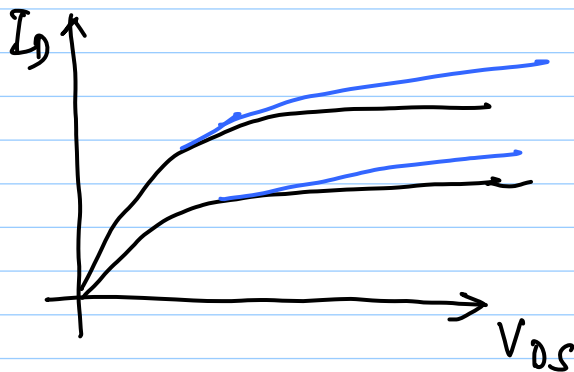


22-8-12

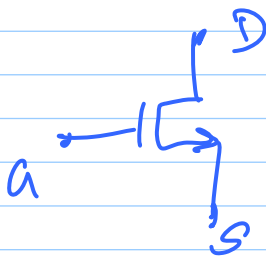
Lec 12

The real MOSFET



In sat.,

$$I_D = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T)^2$$



$$I_D = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T)^2 \underbrace{(1 + \lambda V_{DS})}_{\ll 1}$$

2-port parameters

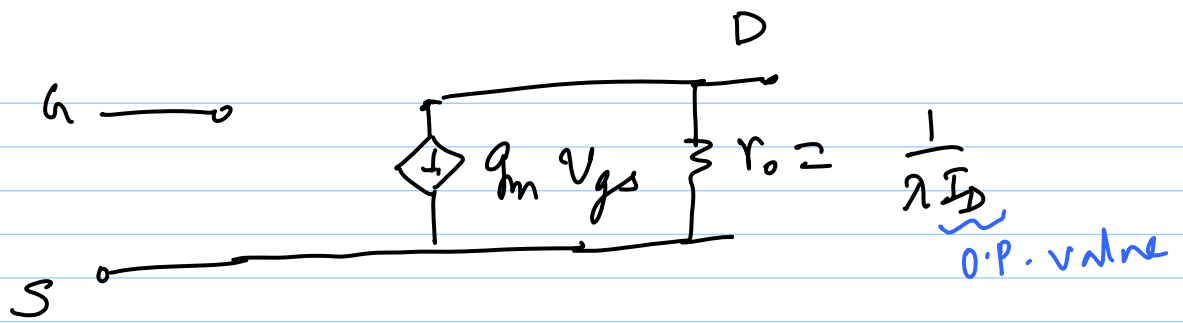
$$Y_{11} = 0 ; Y_{12} = 0$$

$$Y_{21} = g_m = \frac{\partial I_D}{\partial V_{GS}} = \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T) (1 + \lambda V_{DS})$$

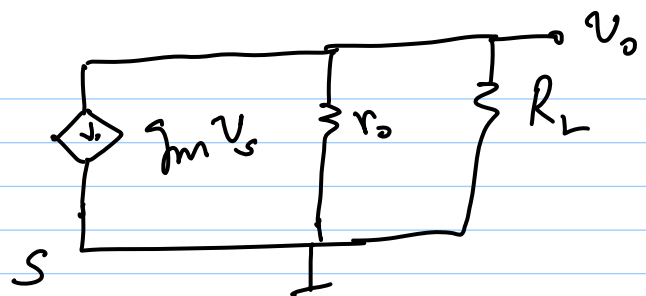
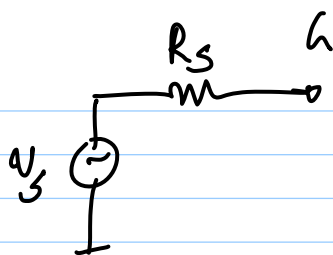
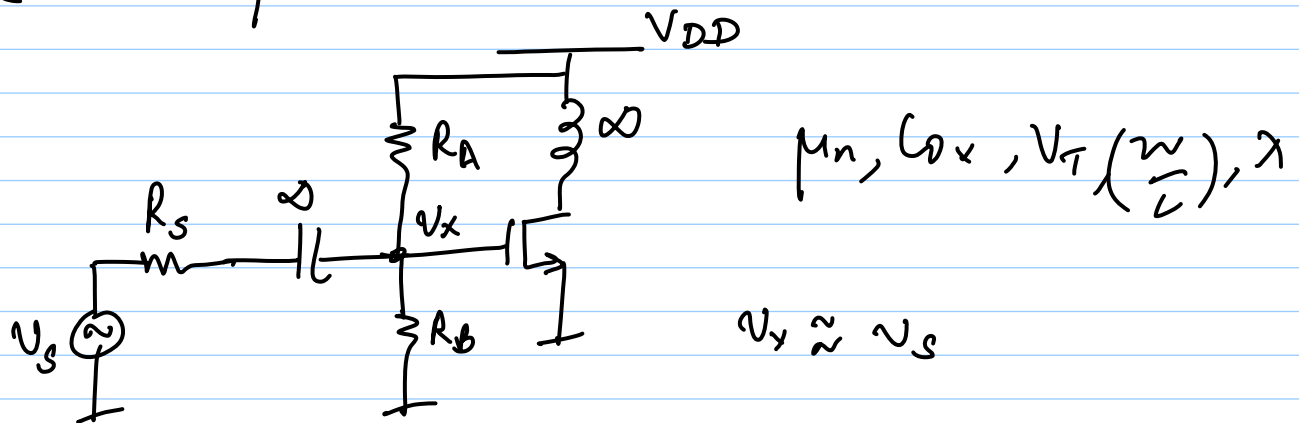
$$\approx \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T)$$

$$Y_{22} = \frac{\partial I_D}{\partial V_{DS}} = \underbrace{\frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L} \right) (V_{GS} - V_T)^2}_{\approx I_D} \cdot \lambda$$

$Y_{22} \approx \lambda I_D \leftarrow$ output conductance of the MOSFET (due to channel length modulation)



C.S. amp :



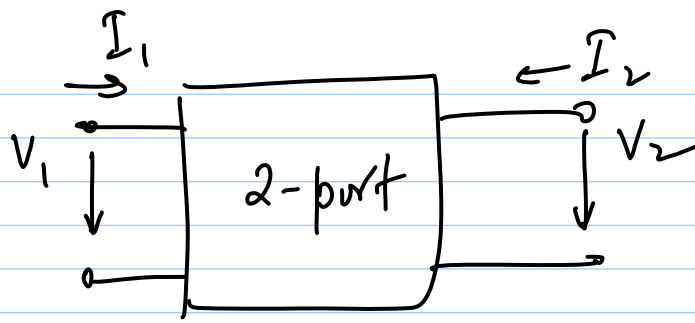
$$\frac{v_o}{v_s} = -g_m (r_o \parallel R_L) \leftarrow$$

max. of largest possible gain $\} = g_m r_o$ (intrinsic gain of MOSFET)

MOSFET in sat-

$\rightarrow$ incr. V_{CCS}

$\rightarrow$ v_{DS} dependence (non-ideal V_{CCS})



$$\begin{bmatrix} Y_{11} & Y_{12} \\ Y_{21} & Y_{22} \end{bmatrix}$$