EE2015

18/8/2017

Circuit: N nodes
B branches
N-1 KCL
B-N+1 KVL

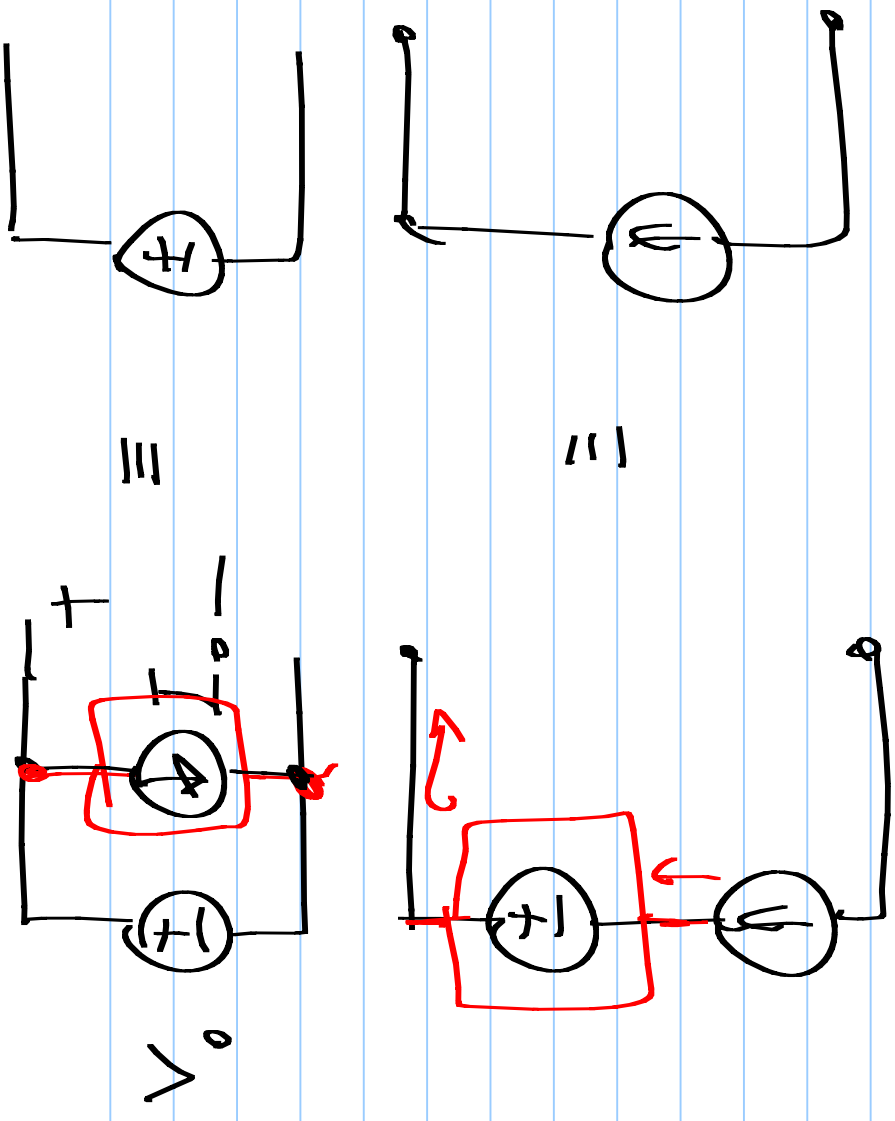
Nodal analysis

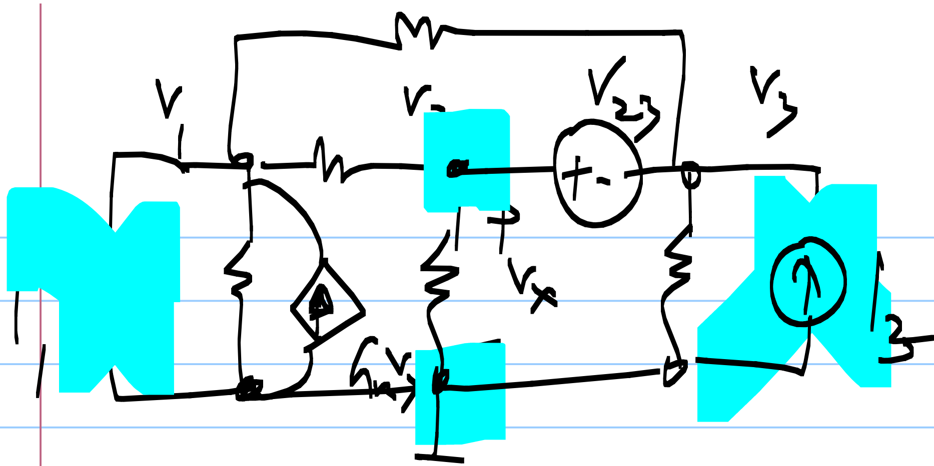
* N-1 nodes (KCL)
* $[G] \cdot \underline{V} = \underline{I_s}$
* Easier for resistors & ind. current sources; V
* Voltage source - Supernode

Mesh analysis

* Loop analysis - planar circuits
* $[R]\ \underline{i} = \underline{V_s}$
  ($\underline{i}$: mesh currents)
* Easier for resistors & voltage sources
* Ind. current source: Supermesh

CCVS





$$\begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = [G]^{-1} \begin{bmatrix} I_1 \\ I_3 \\ V_{23} \end{bmatrix}$$

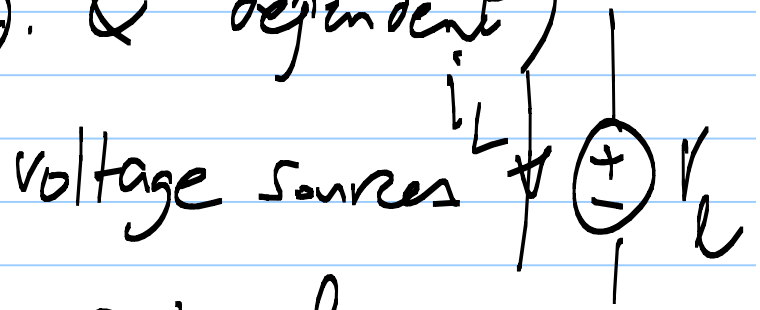
$$= [G]^{-1} \begin{bmatrix} I_1 \\ 0 \\ 0 \end{bmatrix} + [G]^{-1} \begin{bmatrix} 0 \\ I_3 \\ 0 \end{bmatrix} + [G^{-1}] \begin{bmatrix} 0 \\ 0 \\ V_{23} \end{bmatrix}$$

$$\begin{bmatrix} \sqrt{3} & 0 & 0 \end{bmatrix} + \begin{bmatrix} -1 \\ 1 \end{bmatrix} + \begin{bmatrix} -\frac{1}{2} & -\frac{\sqrt{3}}{2} \\ \frac{\sqrt{3}}{2} & -\frac{1}{2} \end{bmatrix}^{-1} \begin{bmatrix} 1 \\ 1 \end{bmatrix} + \begin{bmatrix} -\frac{1}{2} & \frac{\sqrt{3}}{2} \\ -\frac{\sqrt{3}}{2} & -\frac{1}{2} \end{bmatrix}^{-1} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

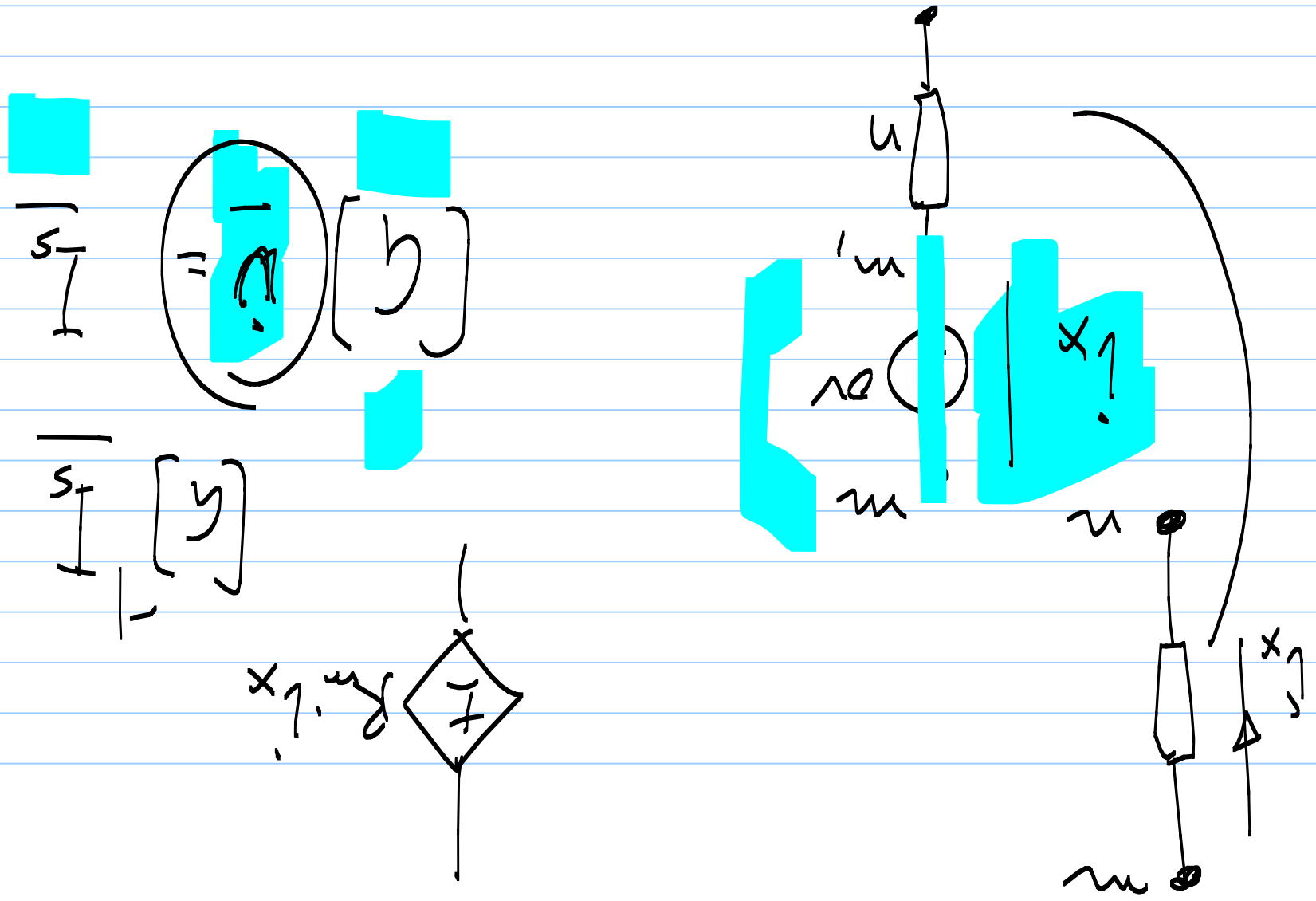
Modified nodal analysis:

* Variables: N−1 node voltages wrt ref. node

* P voltage sources (ind. & dependent)
  P currents through voltage sources



* Q controlling currents } additional variables



$$\begin{array}{c} \\ \text{node } l \\ i_{v,kl} \end{array} \begin{array}{c} \begin{array}{ccc} v_k & v_l & i \end{array} \\ \begin{bmatrix} 0 & 0 & \\ 0 & 0 & -1 \\ +1 & -1 & 0 \end{bmatrix} \end{array} \begin{bmatrix} v_k \\ v_l \\ i_{v,kl} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ V_s \end{bmatrix}$$

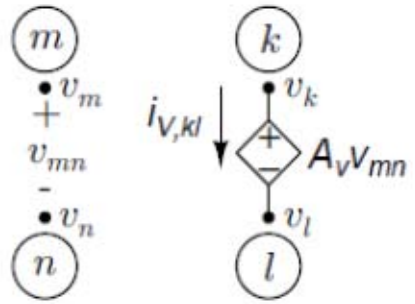
KCL @

: $(\quad) + (\quad) + i_{v,kl} = (\quad) + 0$

@

: $(\quad) + (\quad) - i_{v,kl} = (\quad) + 0$

$$v_k - v_l = v_s$$



$$v_k - v_l = A_v (v_m - v_n)$$

$$v_k - v_l - A_v \cdot v_m + A_v \cdot v_n = 0$$