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lec 4

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

1) no dep. on G_S

$\Rightarrow y_{11} = 0$

2) $y_{12} = 0 \Rightarrow$ "unilateral" network

3) Max. gain $\Rightarrow y_{22} = 0$

$$\frac{v_L}{v_S} = \frac{-y_{21}}{G_L} \qquad \begin{bmatrix} 0 & 0 \\ y_{21} & 0 \end{bmatrix}$$

$I_1 = f_1(V_1, V_2)$

$I_2 = f_2(V_1, V_2)$

$$i_1 = \frac{\partial f_1}{\partial v_1}\cdot v_1 + \frac{\partial f_1}{\partial v_2}\cdot v_2$$

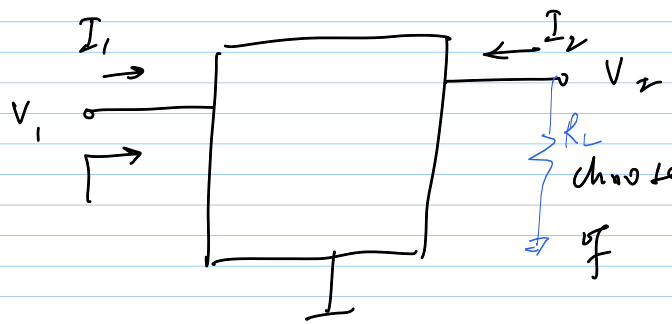
$y_{11} = 0 \Rightarrow \frac{\partial f_1}{\partial v_1} = 0$

$y_{12} = 0 \Rightarrow \frac{\partial f_1}{\partial v_2} = 0$

} $I_1 =$ constant

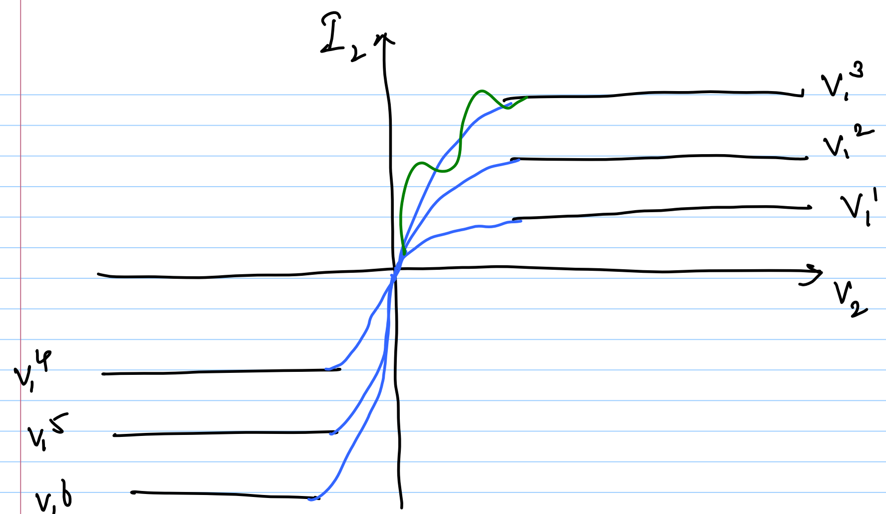
$y_{22} = 0 \Rightarrow \frac{\partial f_2}{\partial v_2} = 0$ $\quad I_2$ is indep. of V_2

$y_{21} =$ large ; $y_{21} = \frac{\partial f_2}{\partial v_1}$ "transconductance") $I_2 = f_2(V_1)$



choose special case

of $I_1 = 0$

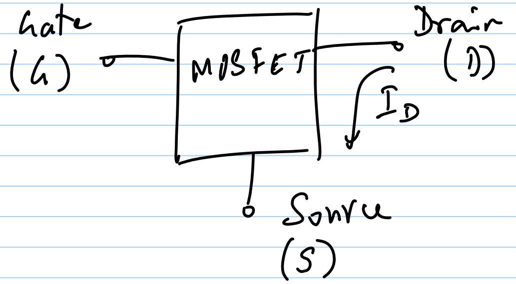


"Output Characteristics"

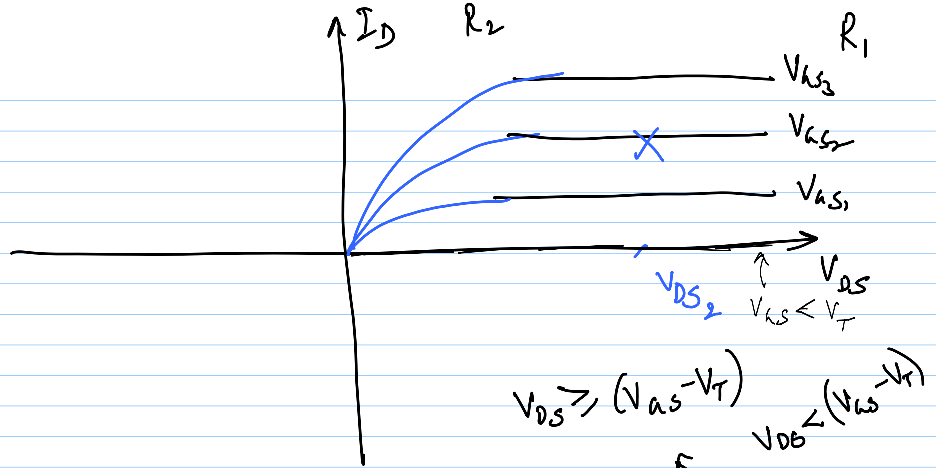
Passivity $V_1 I_1 + V_2 I_2 \geq 0 \rightarrow$ 1st & 3rd quadrants only

* MOSFET $\Rightarrow I_1 = 0$
* BJT, JFET $\Rightarrow I_1 = \text{small}$

MOSFET — Metal oxide Semiconductor field effect transistor



$I_D \neq f(V_{DS})$



$I_G = 0$

$$I_D = \frac{1}{2} \mu_n C_{ox} \left(\frac{W}{L}\right) \cdot (V_{GS} - V_T)^2 \quad \text{in } R_1$$

$$= \mu_n C_{ox} \left(\frac{W}{L}\right) \left((V_{GS} - V_T) V_{DS} - \frac{V_{DS}^2}{2}\right) \quad \text{in } R_2$$

μ_n = mobility of e^- in doped Si

C_{ox} = Oxide Capacitance (C/L^2)

W, L = dimensions of MOSFET (L)

V_{GS} = gate-source voltage (V)

V_{DS} = drain-source voltage

V_T = Threshold voltage (V)

$V_{GS} < V_T \Rightarrow I_D = 0$

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

$$A = \left(\qquad \right) \frac{F}{m^2} \cdot V^2$$

$C = Q/V \Rightarrow C/V \qquad cm^2/(Vs)$

$I = \frac{dQ}{dt} \Rightarrow C/s$

$$I_D = \begin{cases} 0, & V_{GS} \le V_T \\ \frac{1}{2}\mu_n C_{ox}\left(\frac{W}{L}\right)(V_{GS}-V_T)^2, & V_{GS} > V_T \text{ \& } V_{DS} \ge (V_{GS}-V_T) \\ \mu_n C_{ox}\left(\frac{W}{L}\right)\left[(V_{GS}-V_T)V_{DS} - \frac{V_{DS}^2}{2}\right], & V_{GS} > V_T \text{ \& } V_{DS} < (V_{GS}-V_T) \end{cases}$$

$$I_G = 0$$