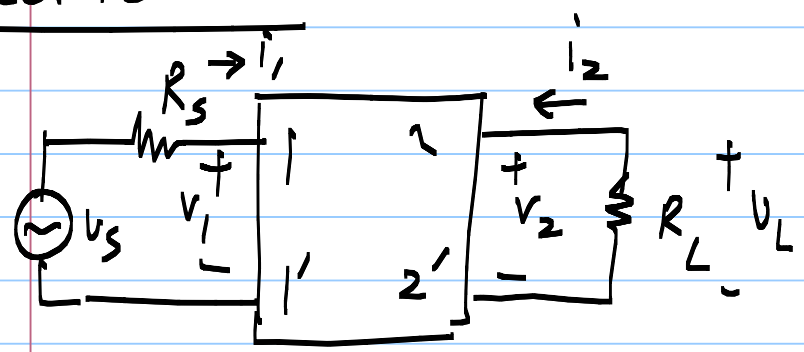
Lecture 2



$y_{11}, y_{22} \rightarrow 0$

y_{21} : as large as possible

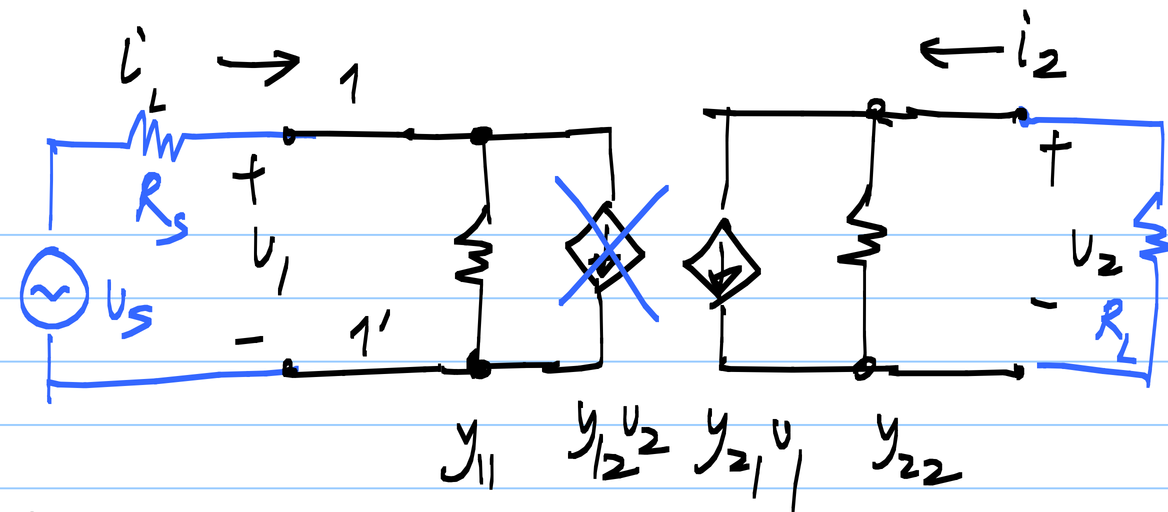
$$\frac{v_L}{v_s} = \frac{-y_{21} G_s}{(y_{11}+G_s)(y_{22}+G_L) - y_{12}y_{21}}$$

$y_{11}, y_{22}, y_{12} = 0$ Zero

$$-\frac{y_{21}}{G_L}$$

$i_1 = y_{11} v_1 + y_{12} v_2$

$i_2 = y_{21} v_1 + y_{22} v_2$



$y_{12} = 0$: unilateral

Large signal characteristics:

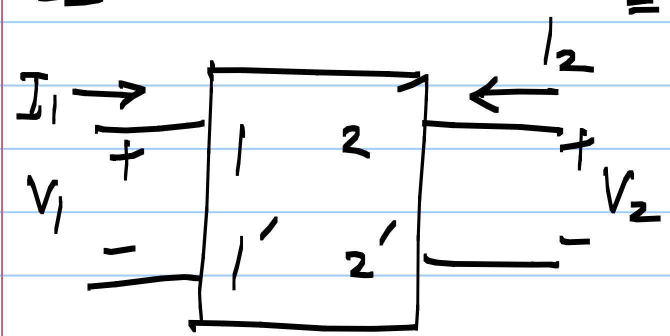
$y_{11} = 0$

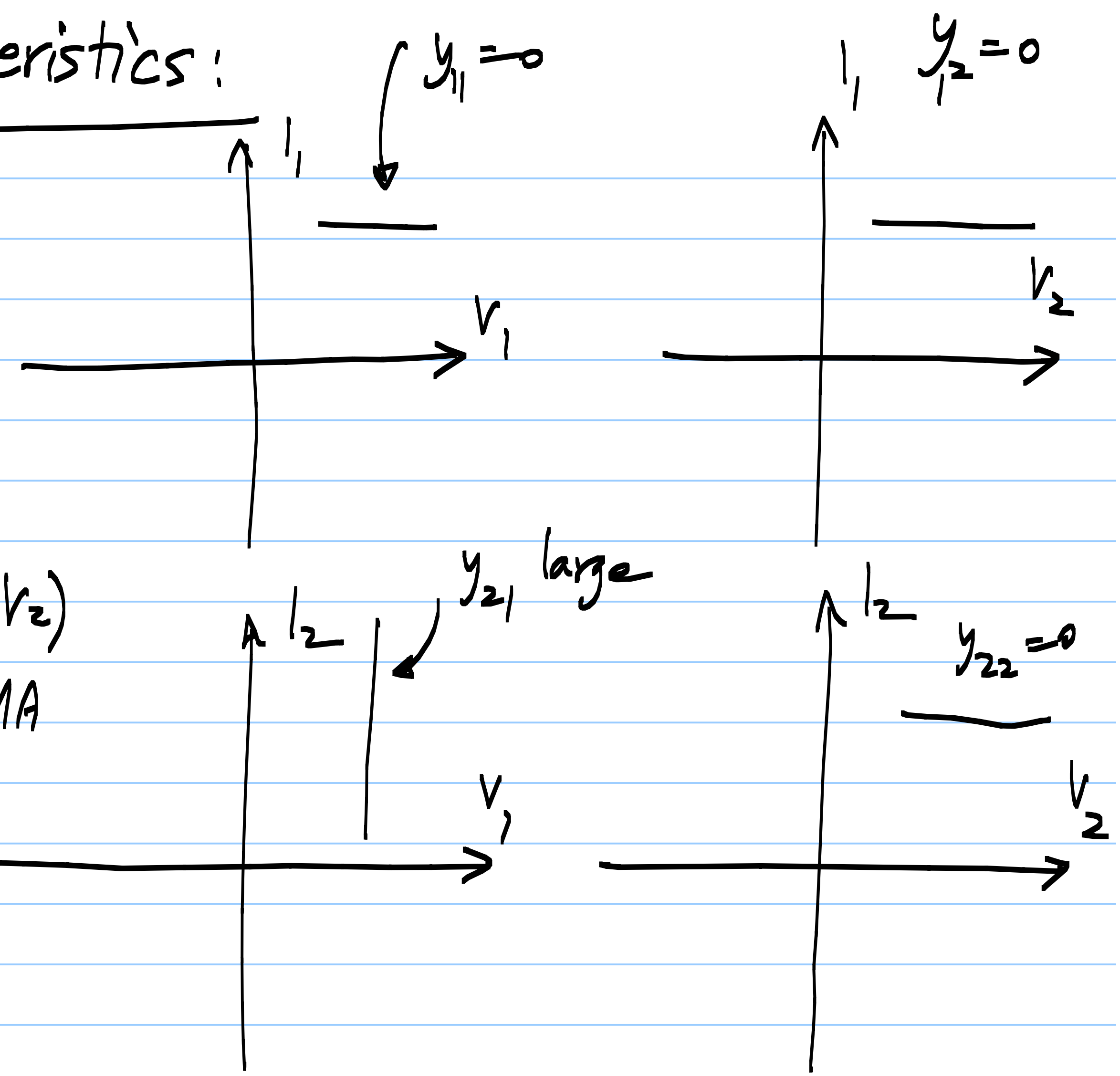
$y_{12} = 0$

y_{21}: large

$y_{22} = 0$

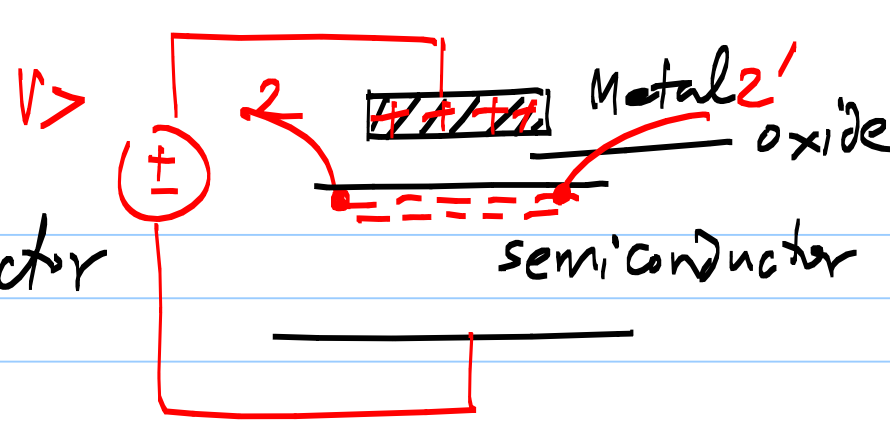
$I_1 = f_1(V_1, V_2) = 1A$

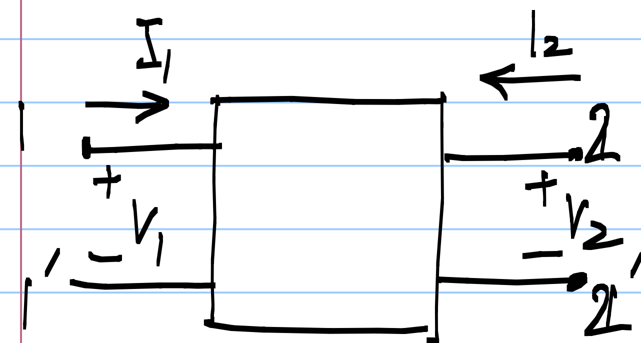


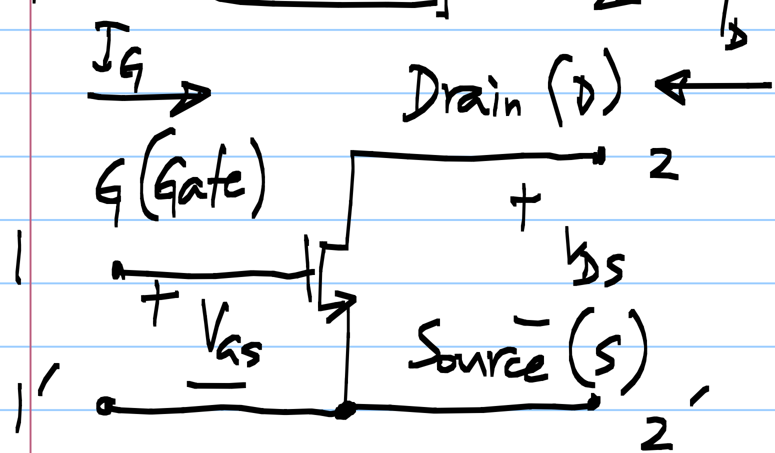


MOS Field-effect transistor

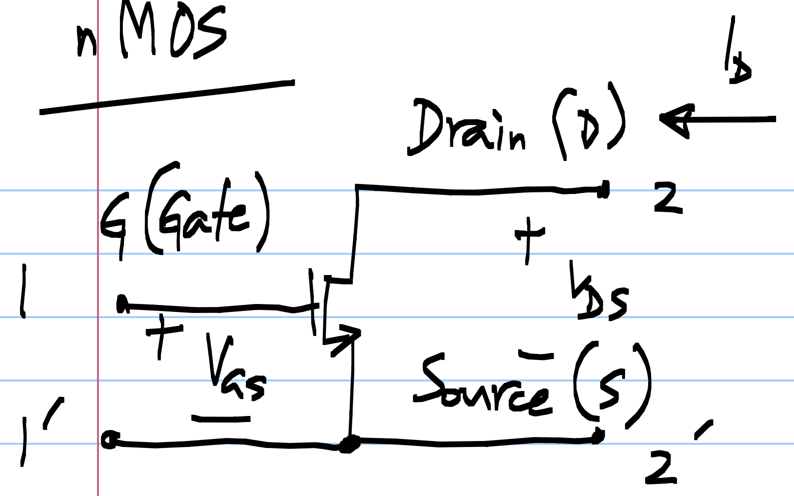
Metal-Oxide-Semiconductor







nMOS



μ_n : mobility of carriers

C_{ox} : Oxide capacitance F/m^2

W : width

L : Length

$\left[\mu_n C_{ox} \frac{W}{L}\right] : k_n$

$I_G = f(V_{GS}, V_{DS}) = 0$

Threshold voltage

$$I_D = \begin{cases} 0 & V_{GS} < V_T \\ \left[\mu_n C_{ox} \frac{W}{L}\right]\left((V_{GS} - V_T) V_{DS} - \frac{V_{DS}^2}{2}\right) & V_{GS} > V_T,\ V_{DS} < V_{GS} - V_T \\ \mu_n C_{ox} \frac{W}{2L} (V_{GS} - V_T)^2 & V_{GS} > V_T,\ V_{DS} > V_{GS} - V_T \end{cases}$$

$I_D = 0 \qquad V_{GS} < V_T \qquad$ cutoff

$\mu_n C_{ox} \frac{W}{L} \cdot \left((V_{GS} - V_T) V_{DS} - V_{DS}^2/2 \right)$ Triode region / linear region

$\mu_n C_{ox} \frac{W}{2L} (V_{GS} - V_T)^2$ Saturation region

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$K_n = \mu_n C_{ox} \frac{W}{L} : 200 \mu A / V^2$

$V_T = 0.5V$

I_D vs V_{GS}

$V_{GS} : 0 - 3V$, $V_{DS} = 3V$

Sketch I_D vs V_{DS}

for $V_G = 0, 1, 2V$

$V_{DS} : 0 - 3V$