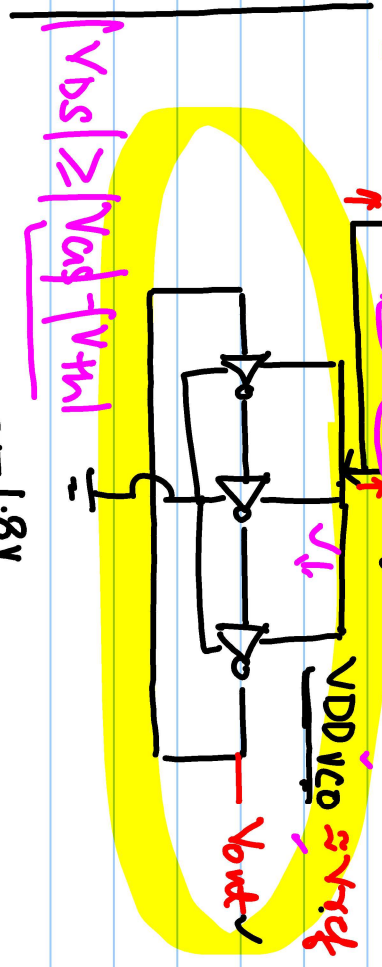
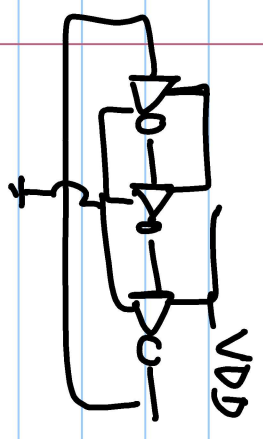
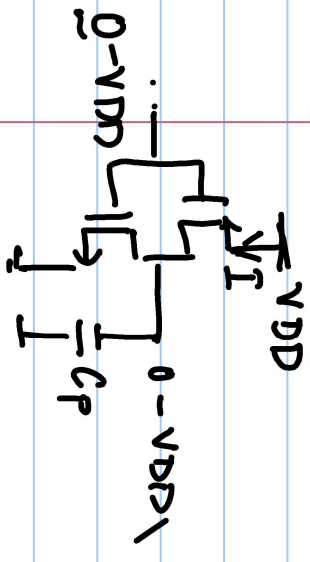
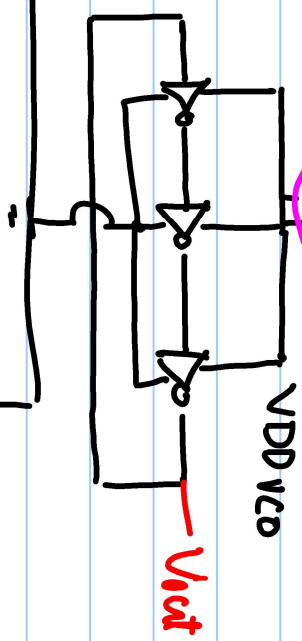


# Lecture # 29

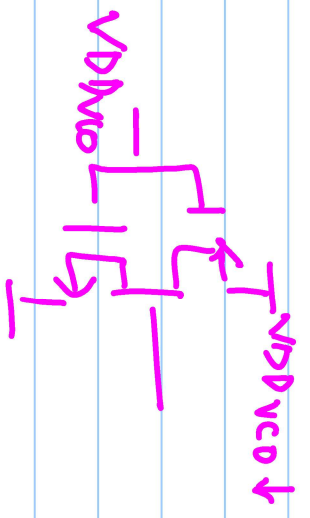
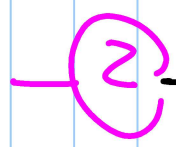
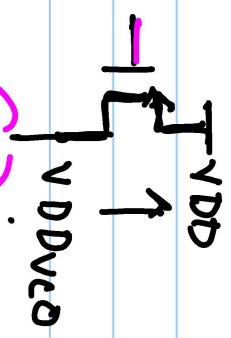


$|V_{ds}| \geq |V_{gs} - V_{th}|$

$\Delta V_{CH} = \frac{1}{g_m} \Delta V_{out}$



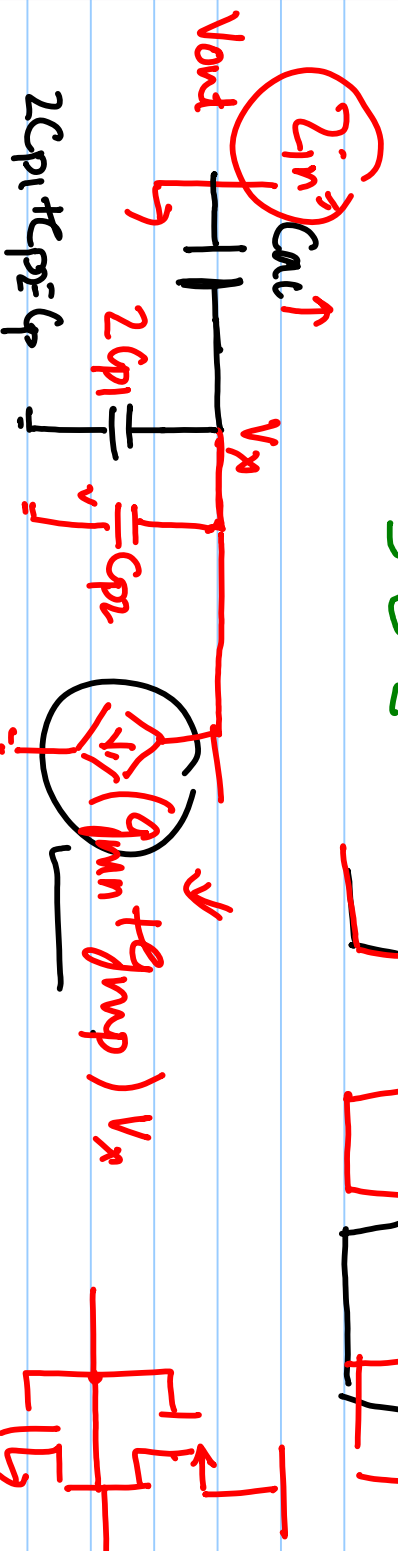
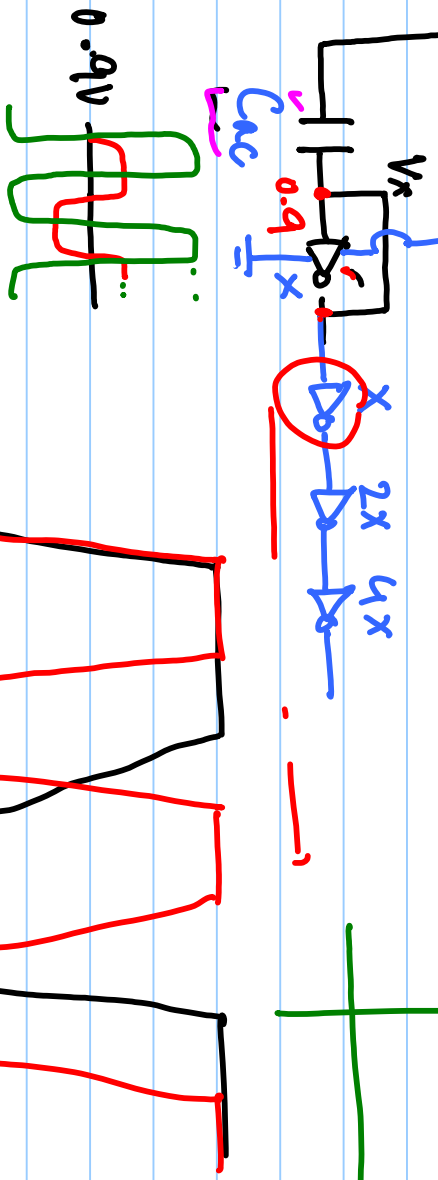
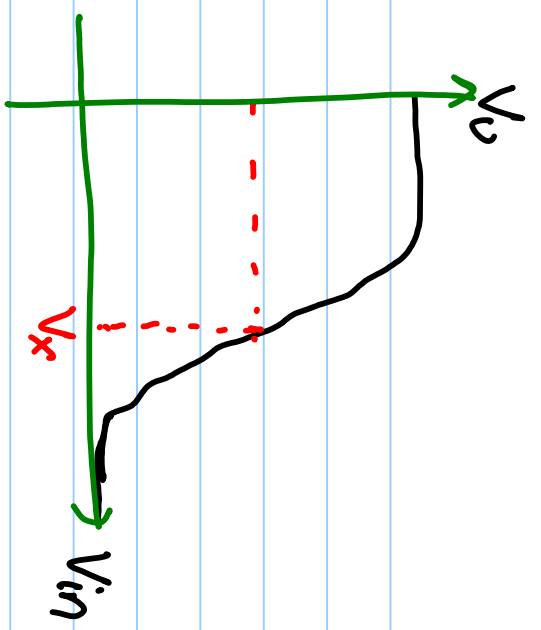
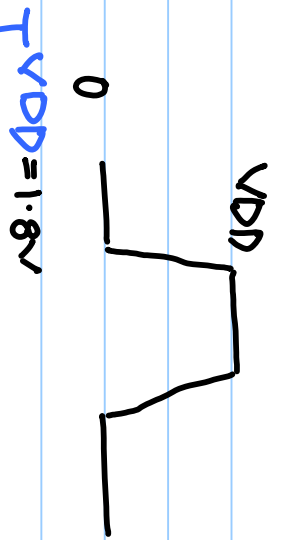
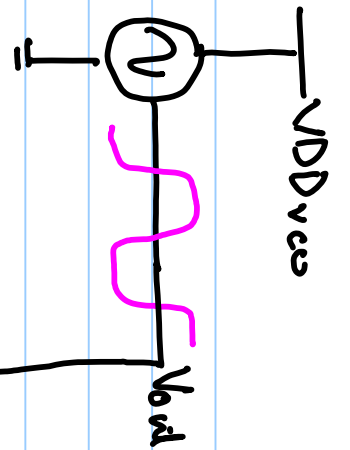
Max.  $(V_{DD_{VCO}}) < V_{DD} - V_{th}$



$V_{DD_{VCO}} - 0 - |V_{TP}| > 0$

$V_{DD_{VCO}} - V_{th} > 0$

$V_{DD_{VCO}} > \max(V_{th}, |V_{TP}|)$



$V_x \approx V_{out}$

$$\frac{V_x}{V_{out}} = \frac{\frac{1}{g_m + g_{mp}} \parallel \frac{1}{r_{sp}}}{\frac{1}{sC_{p1}} + \frac{1}{g_m + g_{mp}} \parallel \frac{1}{r_{sp}}}$$

$$= \frac{1}{(sR_p + g_m)}$$

$$= \frac{1}{sC_{ac} + \frac{1}{sR_p + g_m}}$$

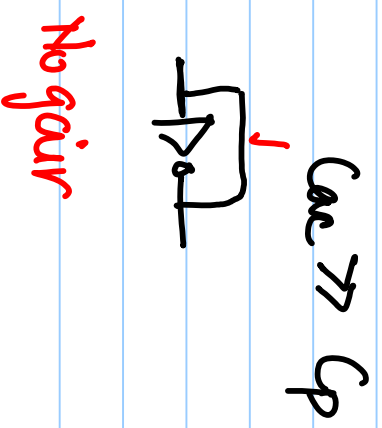
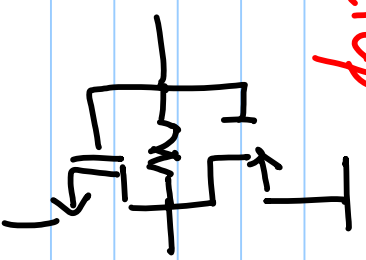
$$= \frac{sC_{ac}}{sC_{ac} + sR_p + g_m} \approx 1$$

$$= \frac{sC_{ac}}{g_m \left( 1 + s(C_{ac} + C_p) \right)}$$

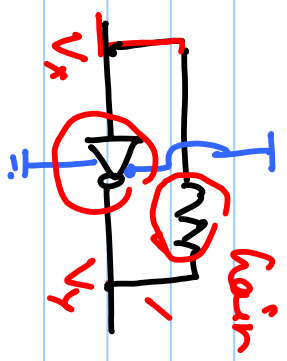
$$\frac{sR_p \times \frac{1}{g_m}}{\frac{1}{g_m} + sR_p}$$

$$= \frac{1}{sR_p + g_m}$$

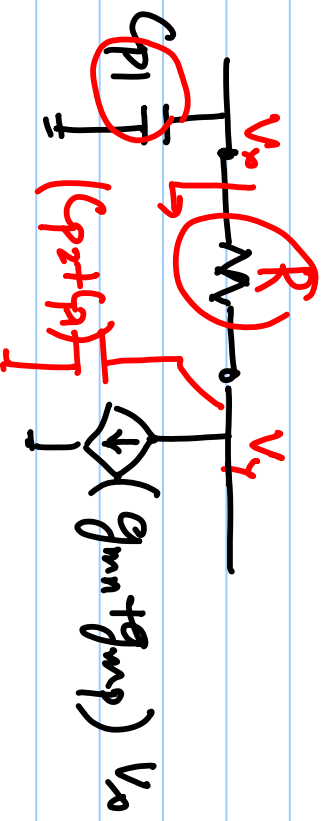
$$R_p = \frac{C_{ac} + C_p}{g_m}$$

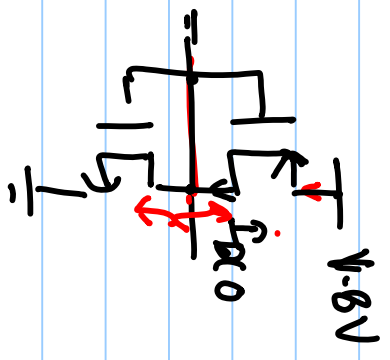
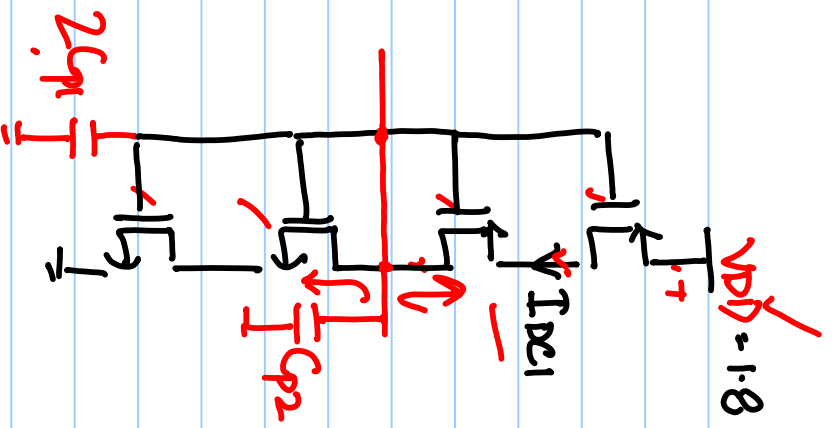


No gain



$$\frac{v_o}{v_i} = \frac{C_{ac}}{C_{ac} + C_p}$$





$$g_m = \frac{2I_D}{V_{DS}}$$

$$I_{Dc1} \approx I_{Dc0}$$

