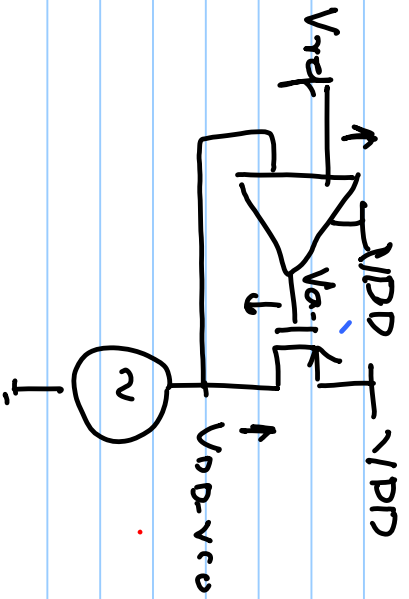
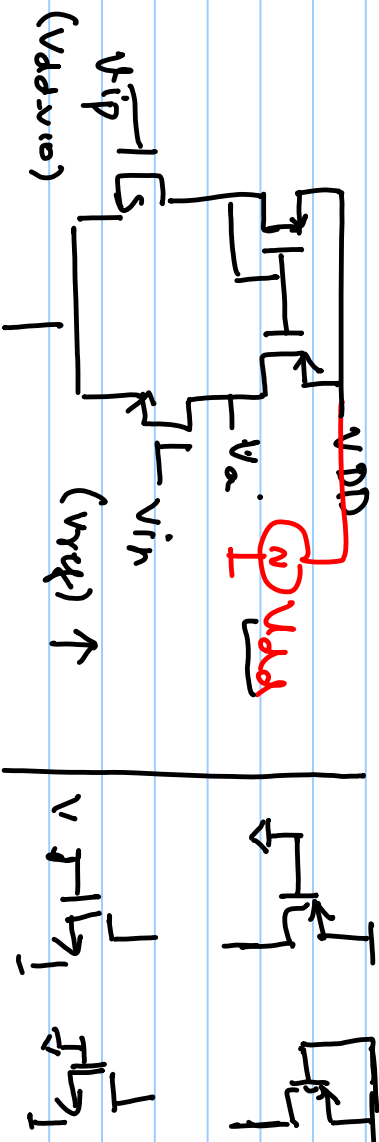
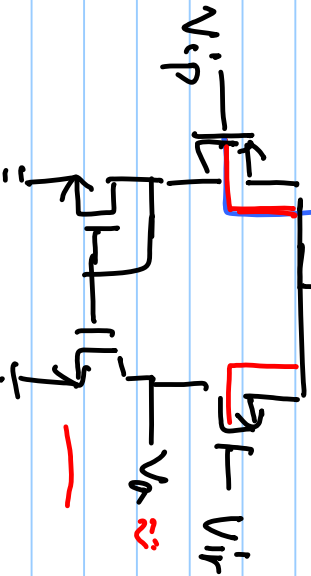


Lecture # 29



$V_a \approx V_{DD}$



$V_a \approx V_{DD}$ (NMOS)

$\frac{V_a}{V_{DD}} \approx 0$ (PMOS)

1.) N-i/p pair + PMOS o/p stage

$v_{out} \approx \frac{v_{in}}{r_{v10} + r_{m1}}$

2.) N-i/p pair + NMOS o/p stage

$v_{out} \approx v_{in} + \frac{v_{in}}{r_{v10} + (r_{m1} || g_m)}$

3) P-ipp pair + PMOS o/p stage

$$\frac{V_o}{V_{in}} = 0 + \dots$$

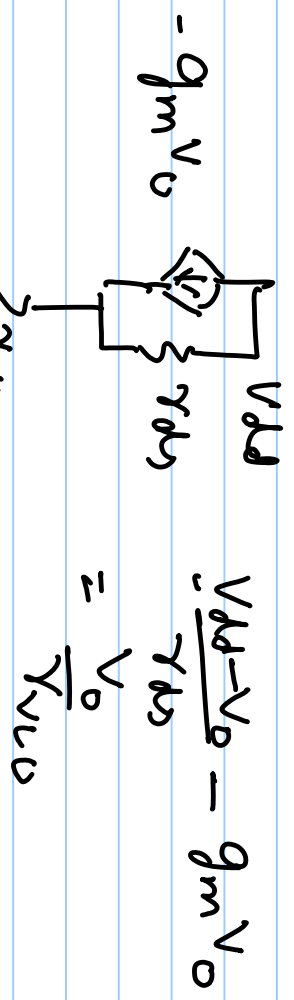
4) F-ipp pair + NMOS o/p stage

$$\frac{V_o}{V_{in}} = r_o + \dots$$



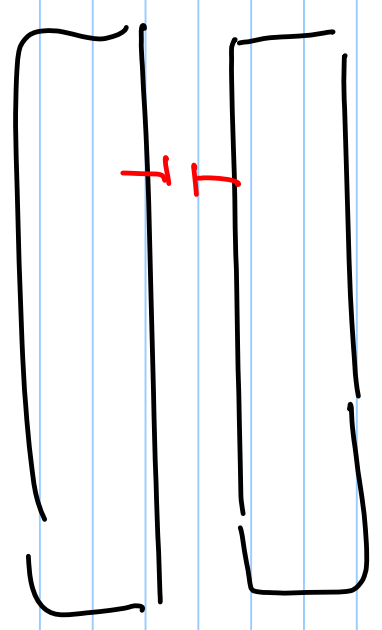
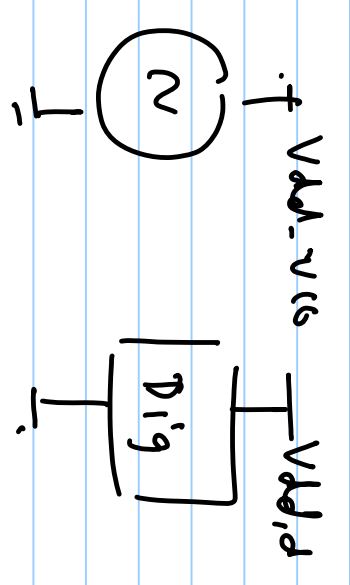
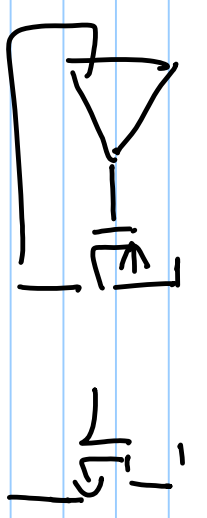
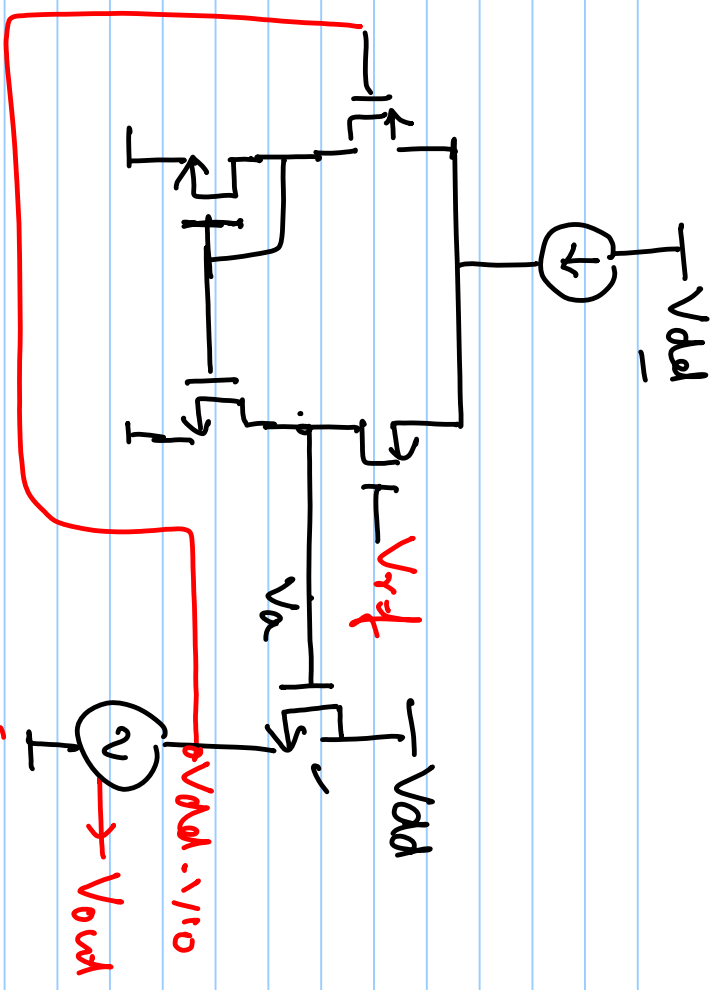
$$V_o = \frac{V_o}{r_{V_{in}}}$$

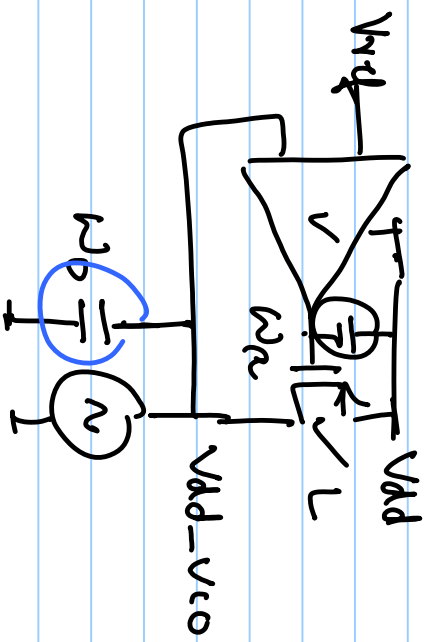
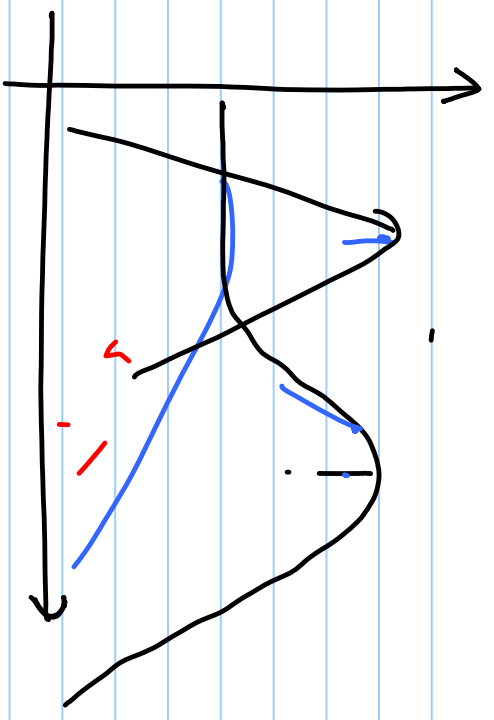
$$\frac{V_o}{V_{in}} = \frac{1}{r_{ds} + g_{mp}} \frac{1}{r_{ds} + r_{V_{in}}}$$



$$\frac{V_{DD} - V_o}{r_{ds}} - g_m V_o = \frac{V_o}{r_{V_{in}}}$$

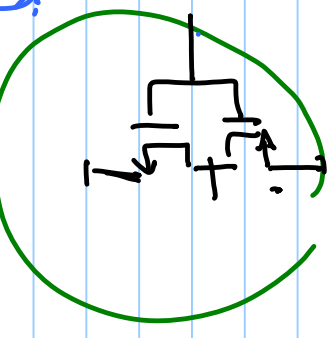
$$\frac{V_o}{V_{in}} = \frac{1/r_{ds}}{r_{ds} + \frac{1}{g_m} + r_{V_{in}}}$$





$$\frac{V_{dd-vic}(s)}{V_{dd}(s)}$$

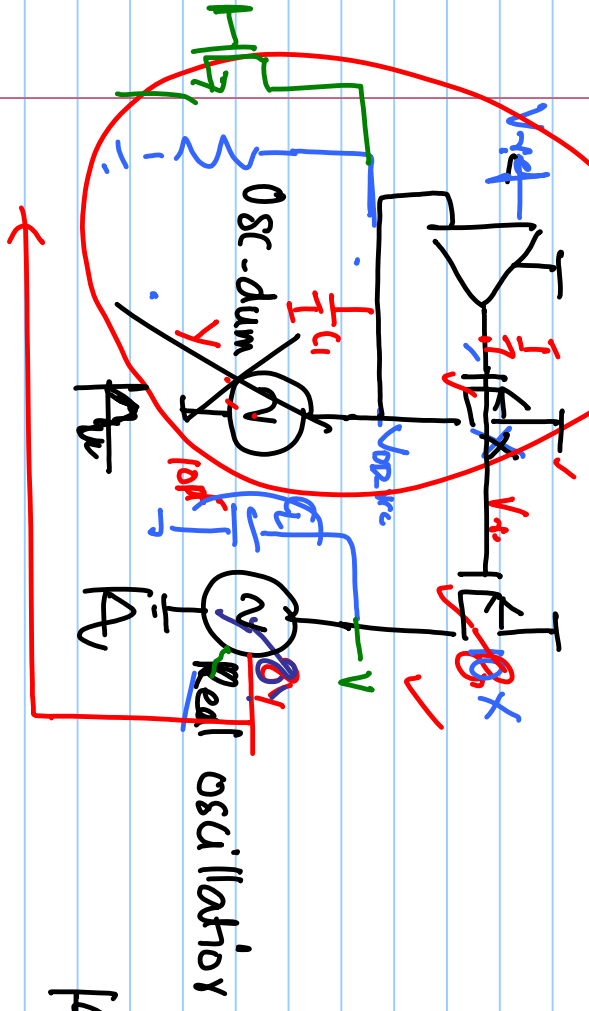
$$\frac{\Phi_{out}(s)}{V_{dd-vic}(s)}$$

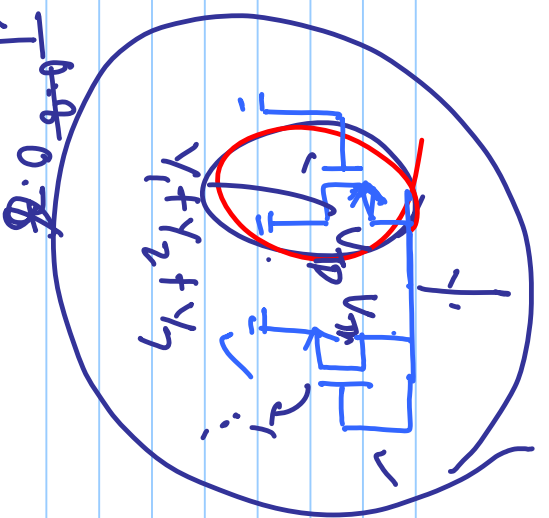
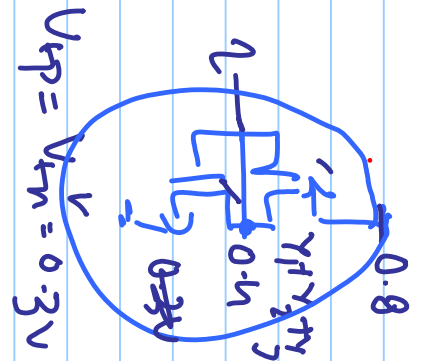
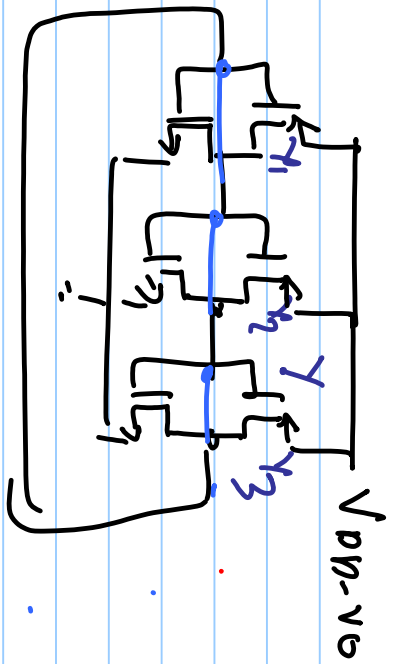


$$f_{out} = K_{v_{ic}} \cdot V_{v_{ic}}$$

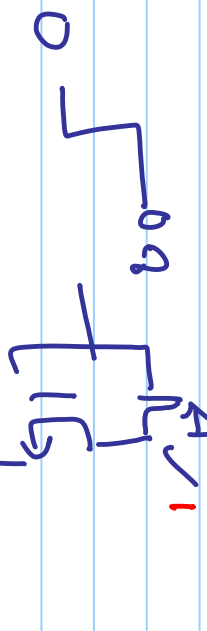
$$I = K \cdot f_{out}$$

AV



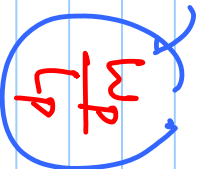


$$3 \left(\frac{W_p}{L_p} \right) \quad 3 \left(\frac{W_n}{L_n} \right)$$



Real osc.

PMOS $8 \left(\frac{W_p}{L_p} \right)$

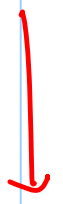


$8 \left(\frac{W_p/8}{L_p} \right)$

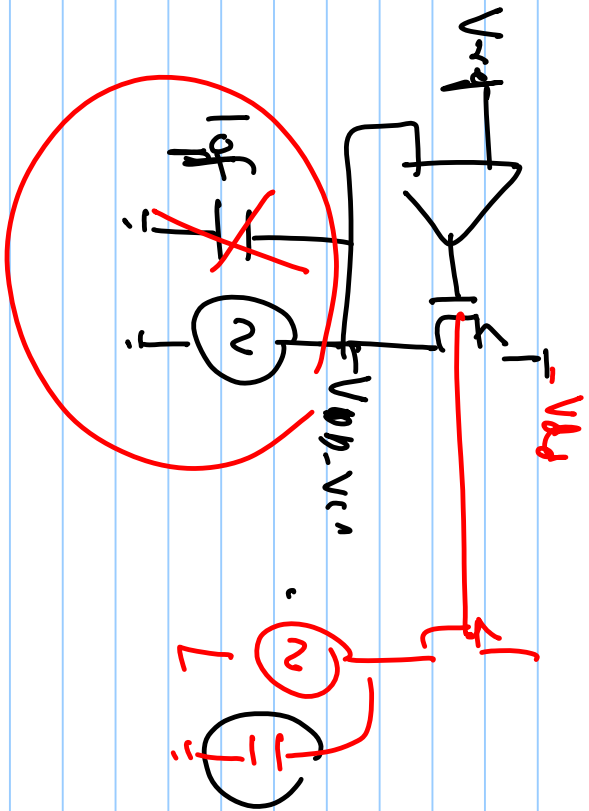
$8 \left(\frac{W_p}{8 L_p} \right)$

$3 \left(\frac{W_p}{L_p} \right)$

NMOS $8 \left(\frac{W_n}{L_n} \right)$



$\frac{W_n}{L_n}$



$$\frac{V_{Oo} - v_{ic0}}{v_{id}} = \frac{L_n}{1 + L_n}$$

$$L_n = \frac{A_n A_o}{\left(1 + \frac{s}{\omega_n}\right) \left(1 + \frac{s}{\omega_o}\right)}$$

