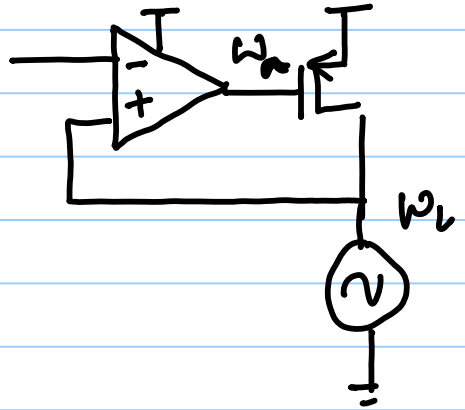
Lecture # 32

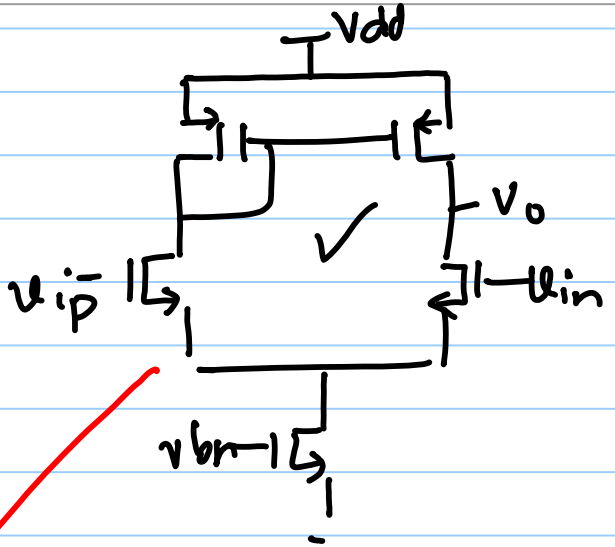
Note Title

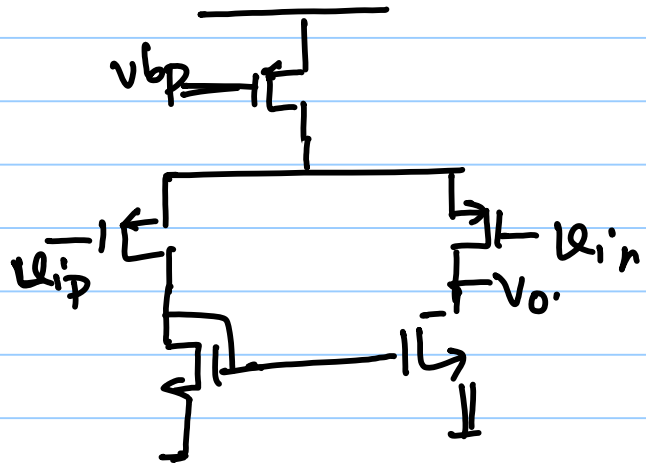
10-11-2020

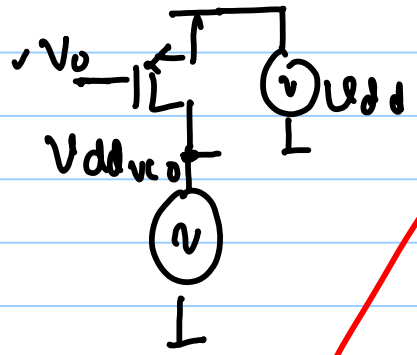
#1

#2



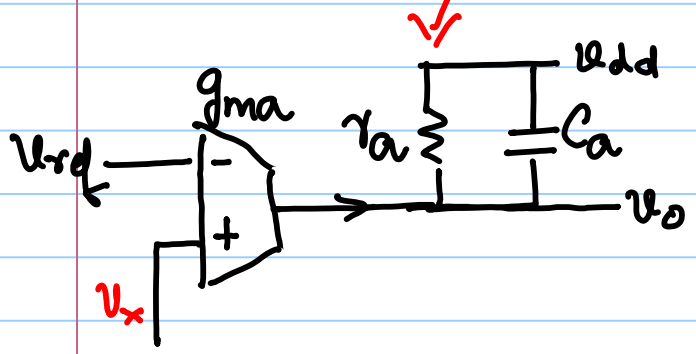




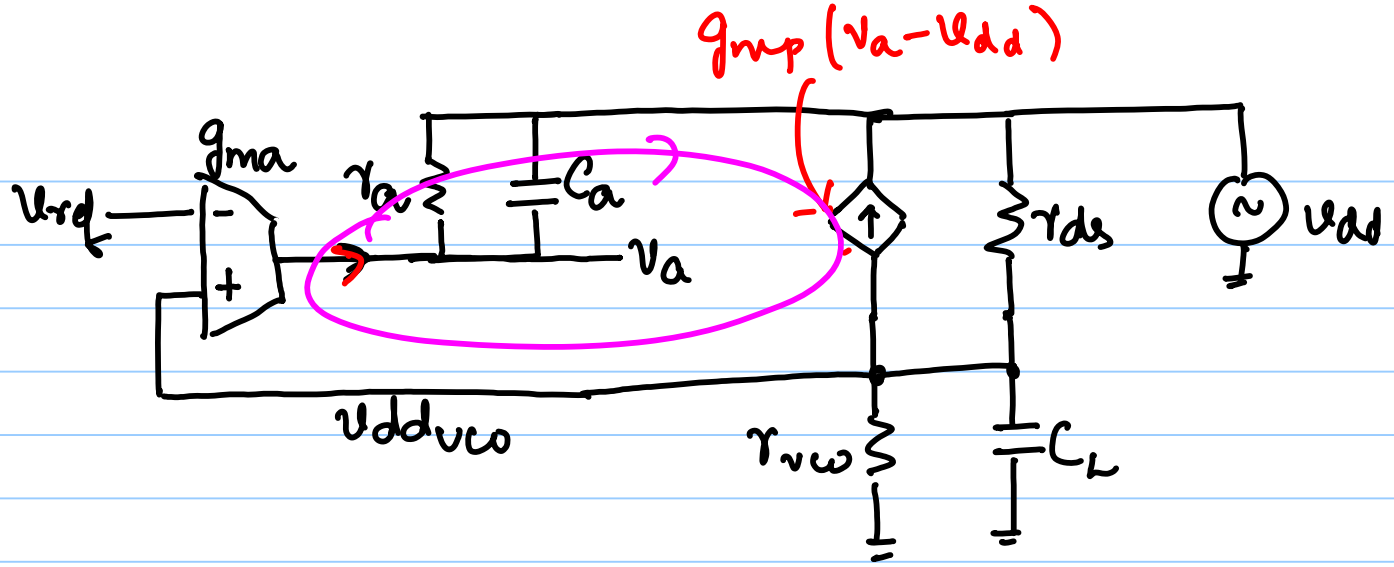


$$\frac{v_{ddvco}}{v_{dd}} = \frac{1}{1+\frac{r_{ds}}{r_{vco}}} \quad (1+g_m r_{ds}) \; v \;\Big|\; \frac{v_o}{v_{dd}} = 0$$

$$\frac{v_{ddv:o}}{v_{dd}} = \frac{1}{1+\frac{r_{ds}}{r_{v:o}}}$$



$$\frac{v_o}{v_x - v_{ref}} = \frac{g_{ma} r_a}{1+sC_a r_a} \;\Big|\; A_a = g_{ma} r_a \qquad \omega_a = \frac{1}{C_a r_a}$$



$$\frac{v_{ddvco}}{v_{ref}} = \frac{L_G}{1+L_G}$$

$$\left[(v_{ddvco} - v_{ref}) \frac{g_{ma} r_a}{1+sC_a r_a} \right] g_{mp} \times \frac{(\overbrace{r_{ds} \| r_{vco}}^{r_L}) \times \frac{1}{sC_L}}{(r_{ds} \| r_{vco}) + \frac{1}{sC_L}} = -v_{ddvco}$$

L_G

$$\frac{g_{ma} r_a \, g_{mp} r_L}{(1+sC_a r_a)(1+sC_L r_L)} (v_{ddvco} - v_{ref}) = -v_{ddvco}$$

$$(v_{ddvco} - v_{ref}) L_G = -v_{ddvco} \Rightarrow \frac{v_{ddvco}}{v_{ref}} = \frac{L_G}{1+L_G}$$

$$\frac{V_{ddvco}}{V_{ref}} = \frac{A_a A_0 \,/\, (1+s/\omega_a)(1+s/\omega_L)}{1 + \;\downarrow} = \frac{1}{1+\frac{1}{L_h}} \approx \frac{1}{1+s/\omega_p}$$

$$= \frac{1}{1 + \dfrac{(1+s/\omega_a)(1+s/\omega_L)}{A_a A_0}}$$

$$= \frac{A_a A_0}{\dfrac{s^2}{\omega_a \omega_L} + s\left(\dfrac{1}{\omega_a} + \dfrac{1}{\omega_L}\right) + (1 + A_a A_0)}$$

$$s_1 \approx -\frac{\left(\frac{1}{\omega_a} + \frac{1}{\omega_L}\right)}{1/\omega_a \omega_L} = -(\omega_a + \omega_L)$$

$$s_2 \approx -\frac{1 + A_0 A_a}{\frac{1}{\omega_a} + \frac{1}{\omega_L}}$$

$ax^2 + bx + c = 0$

$x_1 + x_2 = -\frac{b}{a}$ ✓

$x_1 x_2 = \frac{c}{a}$

$x_1 \gg x_2$ ✓

$\Rightarrow x_1 + x_2 \approx x_1 = -\frac{b}{a}$

$-\frac{b}{a} \times x_2 = \frac{c}{a}$

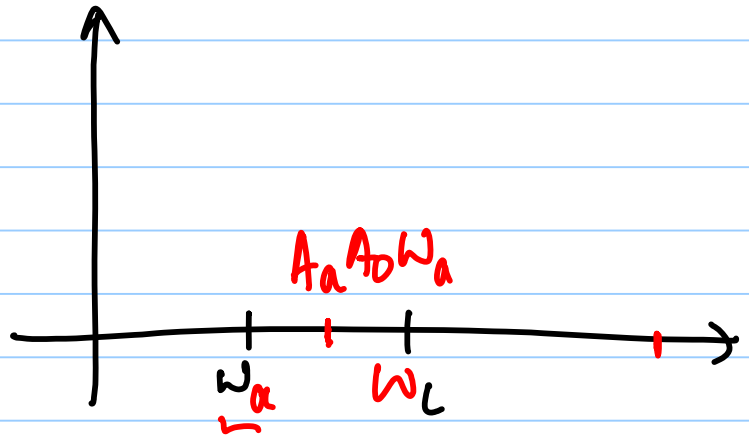
$x_2 = -\frac{c}{b}$ ✓

$s_1 \gg s_2$

$\omega_a \ll \omega_L$

$s_1 \simeq -\omega_L$ ✓

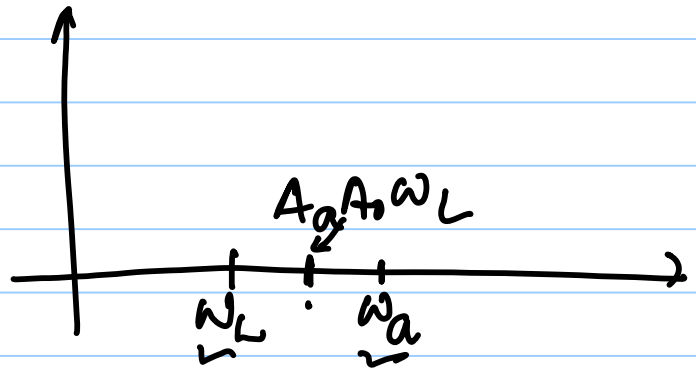
$s_2 \simeq -A_a A_0 \omega_a$



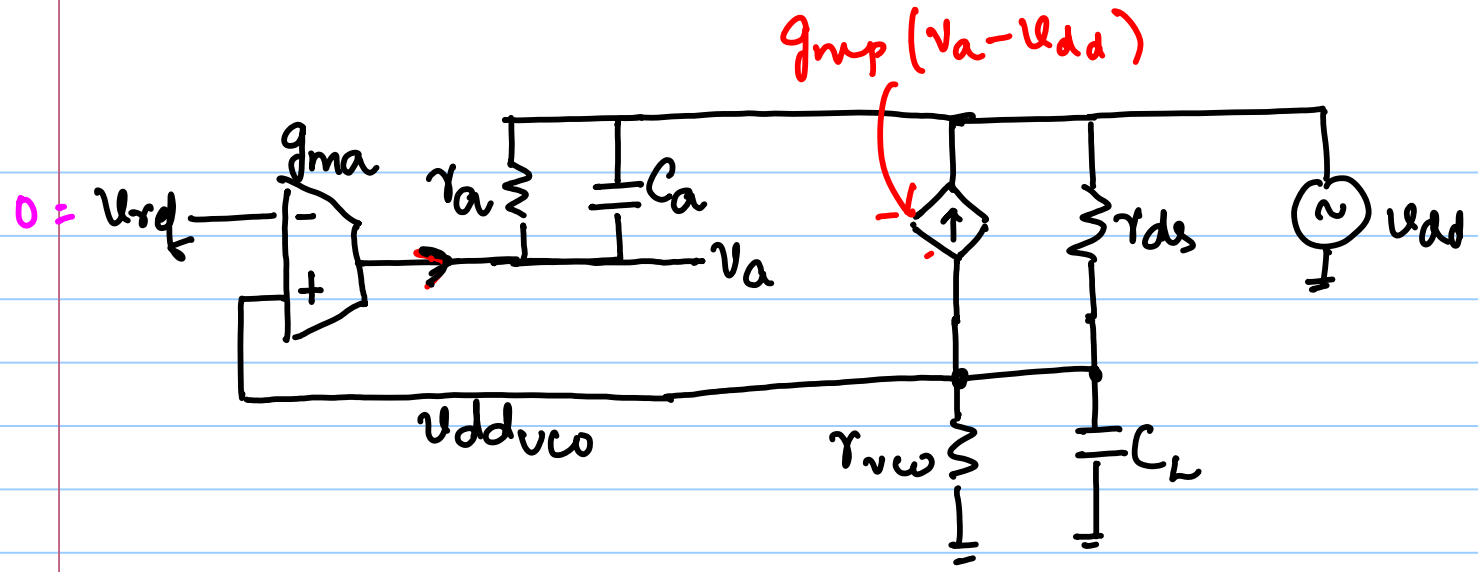
$\omega_L \ll \omega_a$ ✓

$s_1 \simeq -\omega_a$

$s_2 \simeq -A_a A_0 \omega_L$



$$H(s) = \frac{T_{ep}}{2\pi} \cdot \frac{1+sRC_1}{1+sRC_1C_2} \cdot \frac{1}{s(C_1+C_2)} \cdot \frac{1}{1+s/\omega_{rcg}} \cdot \frac{2\pi K_{VCO}}{s} \cdot \frac{1}{N}$$

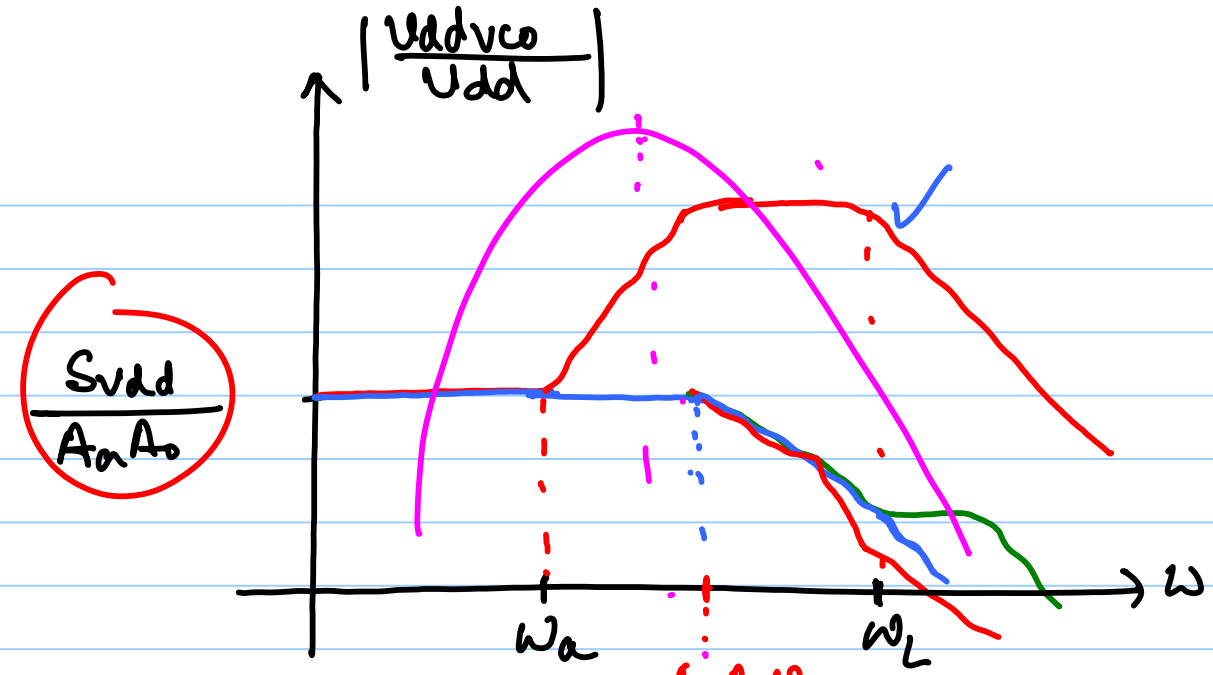


$$g_{ma} v_{ddvco} = \frac{v_a - v_{dd}}{\left(r_a \| \frac{1}{sC_a}\right)} \quad -(1)$$

$$\frac{v_{dd} - v_{ddvco}}{r_{ds}} - g_m(v_a - v_{dd}) = \frac{v_{ddvco}}{\left(r_{vco} \| \frac{1}{sC_L}\right)} \quad -(2)$$

$$\frac{v_{ddvco}}{v_{dd}} = \frac{S_{vdd}\left(1 + \frac{s}{\omega_a}\right)}{\left(1 + \frac{s}{\omega_a}\right)\left(1 + \frac{s}{\omega_L}\right) + A_a A_0}$$

$$S_{Vdd} = \frac{r_{vco}}{r_{vco} + r_{ds}}$$



$\checkmark$ $\omega_a \ll \omega_L$

ω_L, $A_a A_o \omega_a$

$\omega_L \ll \omega_a$ $\checkmark$

ω_a, $A_a A_o \omega_L$

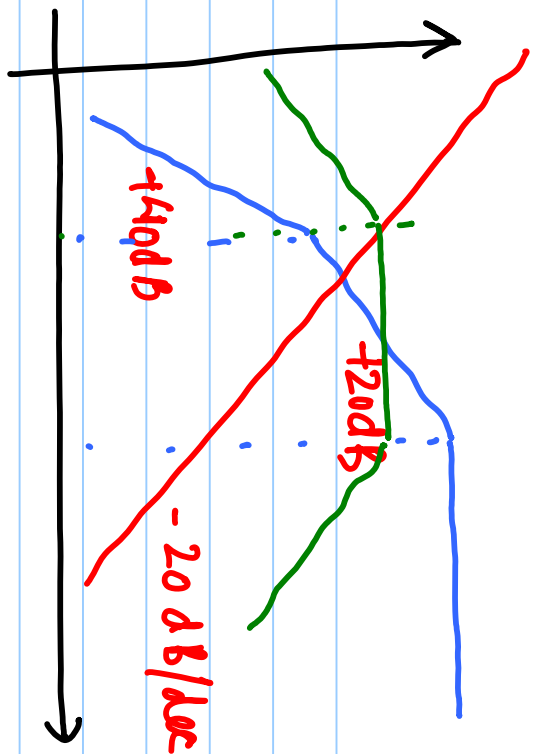
$$\omega_a = \frac{1}{r_a C_a}$$

$$\omega_L = \frac{1}{(r_{vco} \| r_{ds})\, C_L \uparrow}$$

$C_a \uparrow = C_{amp} \uparrow + C_{gg} \uparrow (M)$

$r_{vco} = \frac{1.5\,V}{1.5\,mA} = 1\,k\Omega$

$$\frac{\phi_{out}}{V_{dd,vco}} = \frac{2\pi K_{vco}/s}{1 + L(s)_{PLL}} = \frac{1}{1 + L(s)_{PLL}} \times 2\pi K_{vco}$$


+40dB
+20dB
-20 dB/dec