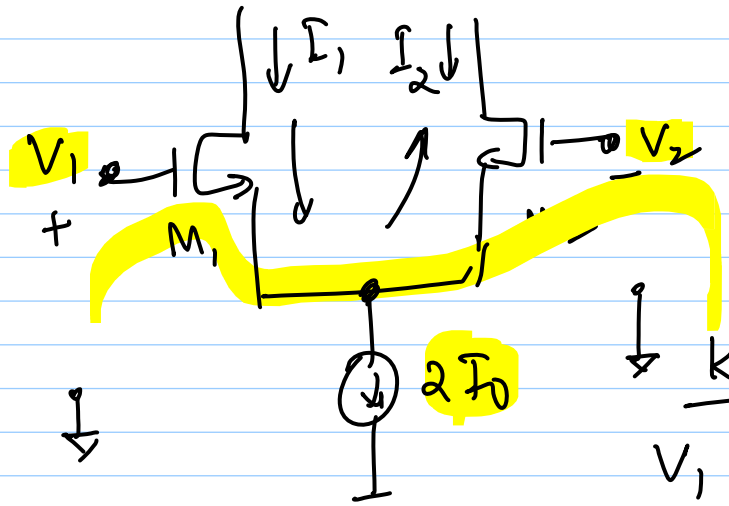
23-10-12

Lec 36



$$V_{id} = V_1 - V_2$$

$$I_{od} = I_1 - I_2$$

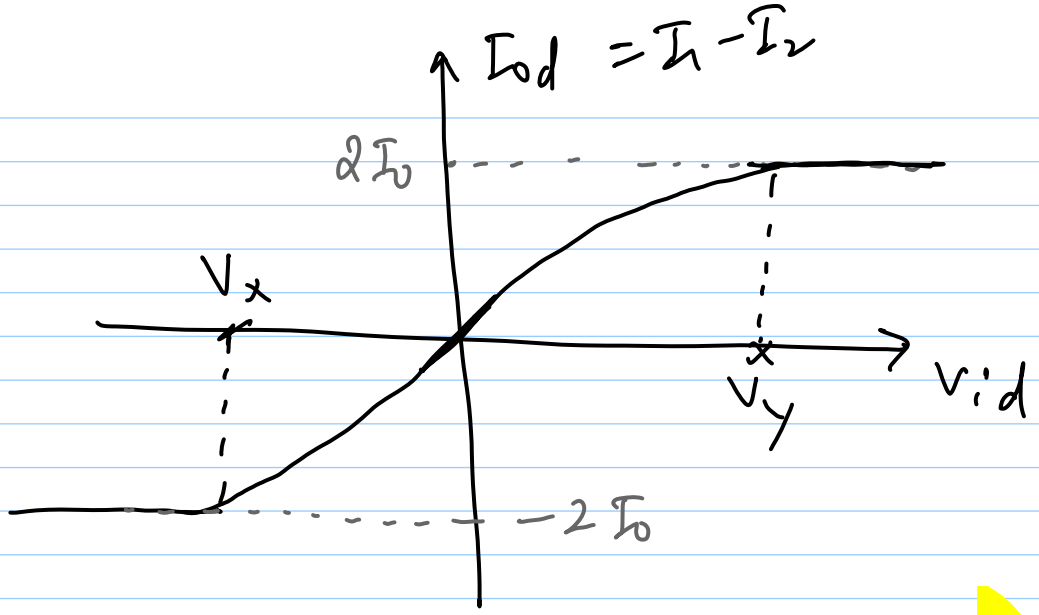
$V_{id} = 0 \Rightarrow I_1 = I_2 = I_0$

KVL

$$V_1 - V_{GS_1} + V_{GS_2} - V_2 = 0$$

$$V_{id} = V_1 - V_2 = V_{GS_1} - V_{GS_2}$$

$$= \left[V_T + \sqrt{\frac{2I_1}{k'(W/L)}}\right] - \left[V_T + \sqrt{\frac{2I_2}{k'(W/L)}}\right]$$



$$V_{id} = \frac{\sqrt{I_1} - \sqrt{I_2}}{\sqrt{\frac{1}{2}k'\left(\frac{W}{L}\right)}} \quad \text{---(1)}$$

$$I_1 + I_2 = 2I_0 \quad \text{---(2)}$$

(HW) Solve for I_1, I_2

$$I_1 = I_0 + \frac{k'}{4}\left(\frac{W}{L}\right) V_{id}\sqrt{\frac{8I_0}{k'\left(\frac{W}{L}\right)} - V_{id}^2}$$

$$I_2 = I_0 - \left\{ \quad \text{,,} \quad \right\}$$

$$g_m = k'\left(\frac{W}{L}\right) \cdot V_{dsat}$$

$$V_{dsat} = \sqrt{\frac{2I_0}{k'\left(\frac{W}{L}\right)}}$$

$$I_1 = I_0 + \frac{1}{2} g_m V_{id}\sqrt{1 - \left(\frac{V_{id}}{2V_{dsat}}\right)^2} \quad \checkmark$$

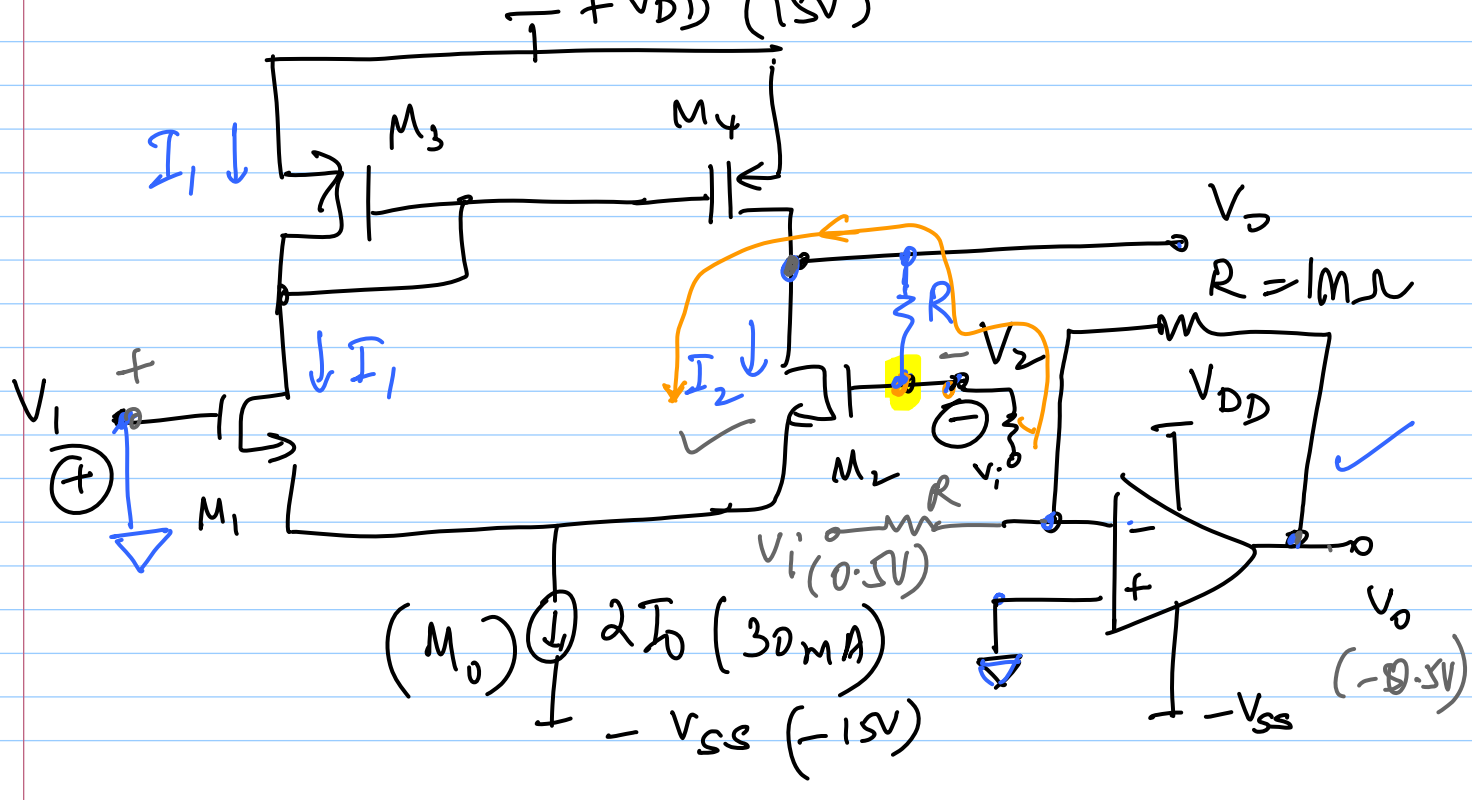
$$I_2 = I_0 - (\quad)$$

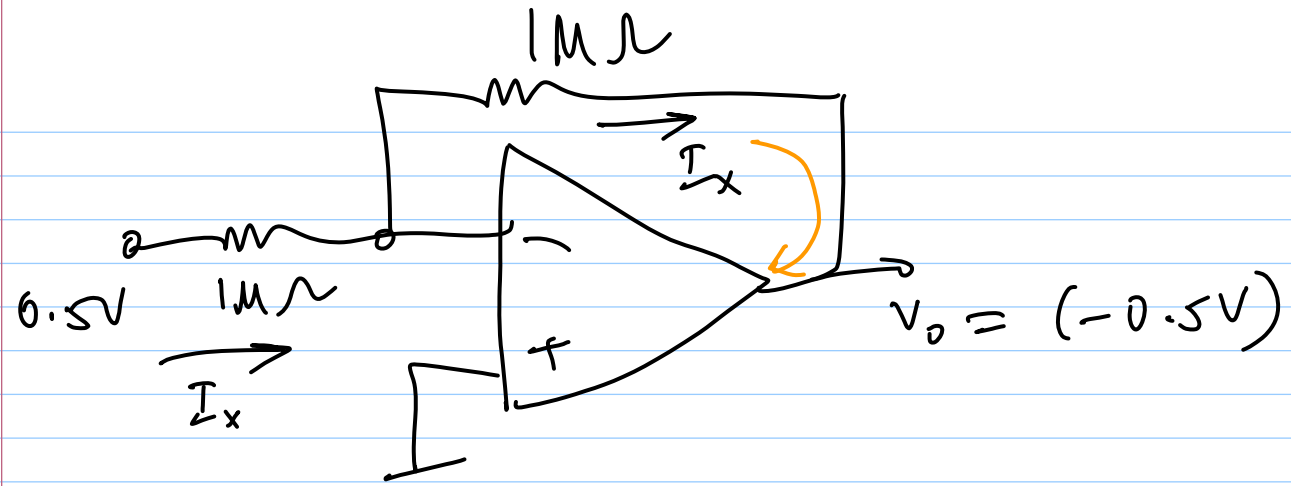
Small-signal

$V_{id} << 2V_{dsat}$.

(*) $V_2 > 0$

$I_2 >> I_1$





$$I_x = \frac{0.5}{1M\Omega} = 0.5\mu A$$