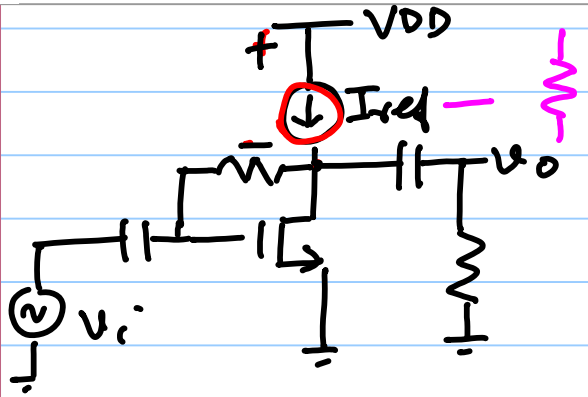
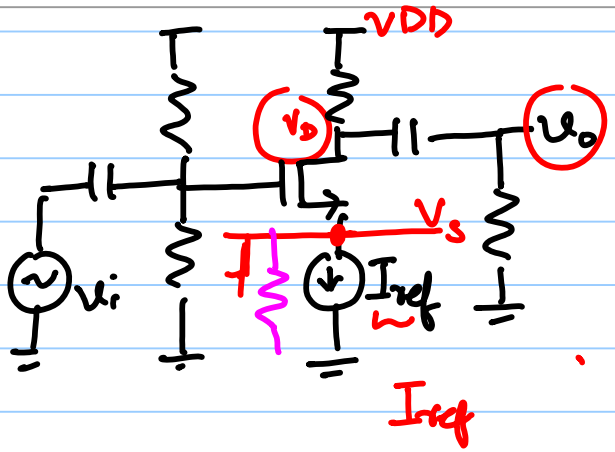
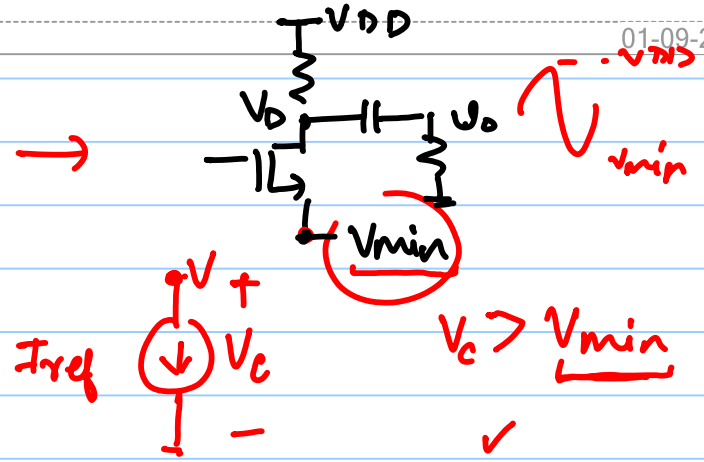
Lecture # 14

Note Title 01-09-2021



#2

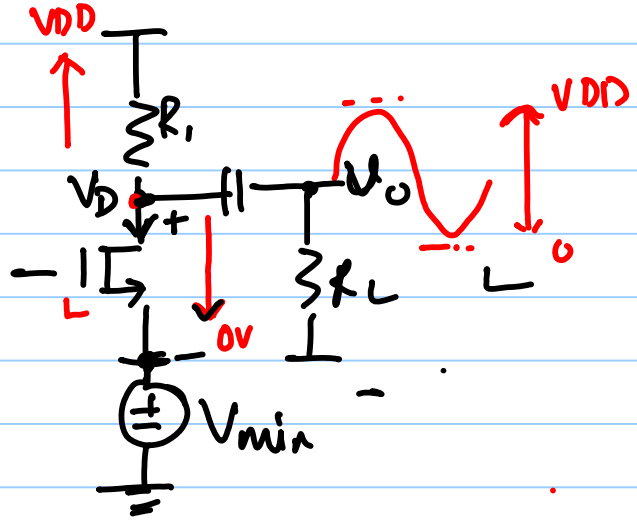


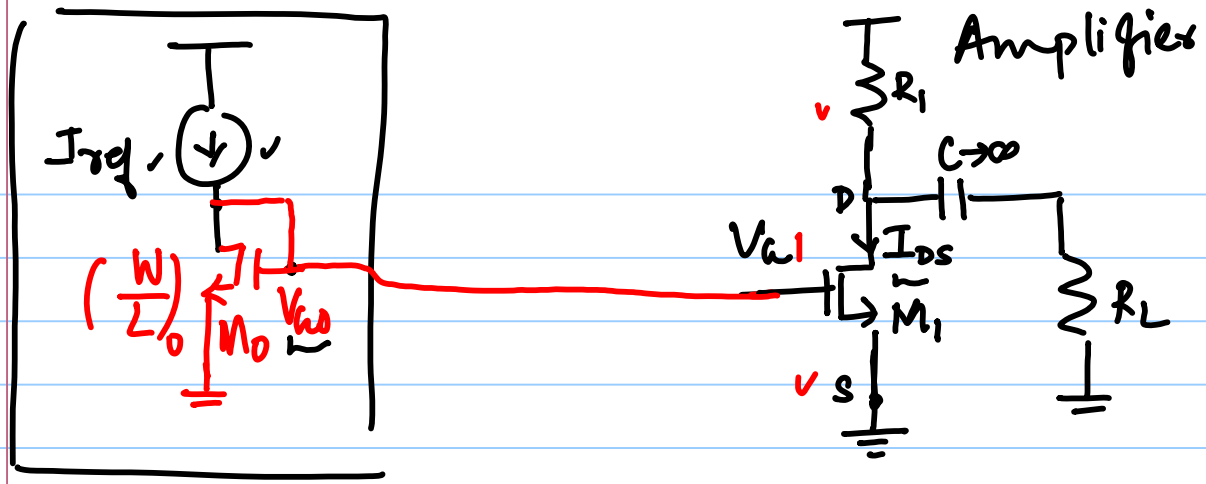


- Real current source will require a potential drop across it.
- It will limit o/p swing.

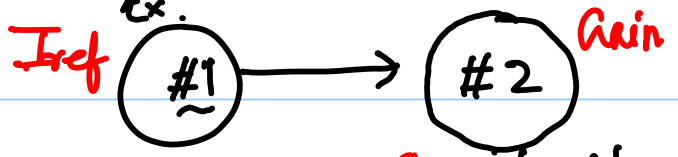
$$V_{DS} \geq V_{GS} - V_{tn}$$

$$V_D > V_n - V_{tn}$$





Ex:

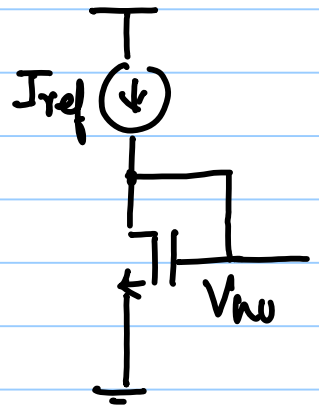


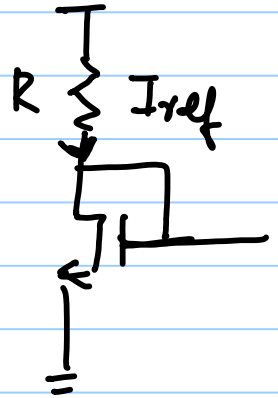
Tut#2 → Evaluation.

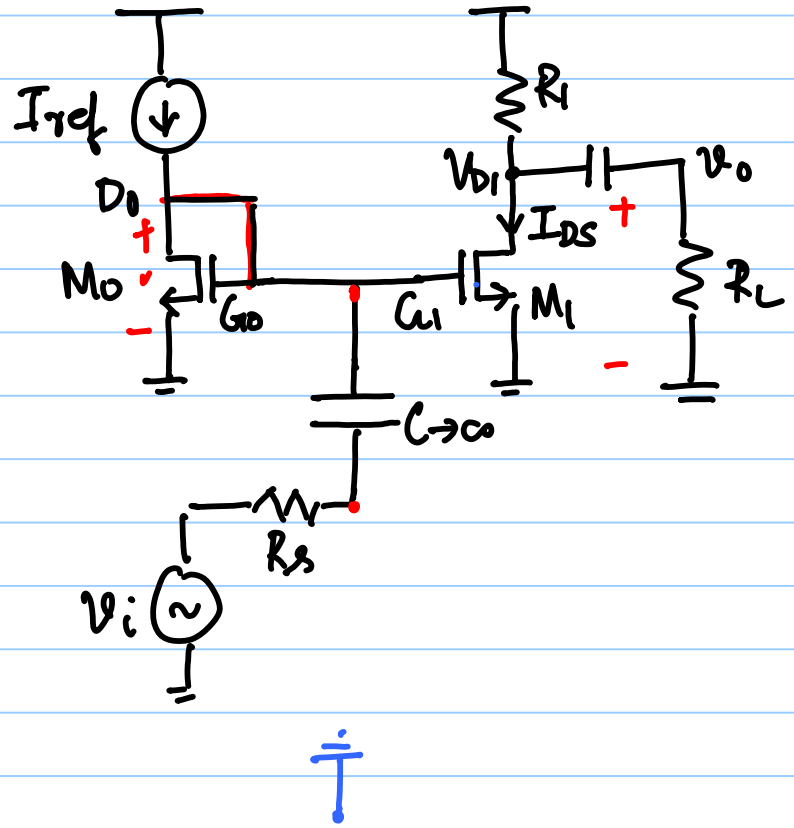
Ans. Copying

$$I_{DS} = I_{ref} = \frac{\mu_n C_{ox}}{2}\left(\frac{W}{L}\right)_1 (V_{in} - 0 - V_{tn})^2$$

$$\left(\frac{W}{L}\right)_0 = \left(\frac{W}{L}\right)_1$$





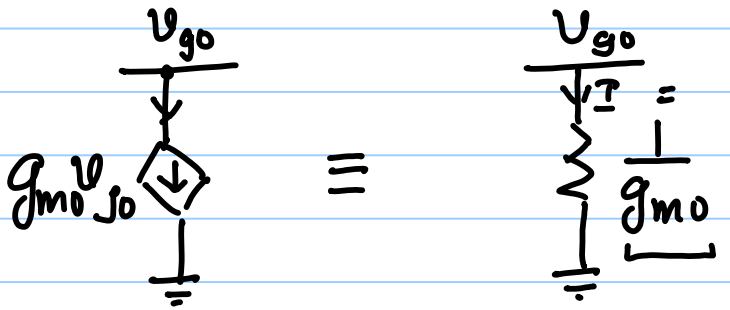


$V_{D0} = V_{GS0} = V_{GS1}$

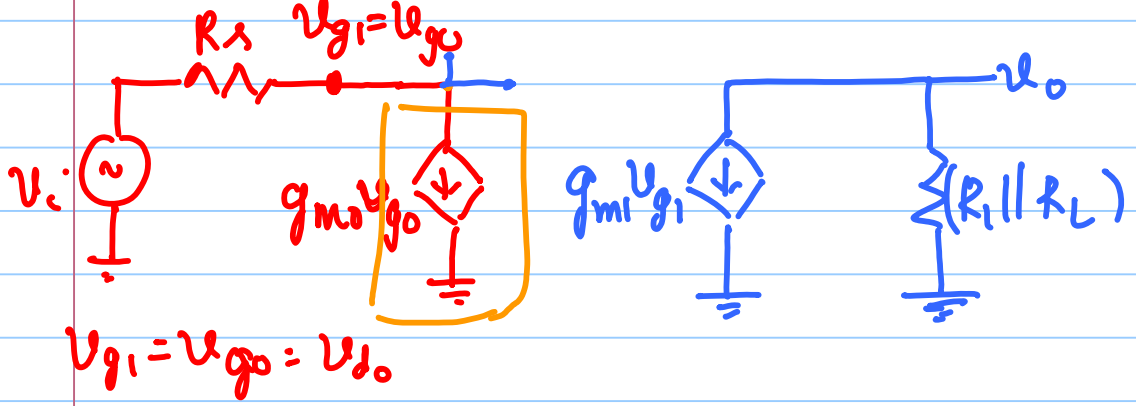
$I_{DS} = I_{ref}$

$I_{DS} = \frac{\mu_n C_{ox}}{2}\left(\frac{W}{L}\right)_1 (V_{GS} - V_{th})^2 \cancel{(1+\lambda V_{DS})}$

$= I_{ref}$

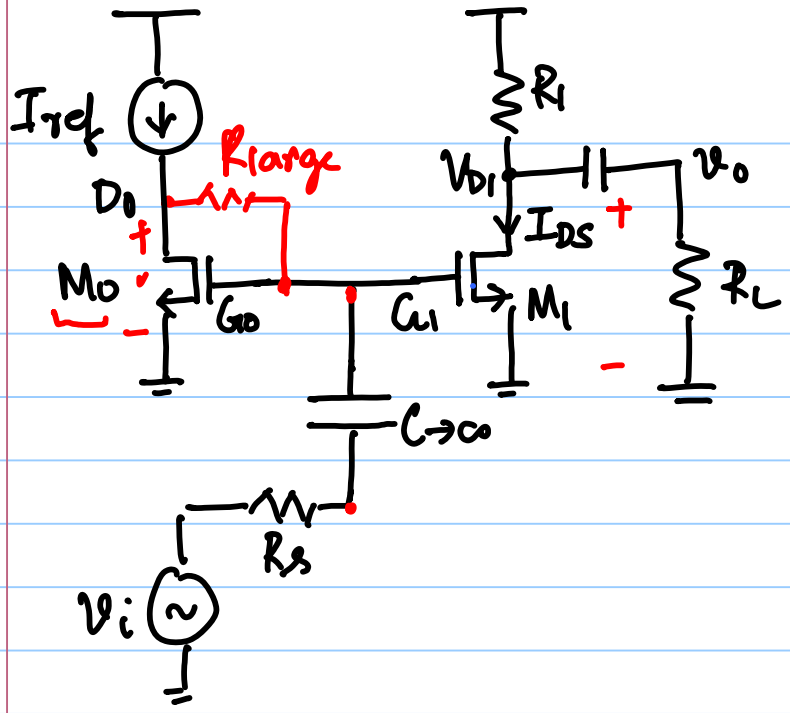


$\frac{v_{go}}{1/g_{mo}} = g_{mo}v_{go}$



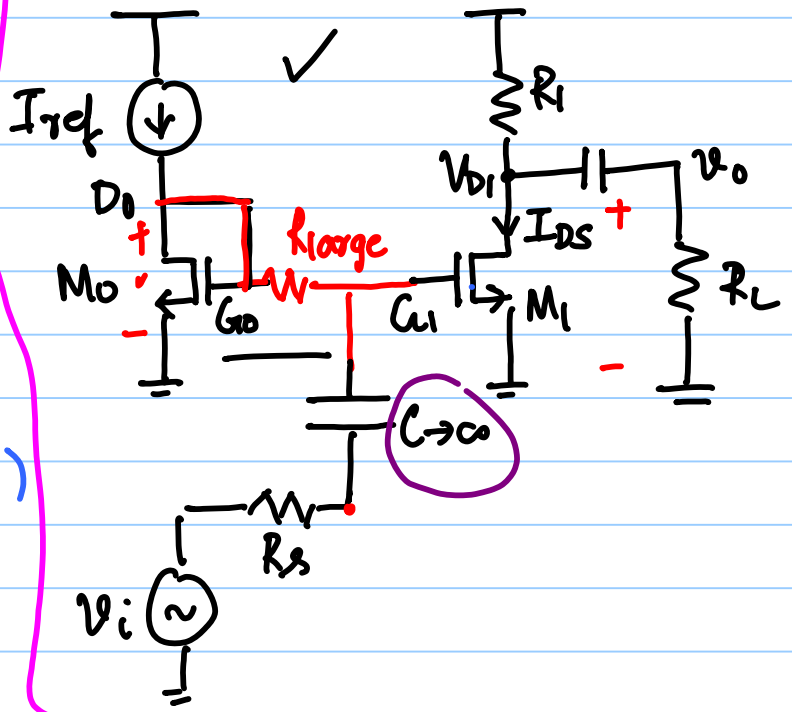
$v_{g0} = v_{g1} = \frac{1/g_{mo}}{\frac{1}{g_{mo}} + R_s} v_i = \frac{1}{1+g_{mo}R_s} v_i$

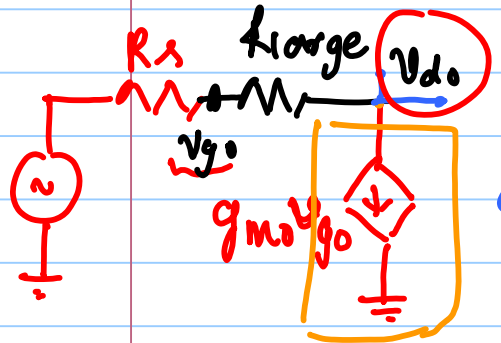
$v_o = -g_{m1} \times \frac{v_i}{1+g_{mo}R_s} \times (R_1 \| R_L)$

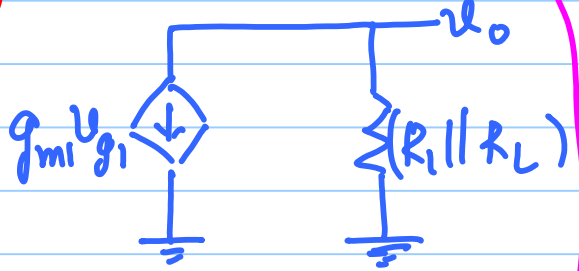


$$\frac{v_o}{v_i} = \frac{-g_{m1}(R_1 \| R_L)}{1 + g_{m0} R_s}$$

$$= -\frac{g_m (R_1 \| R_L)}{1 + g_m R_s}$$

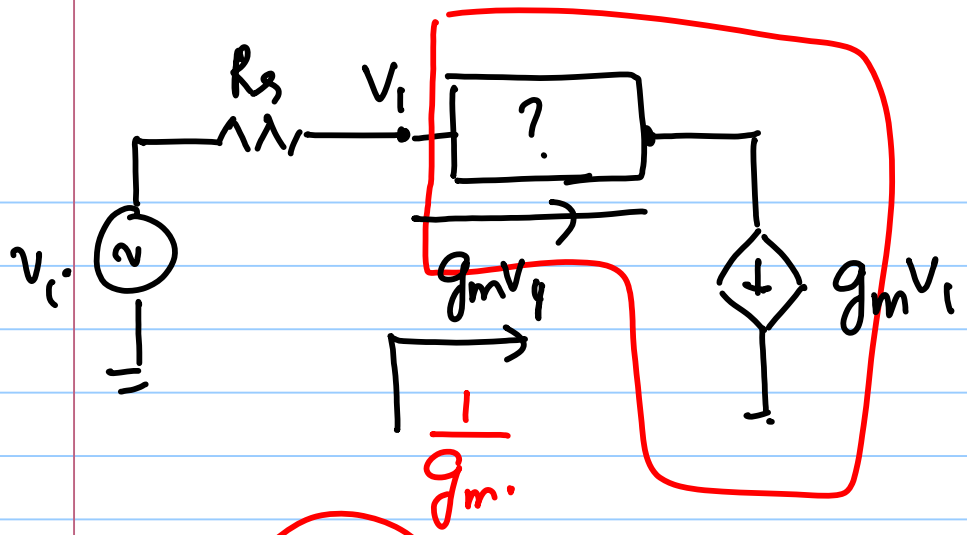


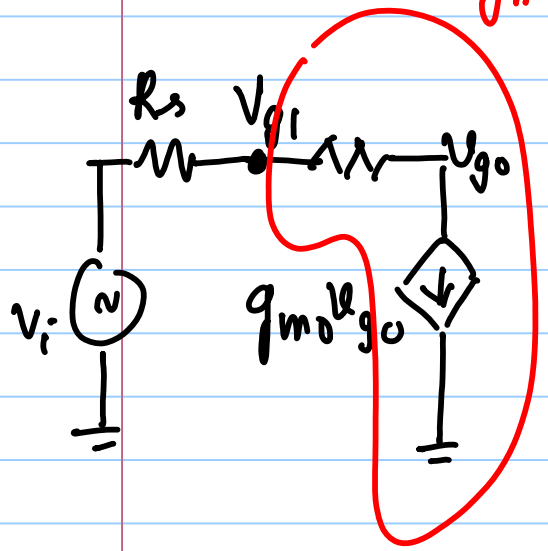


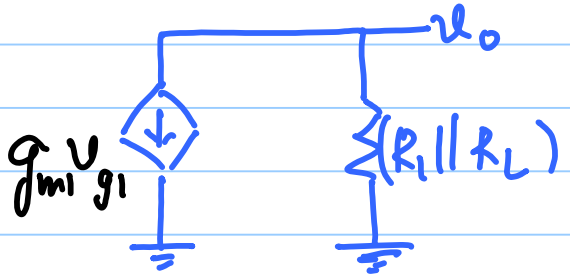


$V_{g1} = V_{go} = V_{do}$

$$\frac{v_i - v_{go}}{R_s} = g_{m0} v_{go} \Rightarrow \boxed{v_{go} = \frac{1}{1 + g_{m0} R_s} v_i}$$







$$v_o = -g_{m1}(R_1 \| R_L) v_{g1}$$

$$\frac{v_o}{v_i} = -\frac{g_{m1}(R_1 \| R_L)\, g_{mo}(R_{large} + R_s)}{1 + g_{mo}(R_{large} + R_s)}$$

$$v_{g1} = \frac{\frac{1}{g_{mo}} + R_{large}}{\frac{1}{g_{mo}} + R_{large} + R_s} v_i = \frac{1 + g_{mo} R_{large}}{\underbrace{1 + g_{mo}(R_{large} + R_s)}_{\approx 1}} v_i$$

$$\approx v_i$$