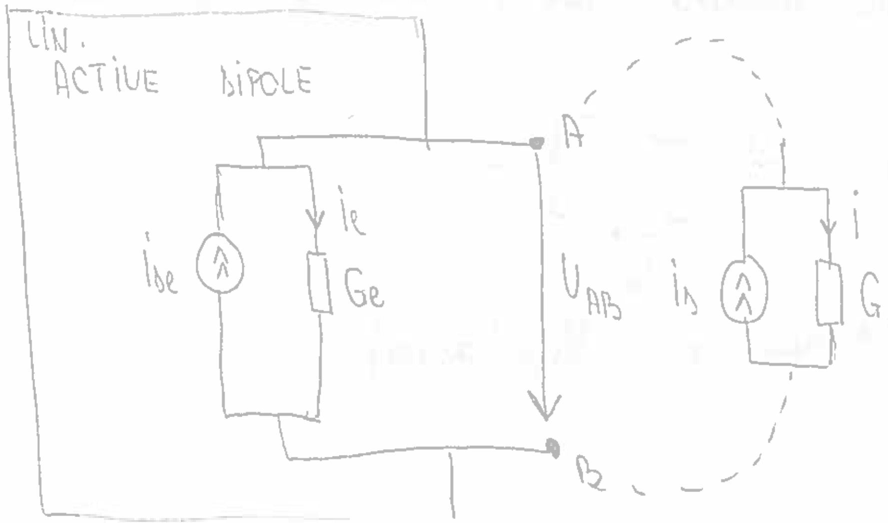
Norton Theoreme (Equivalent current generator) 3



$$U_{AB} = \frac{i_{se} + i_s}{G_e + G}$$

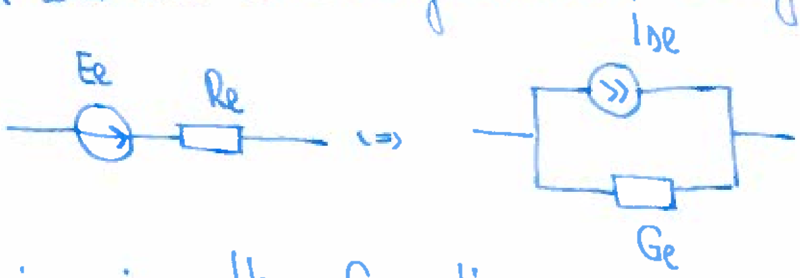
It says that: any liniar active dipole has an eq. current generator with respect to its access terminals, this real current generator has the value of the current equal to the intensity of the short-circuit current established if the access terminals will be shortcircuited and in parallel with an equivalent conductance corresponding to the total conductance calculated with respect to the same terminals for the passivised circuit. (= all the current sources become open circuits & all voltage sources become shortcircuit). Under this circumstances the voltage drop on a branch connected to the access terminals is given by

$$\boxed{U_{AB} = \frac{i_{se} \pm i_s}{G_e + G}}$$

Remark 1 The upper part contains an algebraical sum depending on the orientation of the current sources.

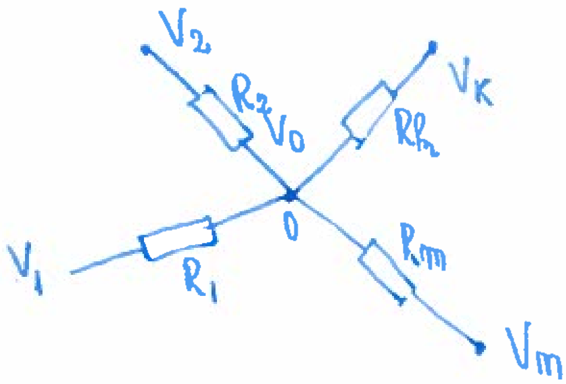
Remark 2.

Once we find out the structure of generators (Thevenin / Norton), the other one can be easily deduced using this transformation



$$i_{se} + i_s = \underbrace{U_{AB} \cdot G_e}_{i_e} + \underbrace{U_{AB} \cdot G}_{i} = U_{AB}\,(G_e + G)$$

Millman Theorem



Refers to a star connection of "n" passive branches characterised by resistance $R_1 \ldots R_n$ and the terminal potential $V_1, \ldots, V_n$. The common node is node 0. Under this circum., the potential of this node is given by:

$$V_0 = \frac{\sum V_k G_k}{\sum G_k}$$

Test: 2.11. } • on DC circuit (literally 3 : K, LOOP, POT. of N
• one numerically solved + Power Balance + 2 weeks

Loop currents Method (10)

This Mth. involves the introduction of a set of new imaginary unknown quantities called loop currents and attributed to each fundamental loop of the circuit

$$\sum_{g=1}^{L=B-N+1} R_{hg} \cdot i_g' = E_h' , \quad h = \overline{1,L}$$

This unknown quantities satisfied the following system of eq:

$$\begin{cases} R_{11} i_1' + R_{12} i_2' + R_{1L} \cdot i_L' = E_1' \\ R_{21} i_2' + R_{22} i_2' + \dots R_{2L} \cdot i_L' = E_2' \\ \dots \\ R_{L1} i_1' + R_{L2} i_2' + \dots R_{LL} \cdot i_2' = E_L' \end{cases}$$

The coef of the system represents:

a). $h = g \Rightarrow R_{hg}$ the total resistance of the respective loop calculated as sum of all the resistances contained by the branches of that loop
$R_{hg} > 0$

b). $h \neq g$, $R_{hg} = R_{gh} \gtrless 0$

They represent the common resistance of the two loops

They are calculated as sum of the resistances of all the mutual branches of the two loops

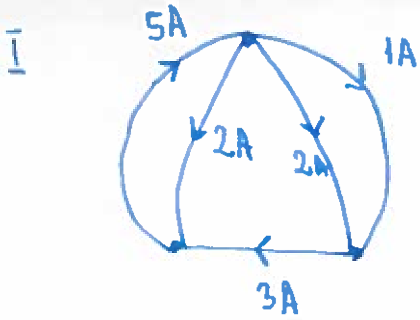
In front of that sum, we have "+" if the loop currents have the same orientation through the common branch and "–" if the loop currents have opposite orientation through the common B.

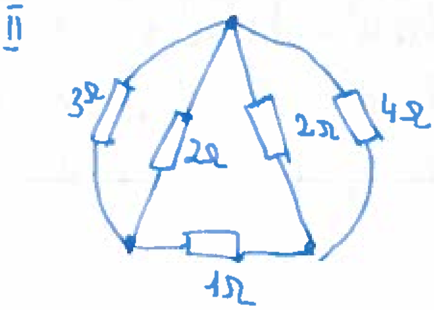
i_g' represent the loop currents (unknown quantities)

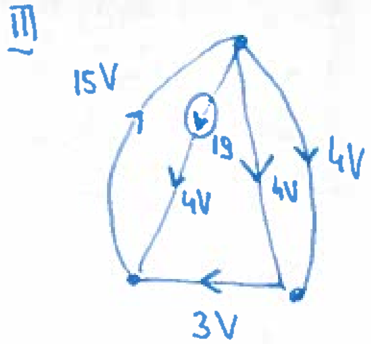
E_h' = total voltage of the loop calculated as algebrical sum of all voltage sources from the branches of the respective loop.

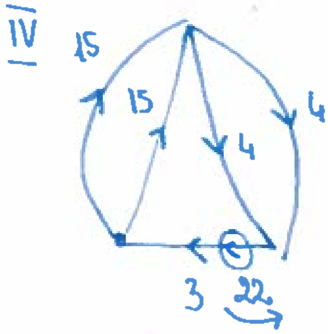
In the algebrical sum, we take with "+" the sources having the same orientation of the loop current, and with "–" those that are opposite to the loop currents.

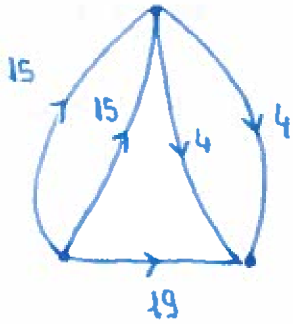
After solving the system of equation and finding the imaginary unknowns quantities, then the real currents of the branches can be calculated as algebrical sum of all the loop currents

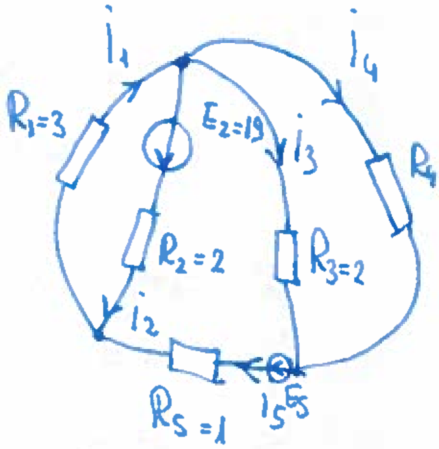










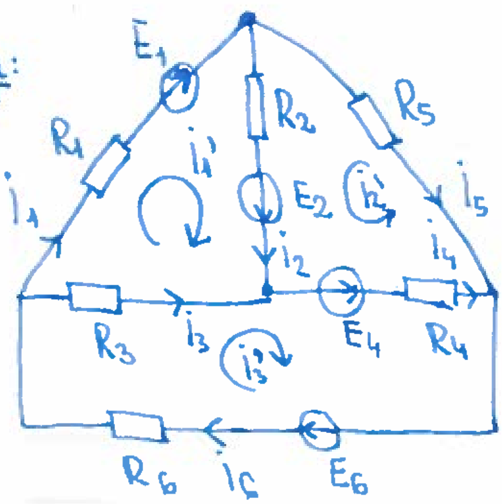


Homework ↗

Restriction of the Method:

In case that the circuit contains one (several) current source, then the loops should be chosen in such way that the current source to be part of one loop and only one. For the respective loop we don't write the eq. corresponding to the Meth. but we identify directly the loop current with the current given by the source. In this way, we eliminate one eq of the system (the Meth. is recommended in such cases).

App:



R(Ω)	I(A)	E(V)
$R_1 = 2$		$E_1 = 6$
$R_2 = 2$		$E_2 = 12$
$R_3 = 2$		
$R_4 = 10$		$E_4 = 6$
$R_5 = 4$		
$R_6 = 1$		$E_6 = 16$

$B=6$ $\quad L_1: b_1, b_2, b_3$
$N=4$ $\quad L_2: b_2, b_4, b_5$
$L=3$ $\quad L_3: b_3, b_4, b_6$

$$\begin{cases} R_{11} i_1' + R_{12} i_2' + R_{13} i_3' = E_1' \\ R_{21} i_1' + R_{22} i_2' + R_{23} i_3' = E_2' \\ R_{31} i_1' + R_{32} i_2' + R_{33} i_3' = E_3' \end{cases}$$

$R_{11} = R_1 + R_2 + R_3$ $\qquad R_{12} = R_{21} = +R_2$

$R_{22} = R_2 + R_4 + R_5$ $\qquad R_{13} = R_{31} = -R_3$

$R_{33} = R_3 + R_4 + R_6$ $\qquad R_{23} = R_{32} = +R_4$

!

$E_1' = E_1 + E_2$

$E_2' = E_2 + E_4$

$E_3' = E_4 + E_6$

$J_1 = +J_1'$

$J_2 = +J_1' + J_2'$

$J_3 = -i_1' + i_3'$

$J_4 = +i_2' + i_3'$

$J_5 = -i_2'$

$J_6 = +i_3'$