitting"

$C_2 \sim 100fF$

$C_1 \sim pF$

$C_x \sim pF$

$$\frac{1}{p_1} \approx \left[C_2 + C_x + g_{m_2}(R_2 \| r_{ds_2}) C_1 \right] (r_{ds_1} \| R_1)$$

$\checkmark\checkmark$

Assume $p_2 \gg p_1 \rightarrow$ At p_2, C_1 behaves like a short

$$\frac{1}{p_2} \approx \frac{1}{g_{m_2}} \cdot (C_x + C_y)$$

$$p_2 = \frac{g_{m_2}}{C_x + C_y}$$

$$p_1 = \frac{1}{(\quad)(\quad)}$$

$$p_1 \approx \frac{1}{g_{m_2}(r_{ds_2}\|R_2)\, C_1\, (r_{ds_1}\|R_1)}$$

$$p_2 \approx \frac{g_{m_2}}{C_x + C_y}$$

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$$p_2 = p_1 \cdot g_{m_1} g_{m_2} (r_{ds_1}\|R_1)(r_{ds_2}\|R_2) \cdot \tan\phi$$

$$\frac{g_{m_2}}{C_x + C_y} = \frac{g_{m_1}}{C_1} \tan\phi$$

$$C_1 = \frac{g_{m_1}}{g_{m_2}} (C_x + C_y) \tan\phi$$

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