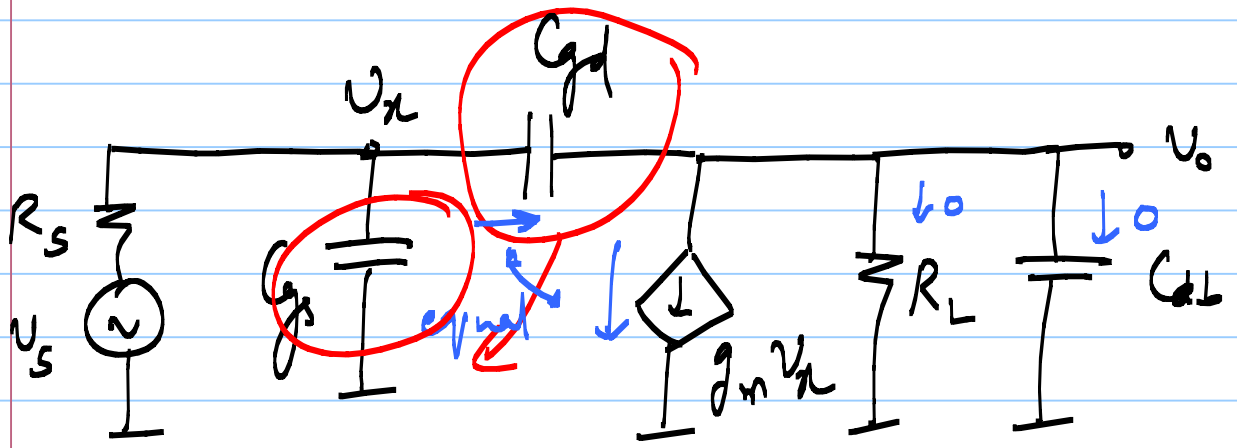
15/10/2020

Lecture 39

2) CSA with C_{gd} considered:

$$\frac{V_o}{V_s}(s) = \left(-\frac{g_m}{G_L}\right) \frac{\left[1 - \frac{sC_{gd}}{g_m}\right]}{\left[\frac{s^2}{G_L G_s}\left(C_{gs}C_{gd} + C_{gs}C_{db} + C_{gd}C_{db}\right) + \frac{s}{G_L G_s}\left(G_L\left(C_{gs}+C_{gd}\right) + G_s\left(C_{gd}+C_{db}\right) + g_m C_{gd}\right) + 1\right]}$$



@ zero freq.

$\Rightarrow V_o = 0$

$$D(s) = \frac{s^2}{G_L G_s}\left[G_{gs}\left(C_{gd} + C_{db}\right)\right]$$

(ignore $C_{gd} C_{db}$)

(ignore C_{gd})

$$+ \frac{s}{G_L G_s}\left[G_L C_{gs} + G_s\left(C_{gd} + C_{db}\right) + g_m C_{gd}\right]$$

$+$

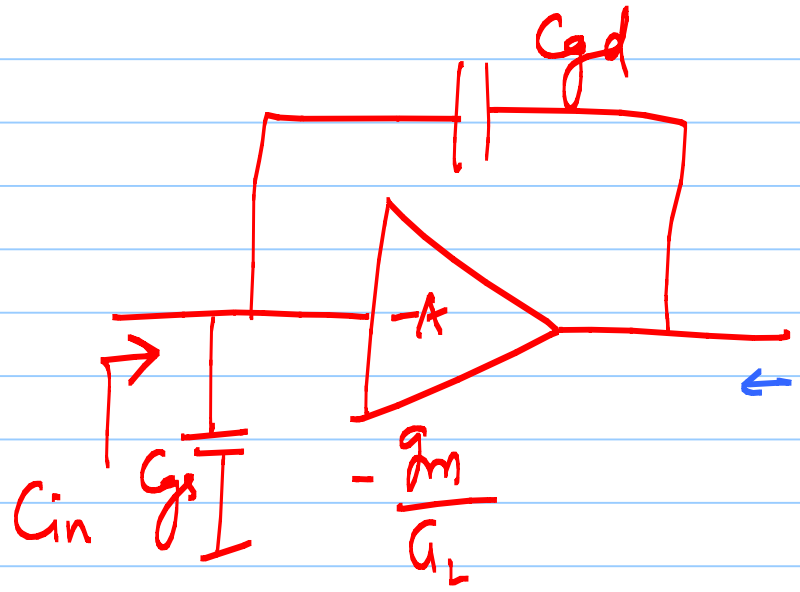
1

$$D(s) = \frac{s^2}{G_L G_s}\left[C_{gs}(C_{gd}+C_{db})\right] + \frac{s}{G_s}\left[C_{gs} + \frac{g_m}{G_L}C_{gd} + \frac{G_s}{G_L}(C_{gd}+C_{db})\right] + 1$$

$\frac{g_m}{G_L}C_{gd}$: due to Miller effect

$\frac{G_s}{G_L}(C_{gd}+C_{db})$: ignore

Miller Effect



$$C_{in} \approx (1+A)C_{gd} + C_{gs}$$

$$\approx \frac{g_m}{G_L}C_{gd} + C_{gs}$$

If $D(s) = \left(1 + \frac{s}{p_1}\right)\left(1 + \frac{s}{p_2}\right)$

$$= \frac{s^2}{p_1 p_2} + s\left(\frac{1}{p_1} + \frac{1}{p_2}\right) + 1$$

$p_1 >> p_2 \Rightarrow \frac{1}{p_2} >> \frac{1}{p_1}$

$$D(s) \approx \frac{s^2}{p_1 p_2} + \frac{s}{p_2} + 1$$

$$p_2 = \frac{G_s}{C_{gs} + C_{gd} \cdot \frac{g_m}{G_L}}$$

Compare this with case without C_{gd}

$$p_{20} = \frac{G_s}{C_{gs}}$$

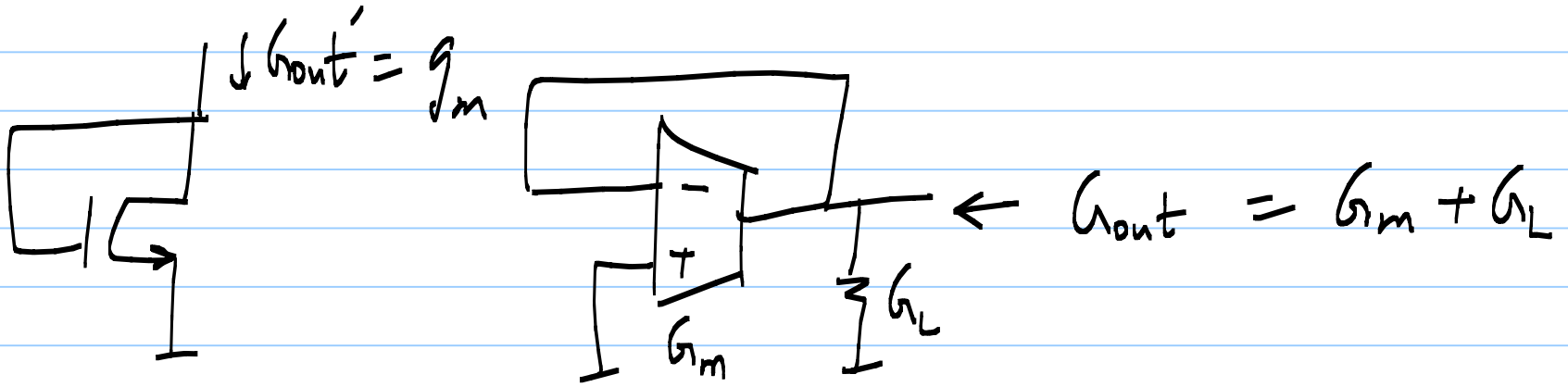
$$p_1 = p_1 p_2 \cdot \frac{1}{p_2}$$

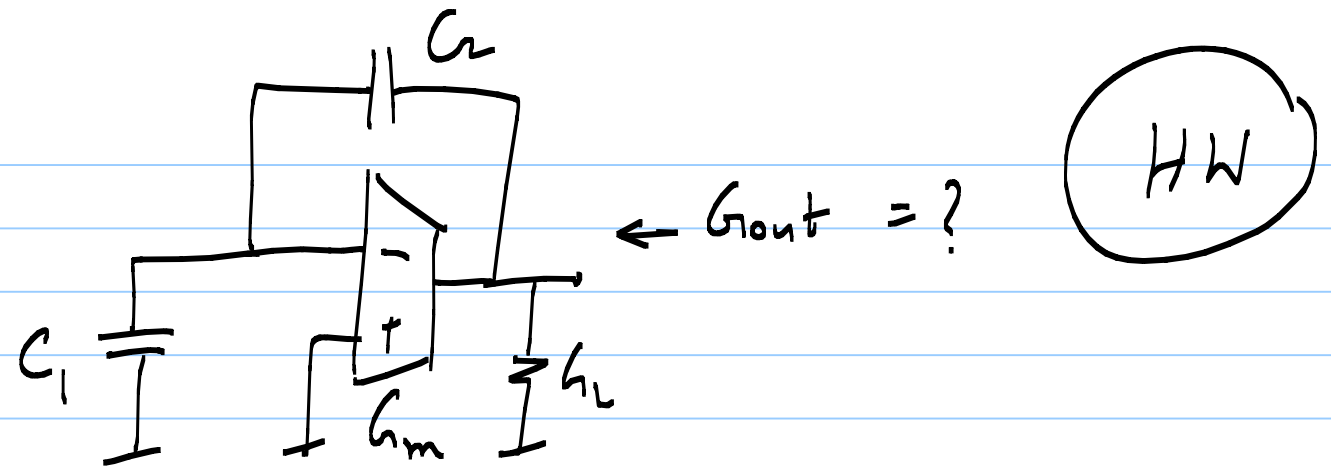
$$= \frac{G_L G_s}{C_{gs}(C_{gd} + C_{db})} \cdot \frac{C_{gs} + C_{gd} \cdot \frac{g_m}{G_L}}{G_s}$$

$$\boxed{p_1 = \frac{G_L\left(C_{gs} + C_{gd} \cdot \frac{g_m}{G_L}\right)}{C_{gs}(C_{gd} + C_{db})}}$$

Compare with case without C_{gd}

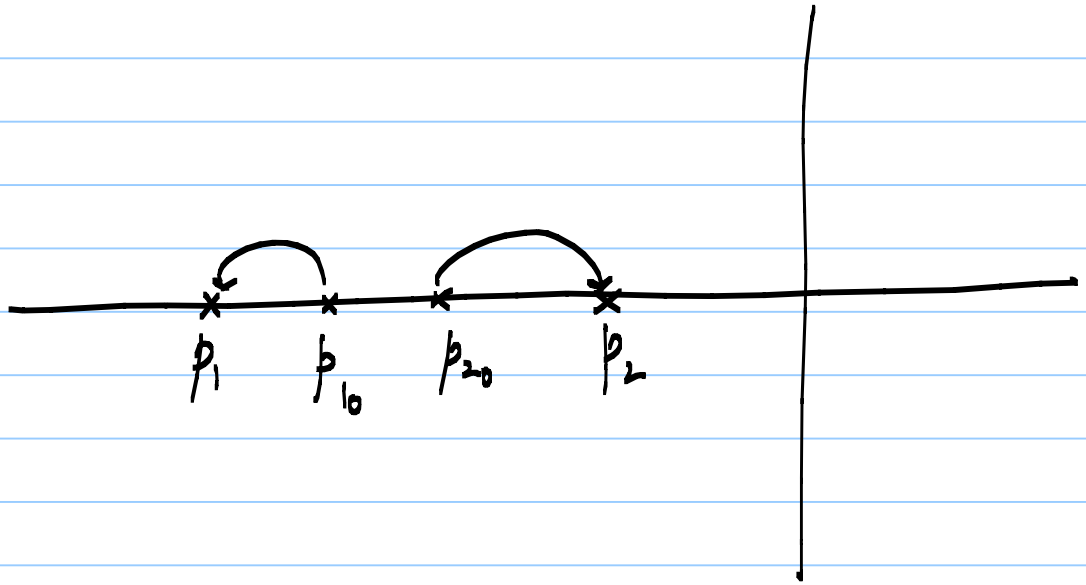
$$p_{1o} = \frac{G_L}{C_{db}}$$





← $G_{out} = ?$

HW



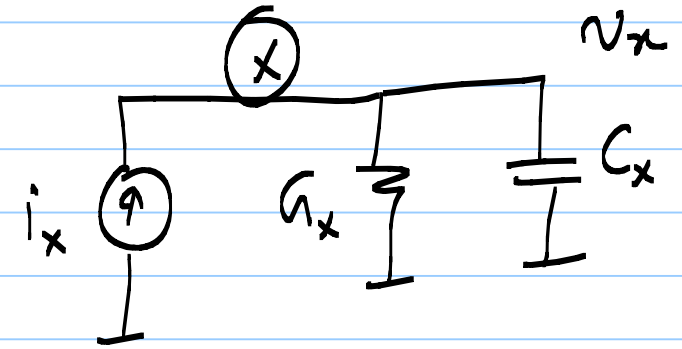
* Every node of an amplifier will have some parasitic cap.

→ made up of device cap. of transistors connected to that node

* pole associated with each mode

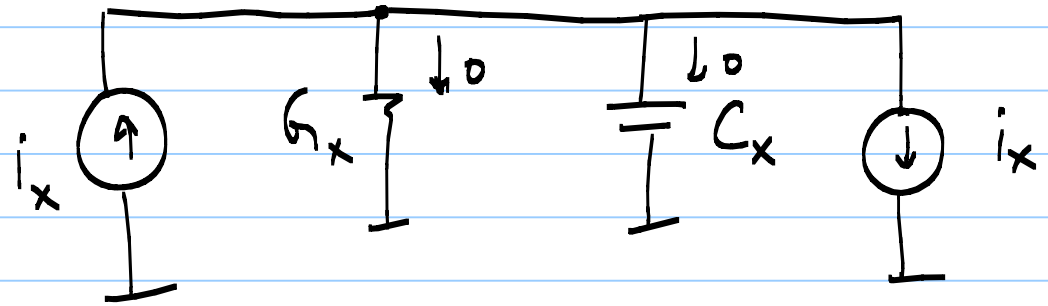
e.g.

$$v_x = \frac{i_x}{Y_x} = \frac{i_x}{G_x + j\omega C_x}$$



pole @ $\frac{G_x}{C_x}$

v_x has no freq. response



* More gain → cascade amplifier stages
→ more # of nodes → more # of poles
(and maybe zeroes)

* More # of poles → possibility of instability
when placed in feedback.