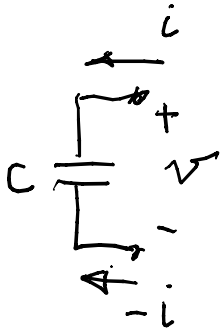


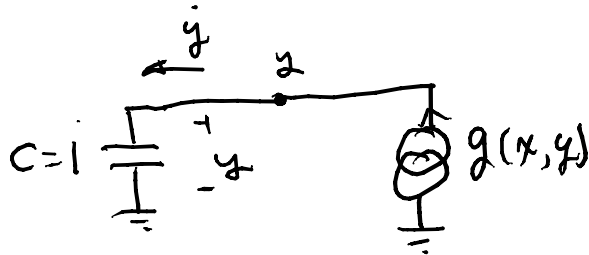
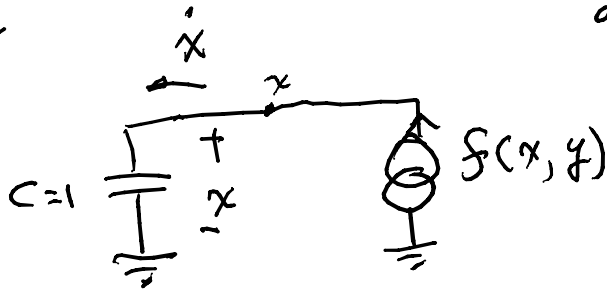
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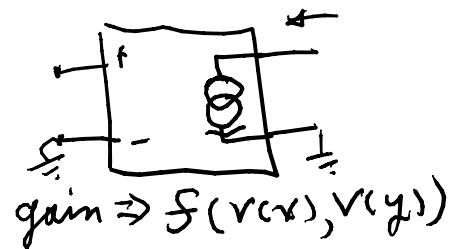
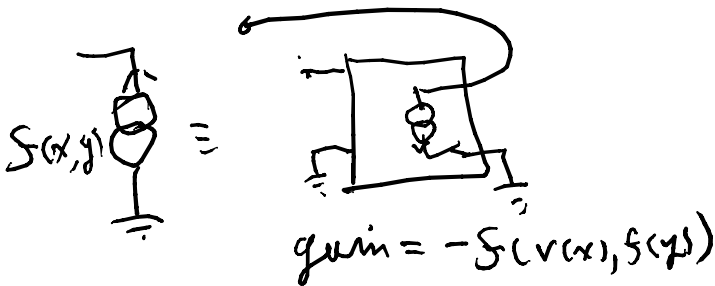
$$i = C \frac{dv}{dt}$$

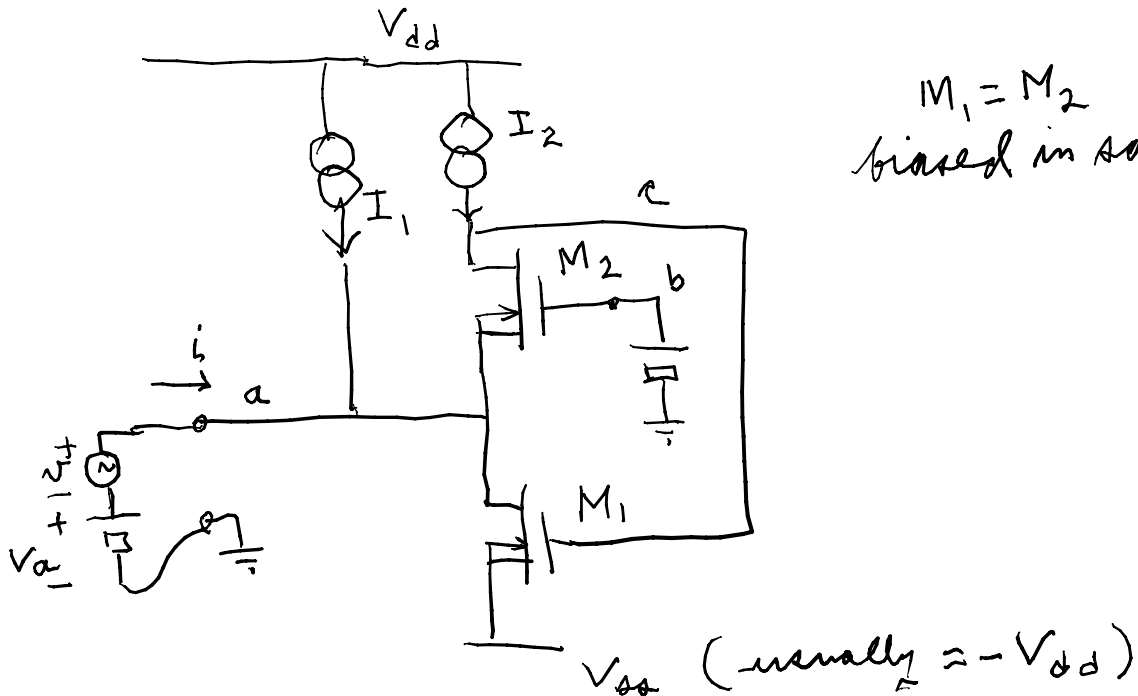
$$\dot{x} = f(x, y)$$

$$\dot{y} = g(x, y)$$



used
G value
= VCCS
where we can
write in the
function
of voltages at
the nodes



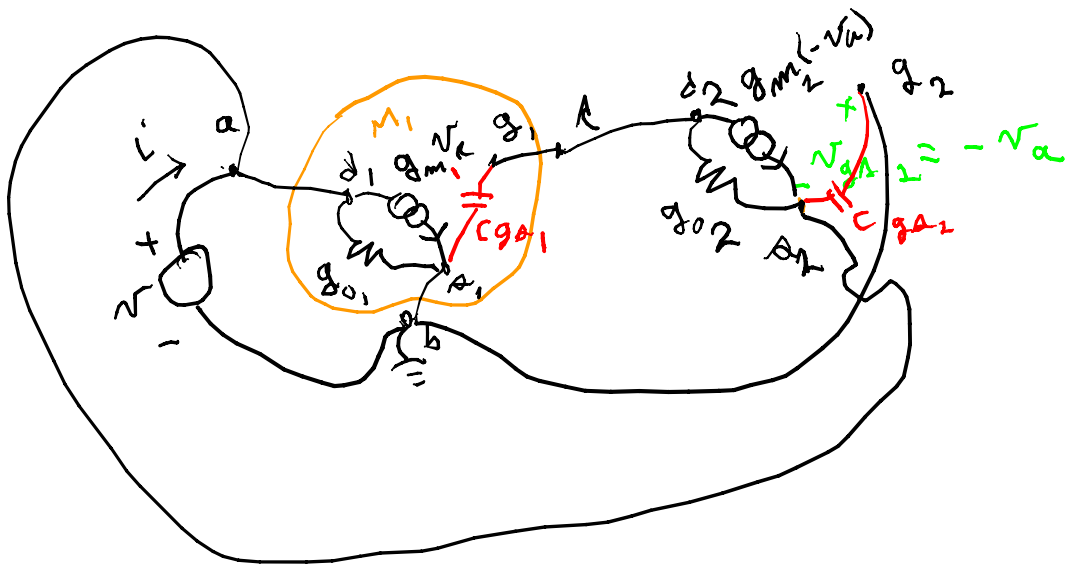
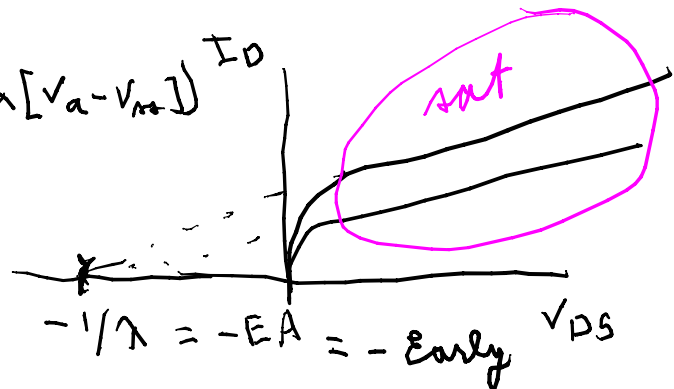


$M_1 = M_2$
biased in saturation

$$I_{D_2} = \frac{KP}{2} \cdot \frac{W}{L} (V_b - V_a - V_{TO})^2 (1 + \lambda [V_c - V_a]) = I_2$$

$$I_{D_1} = \frac{KP}{2} \cdot \frac{W}{L} (V_c - V_{SS} - V_{TO})^2 (1 + \lambda [V_a - V_{SS}])$$

$$= I_1 + I_2$$



KCL node a: $i = g_{o1}v_a + g_{m1}v_c - g_{o2}(v_c - v_a) - g_{m2}(-v_a) + 2C_{gs2}(v_a)$

KCL node c: $0 = 2C_{gs1}v_c + g_{o2}(v_c - v_a) + g_{m2}(-v_a)$

$$\begin{bmatrix} i \\ 0 \end{bmatrix} = \begin{bmatrix} g_{o1} + g_{o2} + g_{m2} + 2C_{gs2} & g_{m1} - g_{o2} \\ -g_{o2} - g_{m2} & g_{o2} + 2C_{gs1} \end{bmatrix} \begin{bmatrix} v_a = v \\ v_c \end{bmatrix}$$

$$(g_{o2} + g_{m2})v = (g_{o2} + 2C_{gs1})v_c \Rightarrow v_c = \frac{g_{o2} + g_{m2}}{2C_{gs1} + g_{o2}} \cdot v$$

$$i = \left[(g_{o1} + g_{o2} + g_{m2} + 2C_{gs2}) + \frac{(g_{m1} - g_{o2})(g_{o2} + g_{m2})}{2C_{gs1} + g_{o2}} \right] v$$

approximate: $g_{o1} \ll g_{m1}$; $C_{gs1} = C_{gs2} = C_{gs}$

$$i \approx \left[(g_{m2} + 2C_{gs}) + \frac{g_{m1}g_{m2}}{2C_{gs}(1 + \frac{g_{o2}}{2C_{gs}})} \right] v$$

looks like an inductor if can write it as

$$i = \frac{g_{m1}g_{m2}}{2C_{gs}} \cdot v \Rightarrow i = \frac{1}{Ls} v \Rightarrow L = \frac{C_{gs}}{g_{m1}g_{m2}}$$