EE 105 Discussion Welcome!

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Today

- Linearize a non-linear device
- Selected homework problems
- Selected S&S exercises

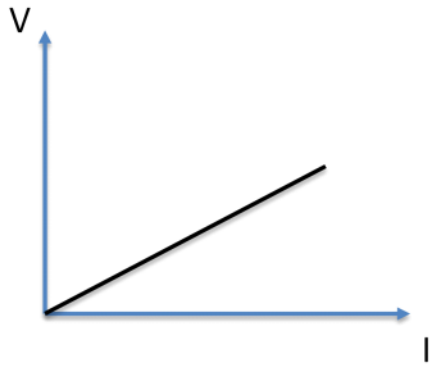
$\boxed{LTI}$

$y = f(x) = ax+b \Rightarrow a, b$ ~~const~~ $(x) = ax+b$, a, b const.

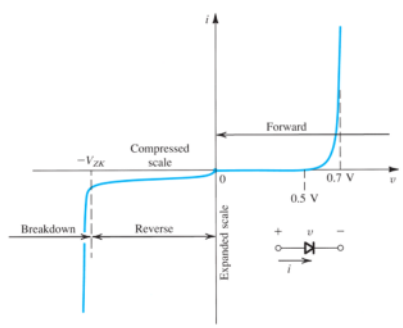
f is a linear function

Linearize a non-linear Device

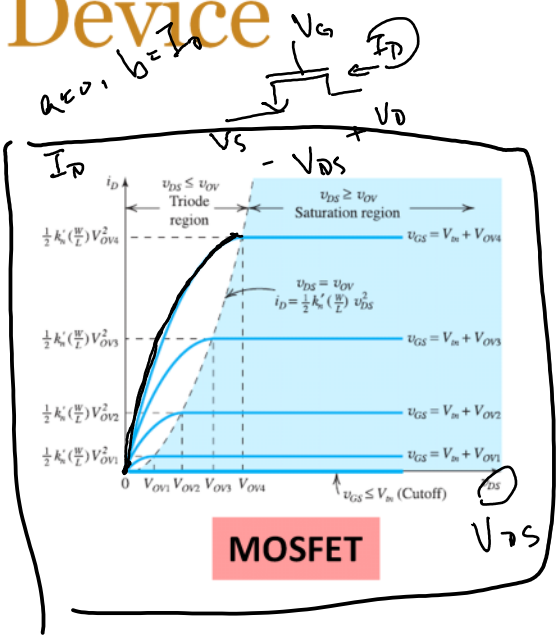
$a=0,\ b=I_D$



Resistor

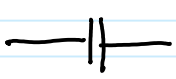


Diode

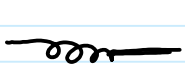


MOSFET

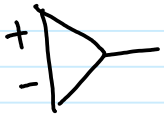
$R = \frac{V}{I}$



$sC = \frac{I}{V}$



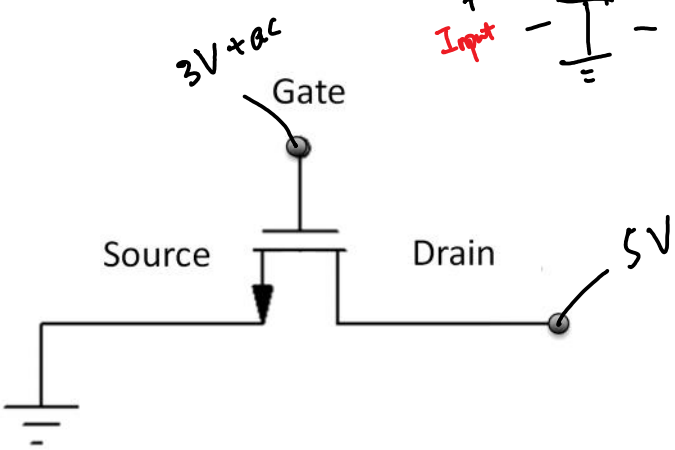
$sL = \frac{V}{I}$

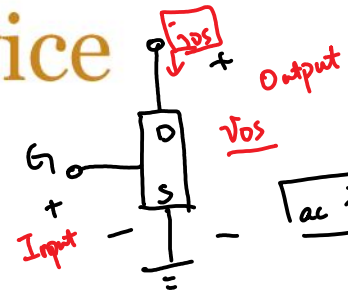


$\Rightarrow \boxed{V\text{-}C\text{-}V\text{-}S}$

2-Port Device

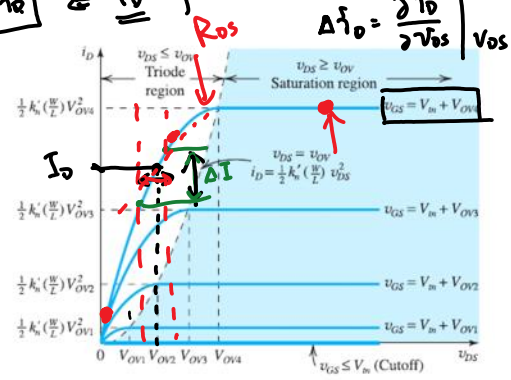
MOSFET



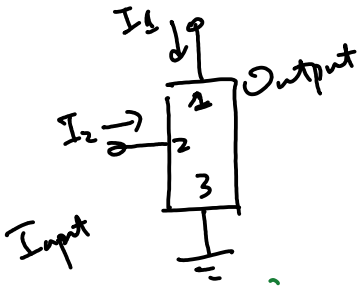


$\boxed{ac\ i_D}$ ← $i_D = f(v_{DS})$ @ V_{DS}

$\Delta i_D = \frac{\partial i_D}{\partial v_{DS}}\Big|_{V_{DS}} \Delta V_{DS}$

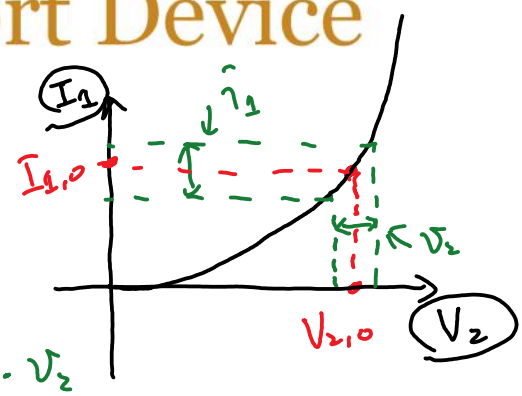


A random 2-Port Device



$V_2 = V_2 - V_3$

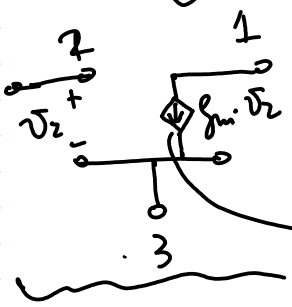
$V_1 = V_1 - V_3$

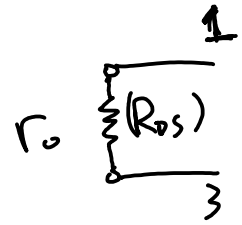


$$i_1 = f(v_2) = \underbrace{\frac{\partial I_1}{\partial V_2}\Big|_{V_{2,0}}}_{} \cdot v_2$$

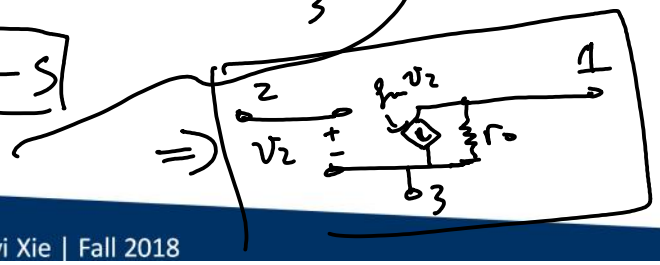
$$= \boxed{g_m} \cdot v_2$$

Trans-conductance





$\boxed{V\text{-}C\text{-}C\text{-}S}$



HW2 Q5

5. Derive an expression for the current I_L in terms of I_S, R_1, and R_2 for the circuit in Figure PS2.1. Calculate the input and output resistance of this circuit if the OpAmp is ideal.

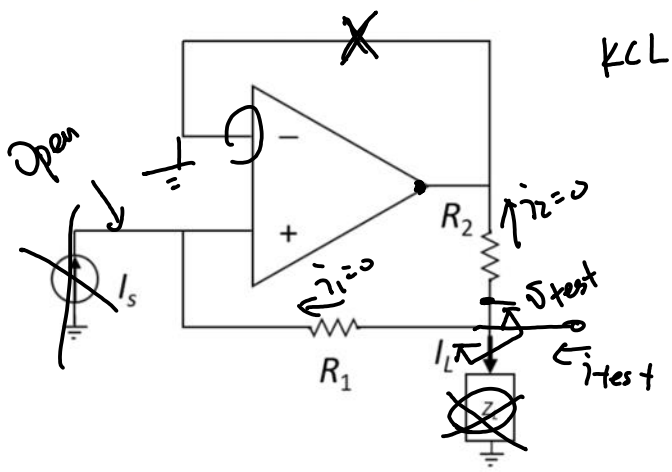
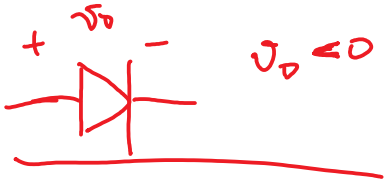


Figure PS2.1

KCL @ Output: $\boxed{i_{test} = i_1 + i_2 = 0}$

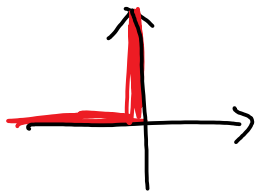
$$\Rightarrow Z_{out} = \frac{v_{test}}{i_{test}} = \frac{☺}{0} = \infty$$

$$\boxed{v^+ = v^-} \Leftarrow \boxed{N.F.}$$



S&S 4.9

Ideal Diode:



Diode

1) Assumption ↓
$\Rightarrow \# = 2^n$

2) Solve with assumptions

3) Only 1 will work.

4.9 Assuming that the diodes in the circuits of Fig. P4.9 are ideal, find the values of the labeled voltages and currents.

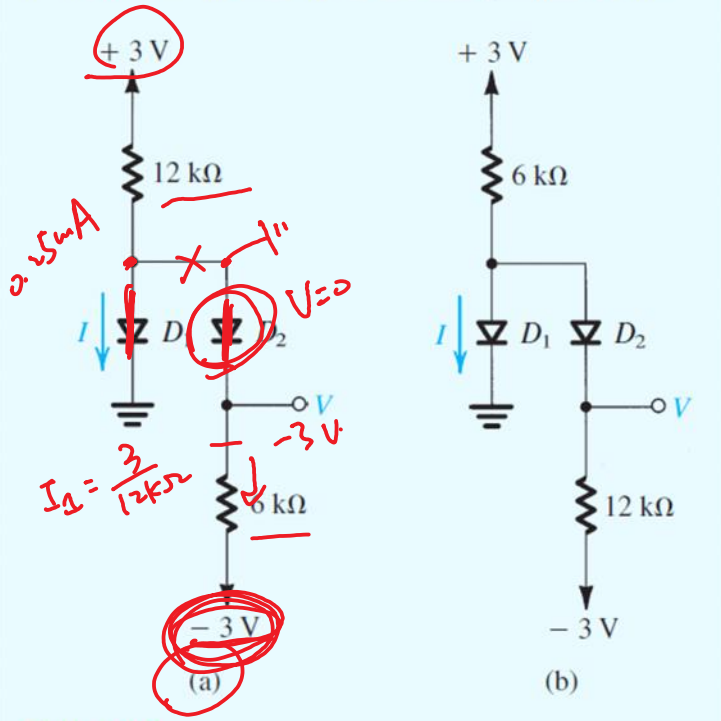


Figure P4.9