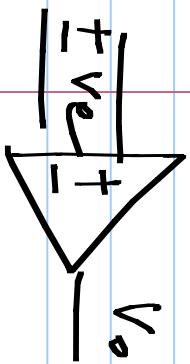


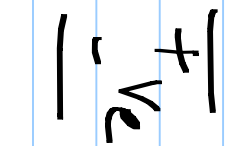
ECE 2019

# Dominant pole compensation

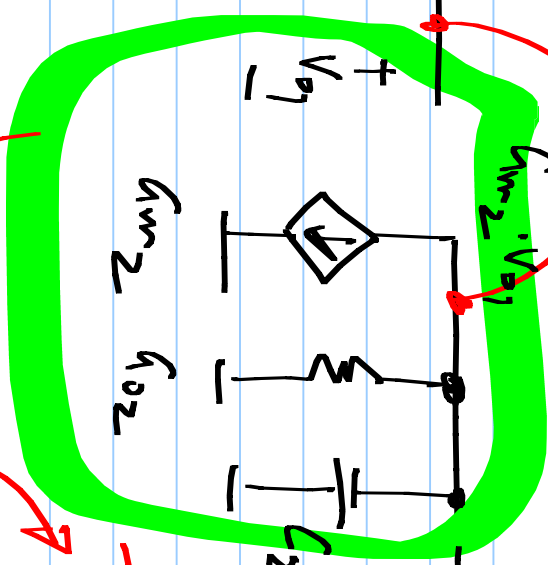
28/2/2017



$A(s)$

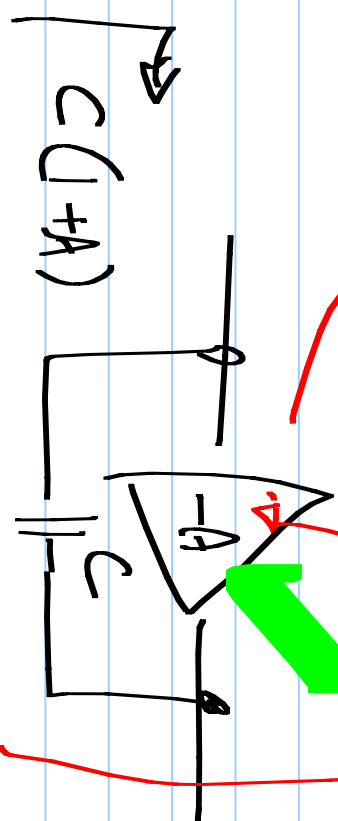
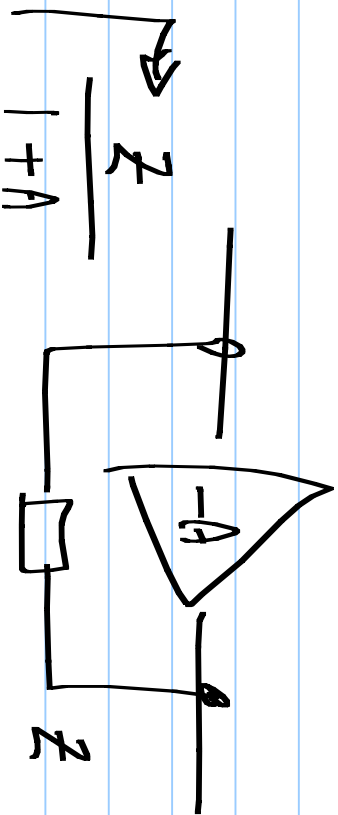


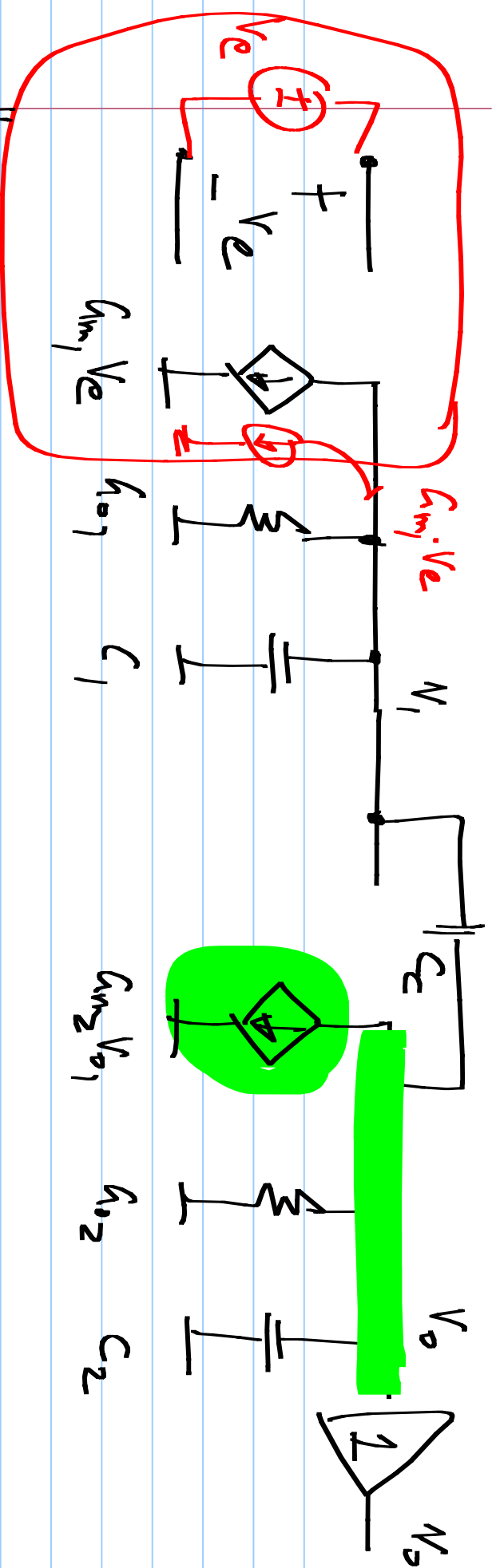
$\underbrace{g_{m1} \quad r_{o1} \quad C_1}_{\text{Pole 1}}$



$g_{m2} \cdot V_{o1}$   
-  $r_{o2}$

Miller effect





$$\begin{bmatrix} g_{o1} + s(C_1 + C_2) & -sC_2 \\ -sC_2 + g_{m2} & g_{o2} + s(C_2 + C_2) \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} -sC_2 \\ -g_{m2}V_o \end{bmatrix}$$

$2 \times 2$

$N$  nodes

$2B$  variables

$B$  branches

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$N-1$  KCL eq.

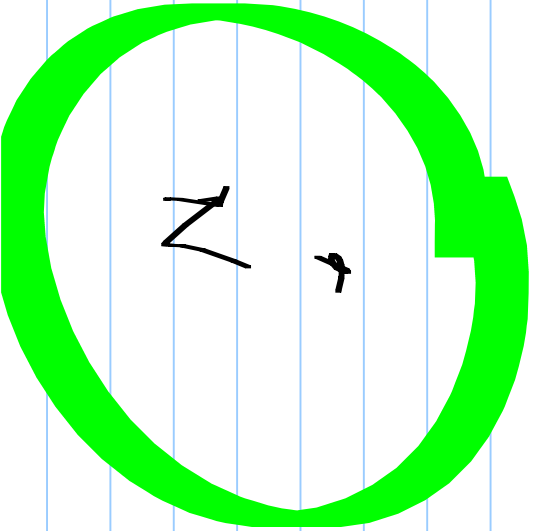
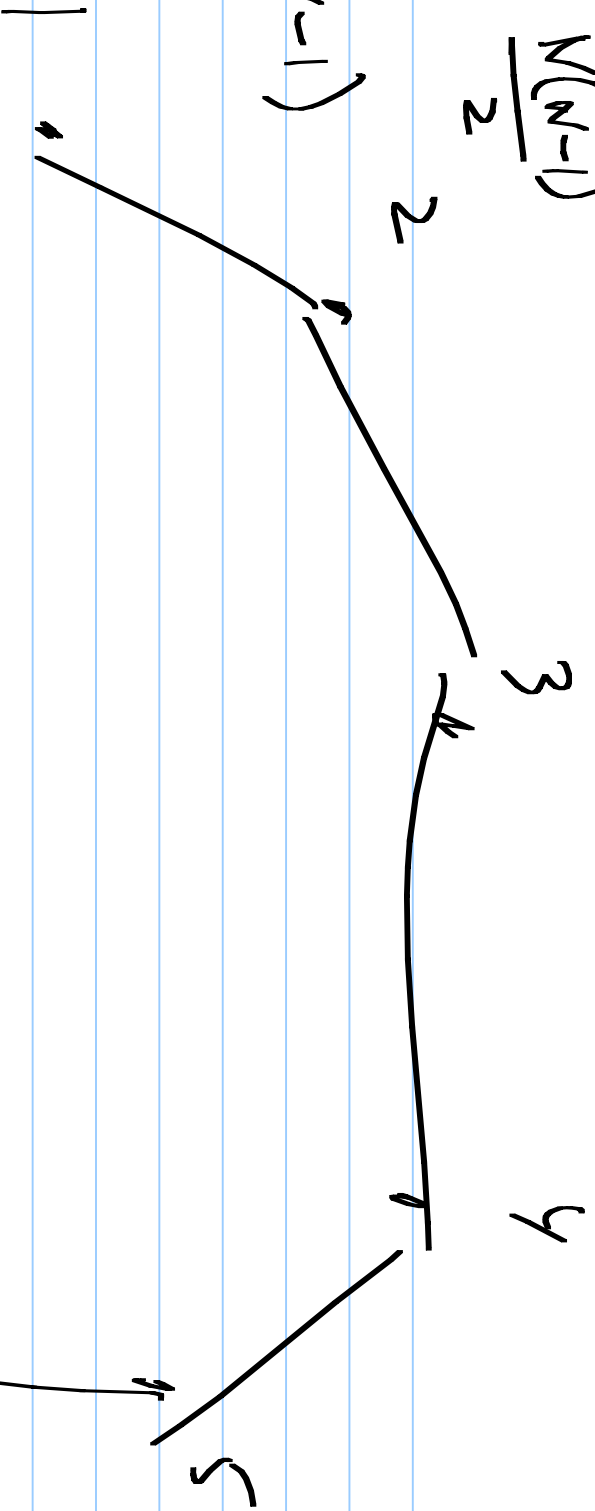
$B-N+1$  KVL eq.

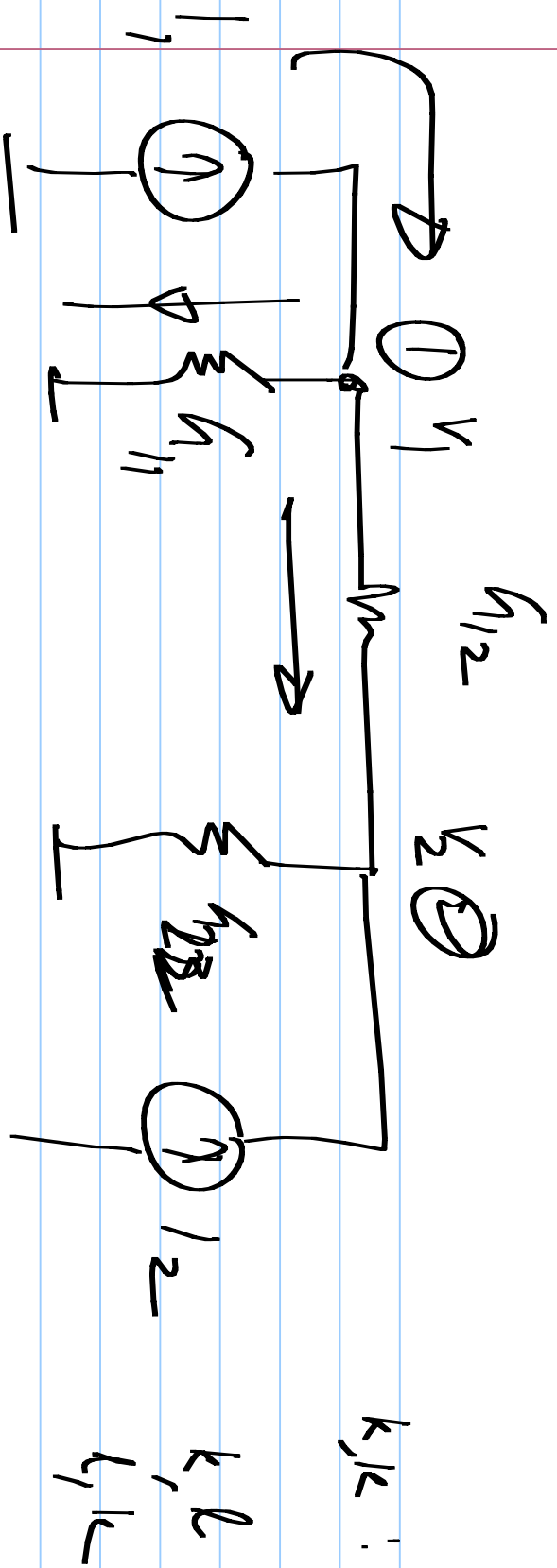
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$B$  Element relationships

$$B < \frac{N(N-1)}{2}$$

$$B = (N-1)$$





② ①:  $V_1 \cdot g_{11} + (V_1 - V_2) g_{12} = I_1$

③ ②:  $\begin{bmatrix} g_{11} + g_{12} & -g_{12} \\ -g_{12} & g_{22} \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} I_1 \\ I_2 \end{bmatrix}$

$$\begin{bmatrix} s_1 + s(C_1 + G_1) & -G_2 \\ -sC_2 + G_2 & s_2 + G_2 \end{bmatrix} \begin{bmatrix} V_1 \\ V_0 \end{bmatrix} = \begin{bmatrix} -G_1 V_e \\ 0 \end{bmatrix}$$

$2 \times 2$

$$V_0 = \frac{+G_1 V_e (G_{m2} - sC_2)}{+G_{m1} V_e (G_{m2} - sC_2)}$$

$$\underline{s^2 (C_1 C_2 + C_2 C_1 + C_1 C_1) + s (C_2 (G_{m2} + G_{o2} + G_{o1}) + C_1 \cdot G_{o2} + C_2 \cdot G_{o1}) + G_{o1} G_{o2}}$$

$$+ g_{m1} v_e (g_{m2} - s C_c)$$

$v_D =$

$$\left[ \frac{s^2 (C_1 C_2 + C_c C_c + C_c C_1) + s (C_c (g_{m2} + g_{o2} + g_{o1}) + C_1 \cdot g_{o2} + C_2 \cdot g_{o1}) + g_{o1} g_{o2}}{(s + p_1)(s + p_2)} \right]$$

$$(s + p_1)(s + p_2)$$

$$g_{o1} g_{o2}$$

$p_1 \approx$

$$\frac{C_c (g_{m2} + g_{o2} + g_{o1}) + C_1 \cdot g_{o2} + C_2 \cdot g_{o1}}{g_{o1} g_{o2}}$$

$$C_c (g_{m2} + g_{o2} + g_{o1}) + C_1 \cdot g_{o2} + C_2 \cdot g_{o1}$$

$p_2 \approx$

$$\frac{C_1 C_2 + C_c C_c + C_c C_1}{C_c (g_{m2} + g_{o2} + g_{o1}) + C_1 \cdot g_{o2} + C_2 \cdot g_{o1}}$$

$$\frac{g_{o1}}{C_1}$$

$$\frac{C_{12}}{C_2}$$