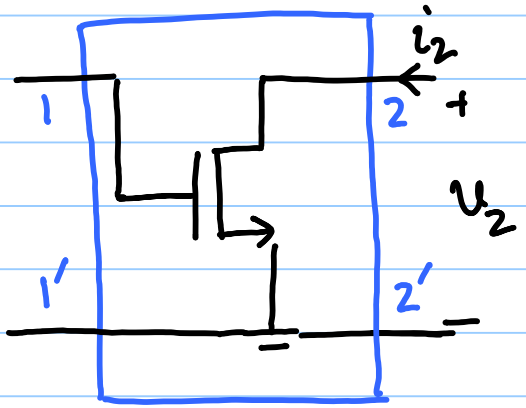
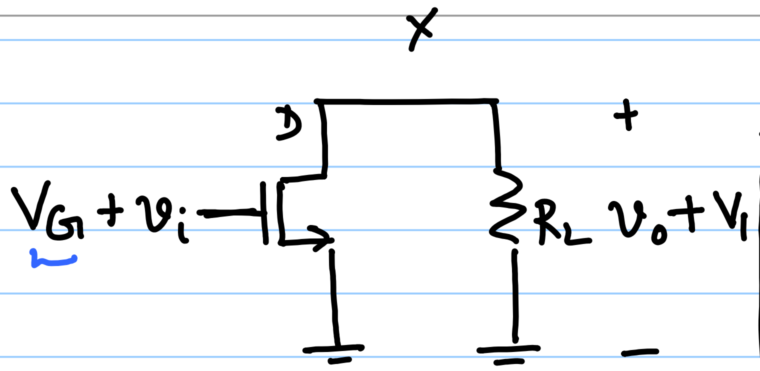
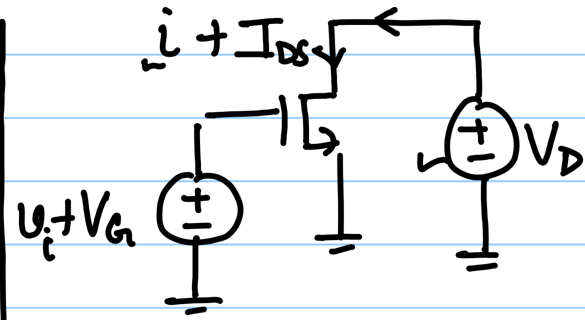
Lecture # 09

Note Title 19-08-2021

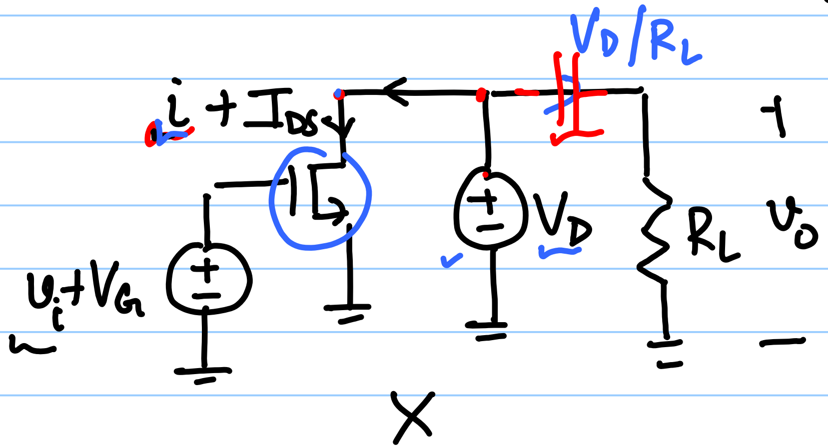




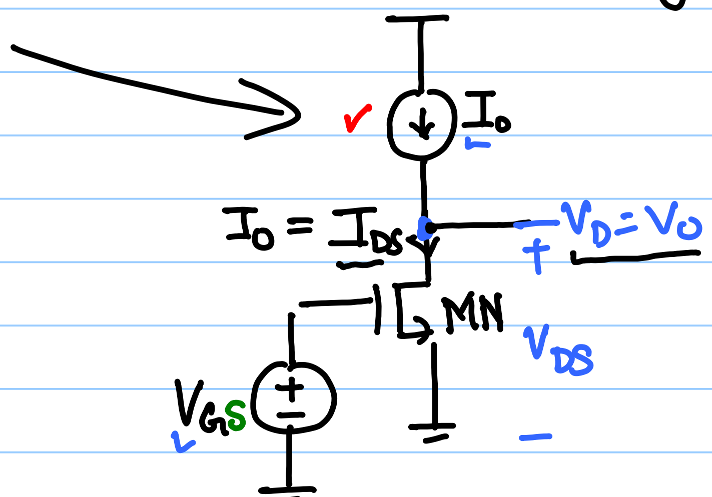


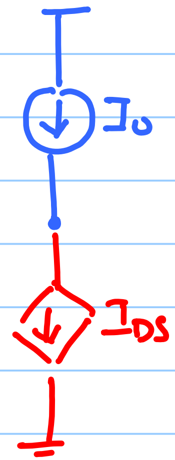
$\frac{v_o}{v_i} =$

$I_{DS} = \frac{\mu_n C_{ox}}{2} \frac{W}{L} (V_{GS} - V_{th})^2$



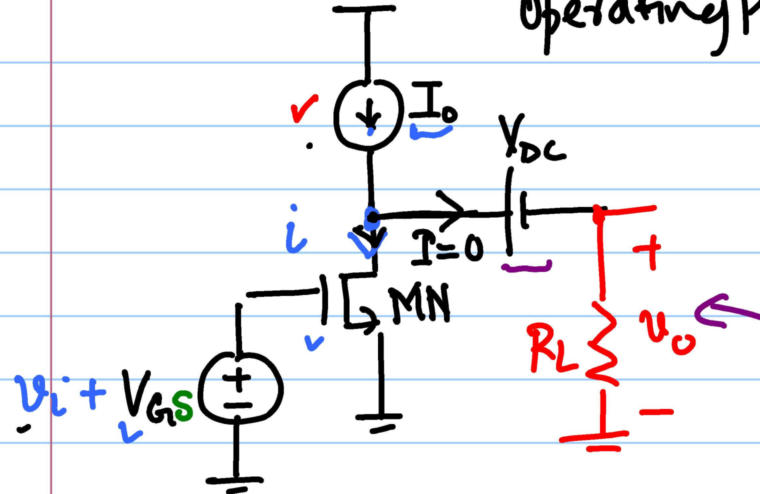
$i = y_{21} v_i$



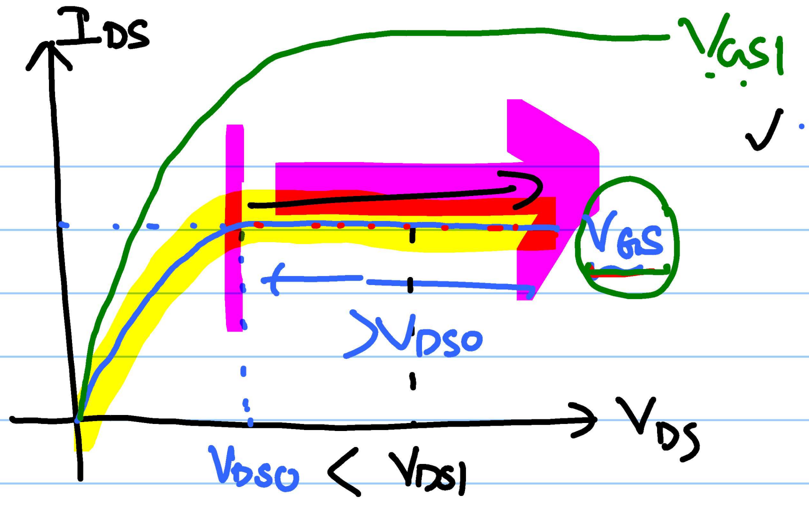


- Bias MN in saturation region
- Don't fix drain voltage to ideal voltage source

"Operating Point"

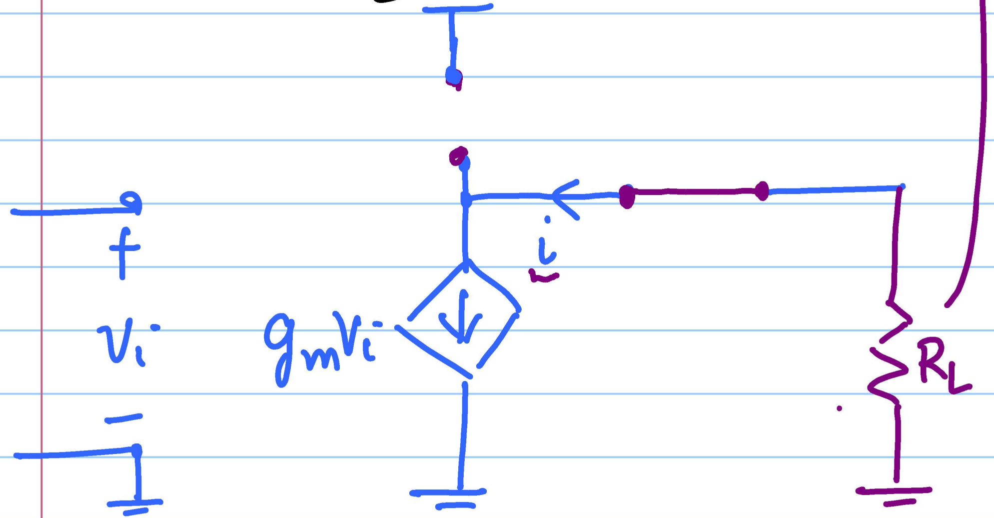


$I_{DS} = I_o$



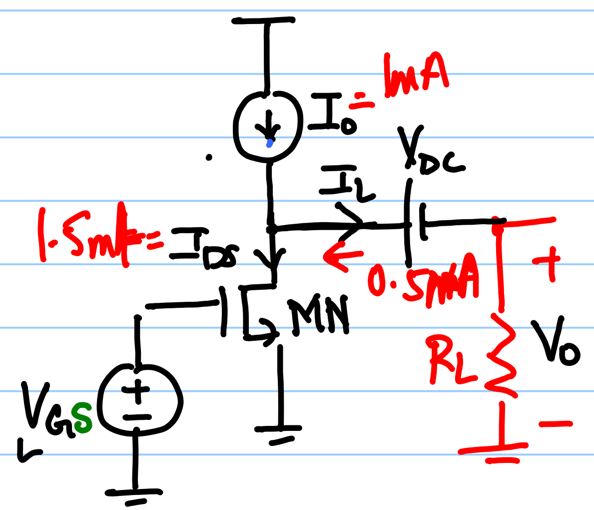
$V_{DC} > V_{GS} - V_{tn}$

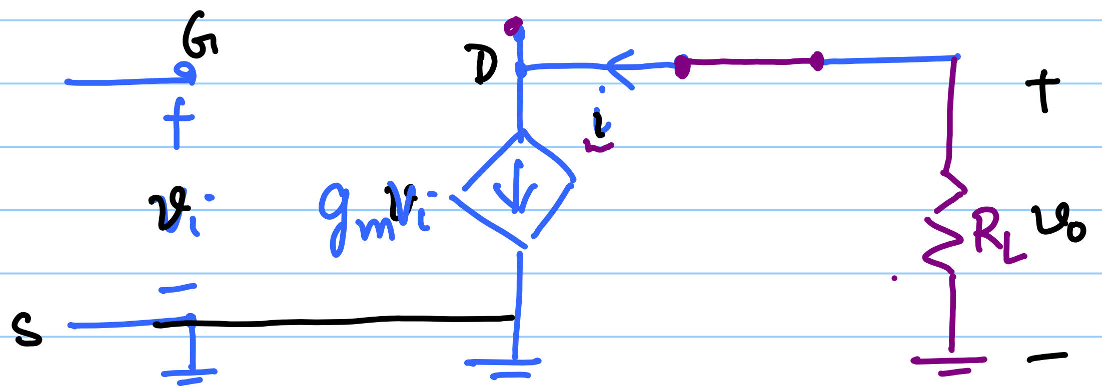
$$I_o = \frac{\mu_n C_{ox}}{2} \frac{W}{L} (V_{GS} - V_{tn})^2$$



Ideal current → open ckt

Ideal voltage → short ckt





$$I_{DS} = I_o = \frac{\mu_n C_{ox}}{2} \frac{W}{L} (V_{GS} - V_{tn})^2$$

$I_L = 0$

$V_o = I_L \cdot R_L = 0V$

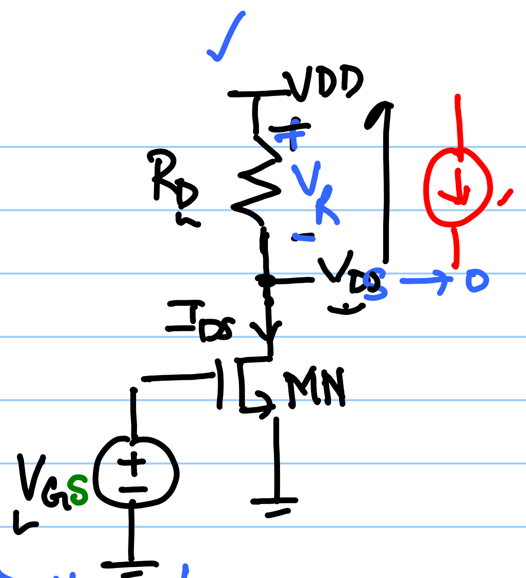
$V_{DC} > V_{GS} - V_{th}$

$i = g_m v_i$

$v_o = -i \cdot R_L = -g_m v_i R_L$

$$\frac{v_o}{v_i} = -g_m R_L$$

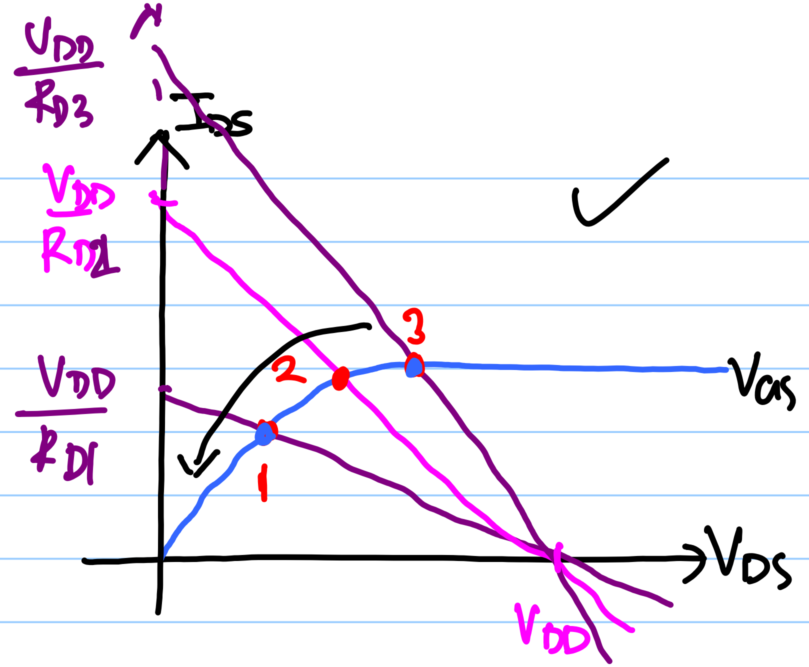
Assumption: MOSFET remains in saturation.



$V_{DS} > V_{GS} - V_{th}$

$$\begin{cases} V_{DS} = V_{DD} - I_{DS} \cdot R_D \\ I_{DS} = \frac{\mu_n C_{ox}}{2} \frac{W}{L} (V_{GS} - V_{tn})^2 \end{cases}$$

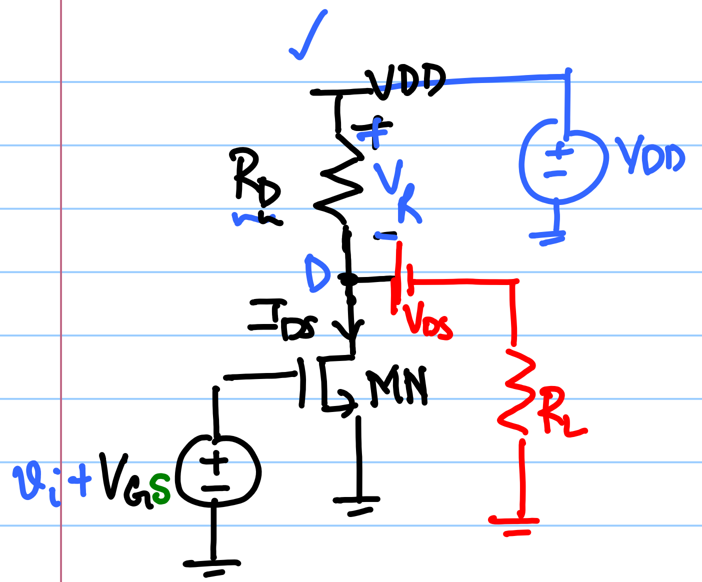
$$I_{DS} = \frac{V_{DD} - V_{DS}}{R_D}$$

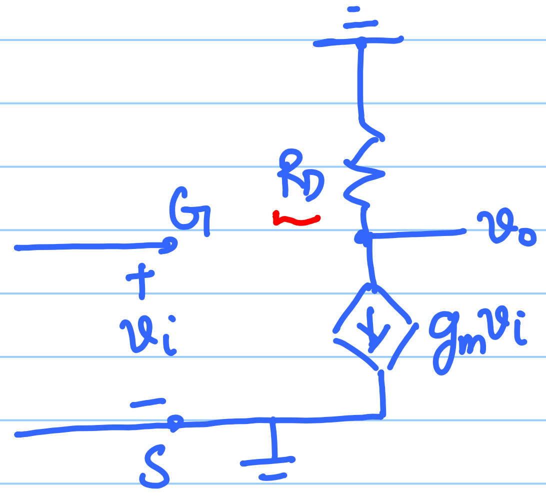


$R_{D1} > R_{D2} > R_{D3}$

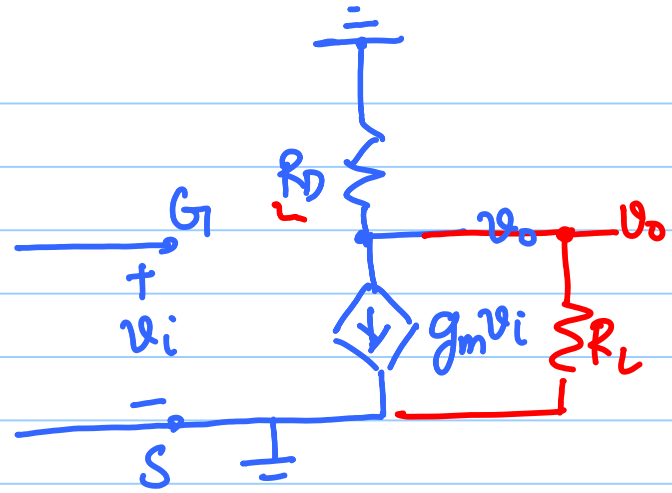
- Choose R_D such that transistor is saturation region.

v_i : ac/dc





$$\frac{v_o}{v_i} = -g_m R_D$$

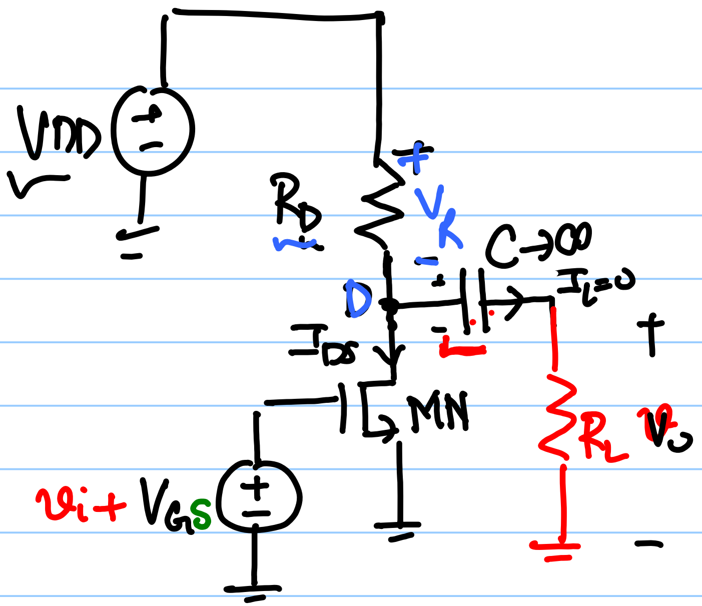


$$\frac{v_o}{v_i} = -g_m (R_D \| R_L)$$

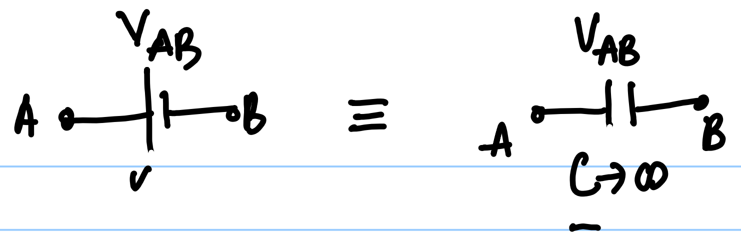
$(R_D \| R_L) < R_L$

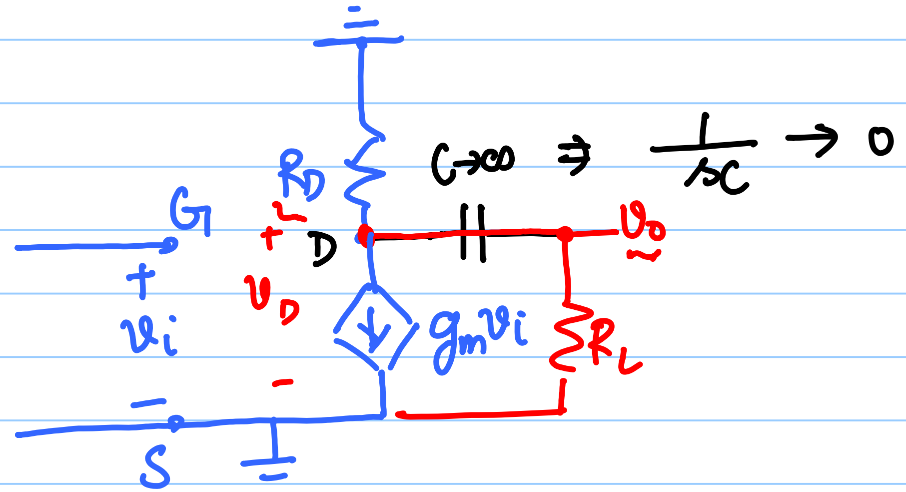
Ideal Current Source is replaced w/ R_D

- Watch for region of operation
- Gain drops.



vi is ac.





$$\frac{v_o}{v_i} = -g_m (R_D \| R_L)$$