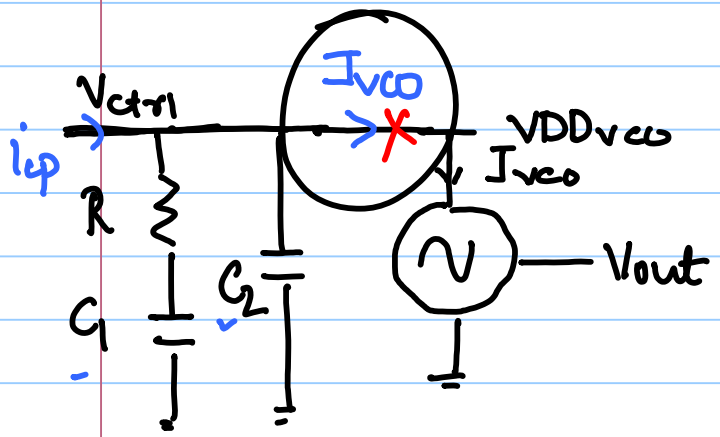
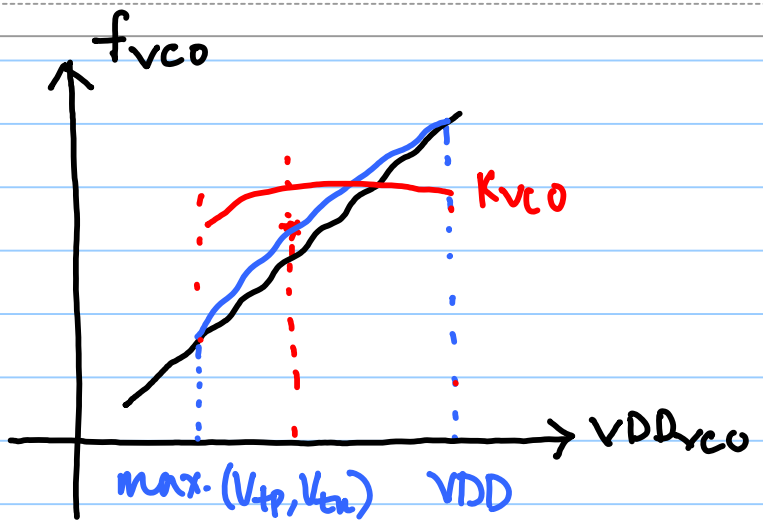
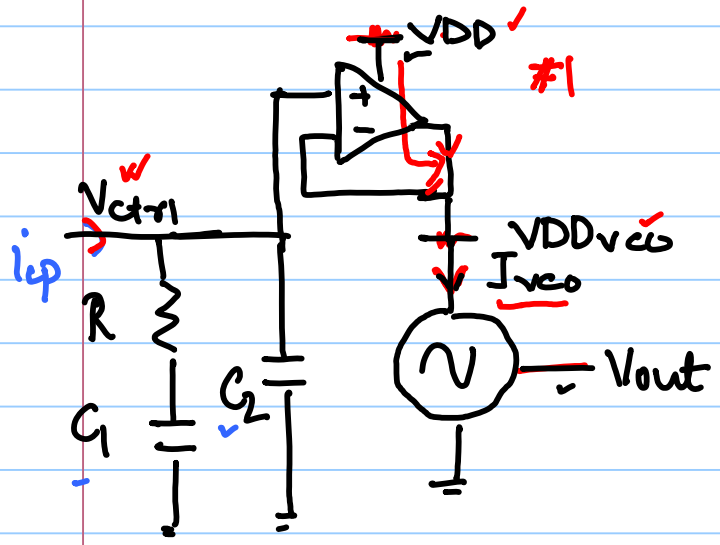
Lecture #31

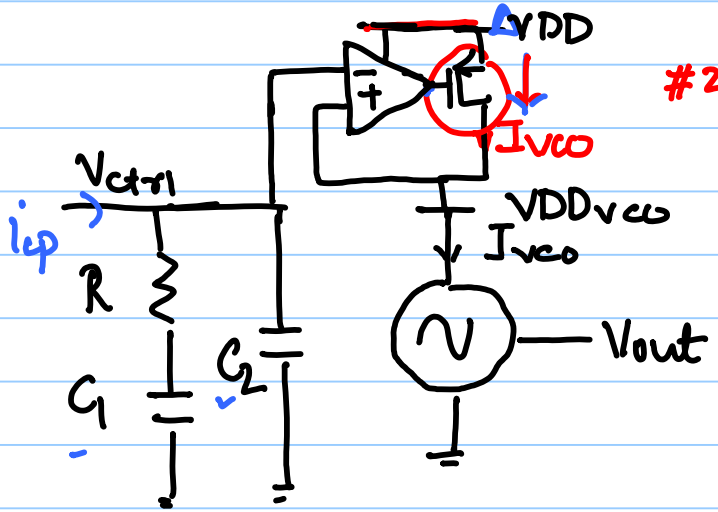
Note Title 09-11-2020

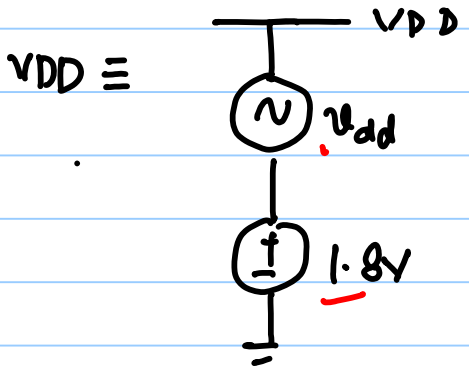




$$K_{VCO} = \frac{d(f_{VCO})}{d(VDD_{VCO})}$$





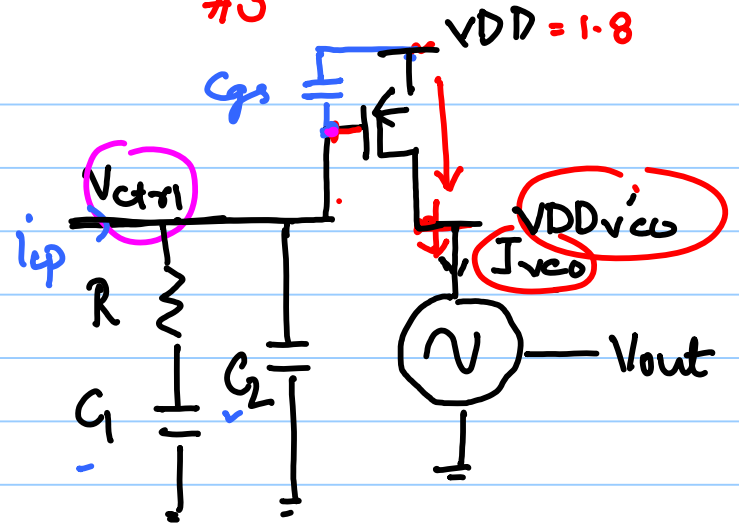


$$\frac{\Delta VDD_{VCO}(s)}{V_{dd}(s)} \times \frac{\Delta\phi_{out}}{\Delta VDD_{VCO}(s)} = \frac{\Delta\phi_{out}(s)}{V_{dd}(s)}$$ ✓

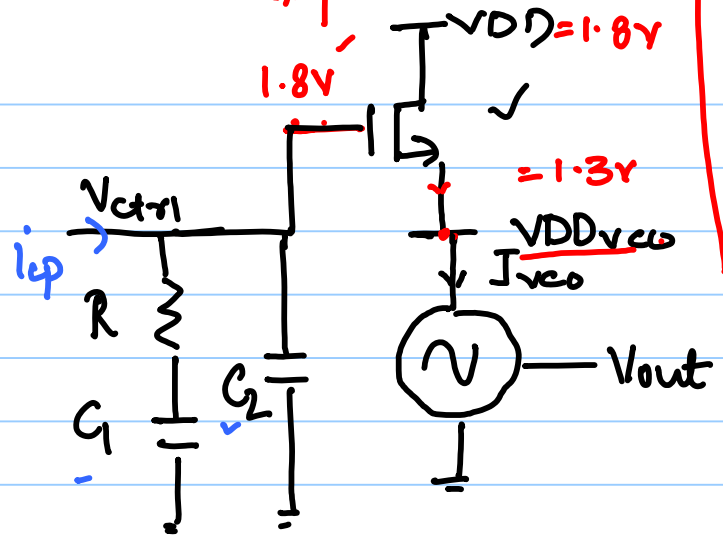
(Power Supply Rejection Ratio)

(PSRL)

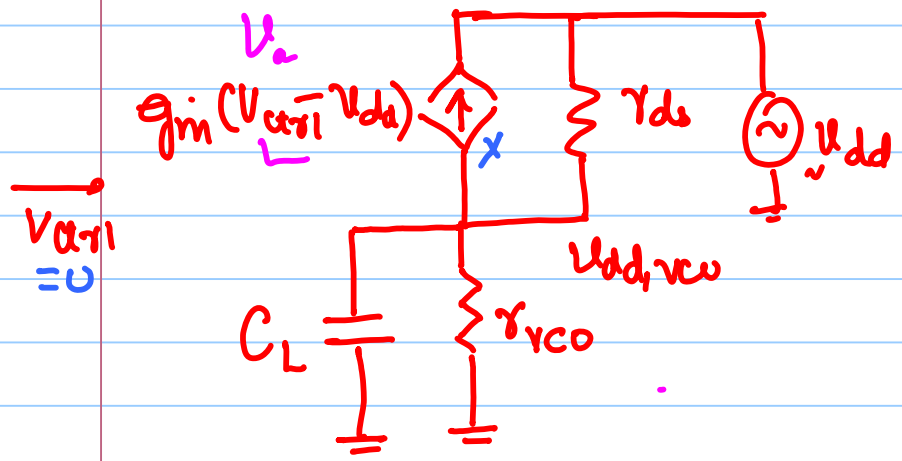
#3 $0.5V = |V_{tp}| = V_{tn}$



#4



$$\frac{\Delta VDD_{vco}\,(-3)}{\Delta V_{ctrl}\,(-3)}$$

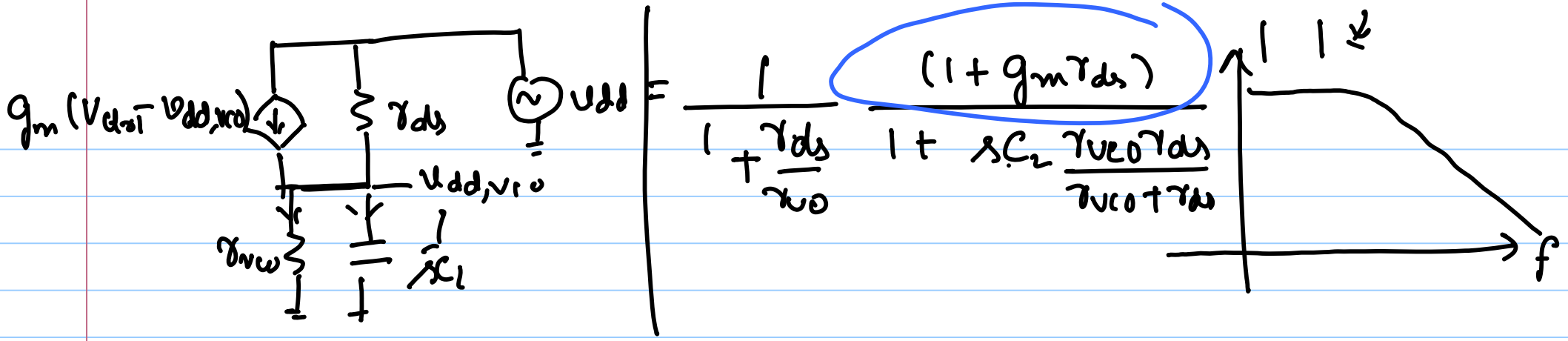


$$V_{dd,vco}\left(\frac{1}{r_{ds}} + \frac{(1+sC_L r_{vco})}{r_{vco}}\right) = V_{dd}\left(g_m + \frac{1}{r_{ds}}\right)$$

$$\frac{V_{dd,vco}}{V_{dd}} = \frac{(1+g_m r_{ds})\,/\!/\,r_{ds}}{\dfrac{(r_{vco} + r_{ds} + sC_L r_{vco} r_{ds})}{r_{vco}\,/\!/\,r_{ds}}}$$

$$\frac{V_{dd,vco}}{\left(r_{vco}\,/\!/\,\frac{1}{sC_L}\right)} = \frac{V_{dd} - V_{dd,vco}}{r_{ds}} + g_m V_{dd}$$

$$= \frac{1}{1 + \dfrac{r_{ds}}{r_{vco}}} \cdot \frac{(1+g_m r_{ds})}{1 + sC_L \dfrac{r_{vco} r_{ds}}{r_{vco} + r_{ds}}}$$

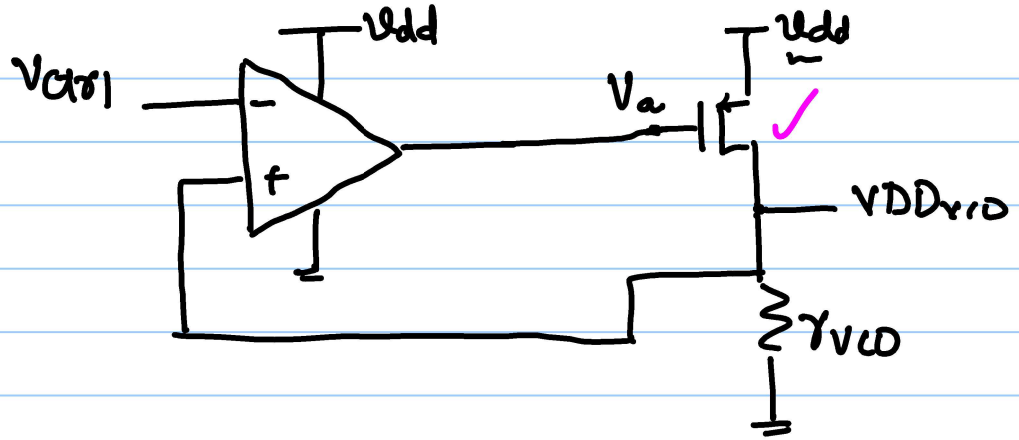


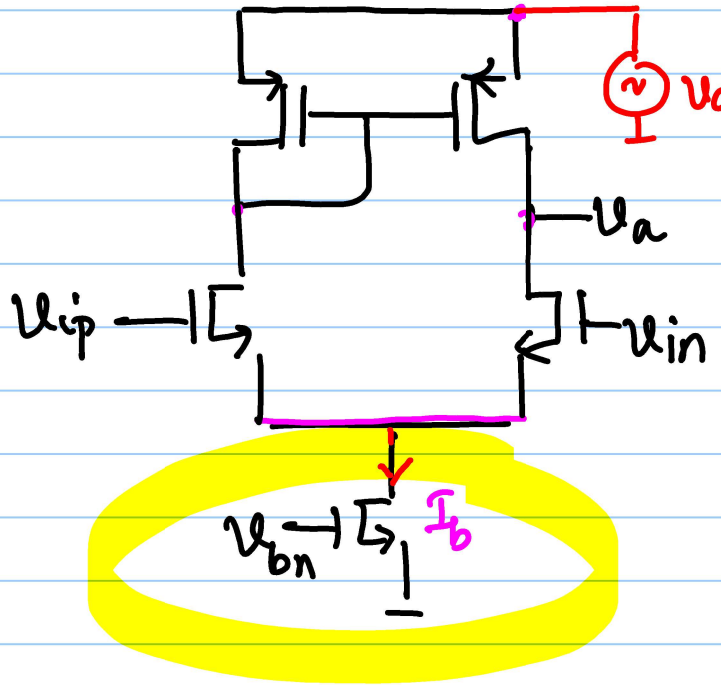
$$\frac{v_{dd,vco}\,(1+sC_L r_{vco})}{r_{vco}} = \frac{v_{dd} - v_{dd,vco}}{r_{ds}} - g_m v_{dd,vco}$$

$$v_{dd,vco}\left(\frac{1}{r_{ds}} + \frac{1}{r_{vco}} + g_m + sC_L\right) = \frac{v_{dd}}{r_{ds}}$$

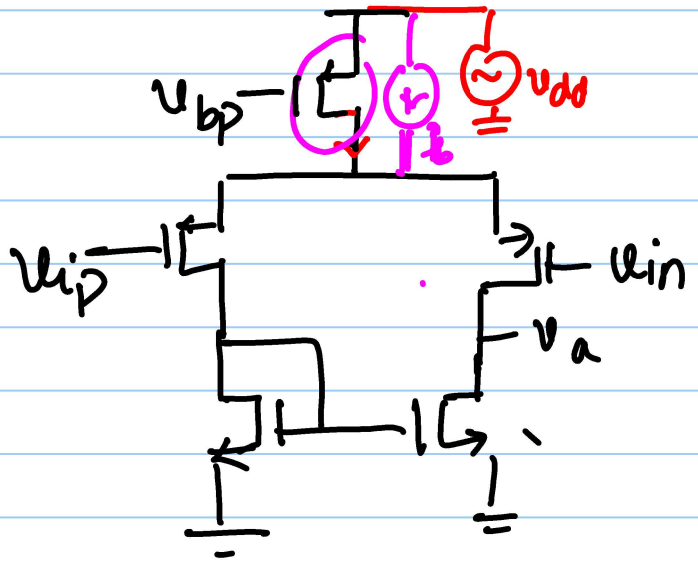
$$\frac{v_{dd,vco}}{v_{dd}} = \frac{1}{r_{ds}} \cdot \frac{1}{\left(\frac{1}{r_{ds}} + \frac{1}{r_{vco}} + g_m\right)} \cdot \frac{1}{1+\frac{sC_L}{\left(\frac{1}{r_{vco}} + \frac{1}{r_{ds}} + g_m\right)}}$$

$$= \frac{1}{1+\frac{r_{ds}}{r_{vco}} + g_m r_{ds}} \cdot \frac{1}{1+\frac{sC_L r_{vco} r_{ds}/(r_{vco}+r_{ds})}{1+g_m \frac{r_{ds} r_{vco}}{r_{ds}+r_{vco}}}}$$





$\frac{V_a}{V_{dd}} = 1$



$\frac{V_a}{V_{dd}} = 0$