Inbyggd Elektronik 2018-03-26 #4

REP. KCL, KVL, Ohm's law, Passive sign convention

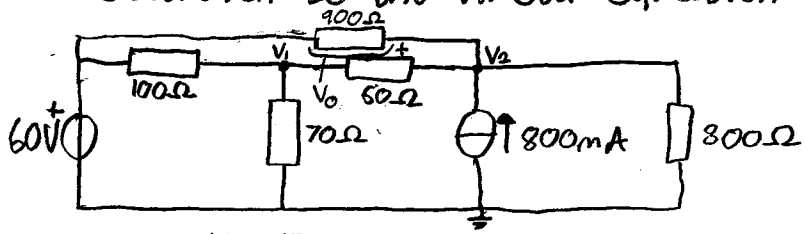
Node-Voltage-Method

① Introduce independent node potentials (V_1, V_2, V_3) at all nodes except one (ground). Ground node is assigned to 0V. (Variables)

② Express all branch currents in the node potentials using Ohm's law. e.g. $I_a = \frac{V_1 - V_2}{R_2}$

③ Use KCL (Kirchoff's Current Law) on all nodes except one (normally we skip the ground node)
⇒ This gives the same amount of equations as variables (node potentials)

④ Solve the linear equation system. (Gauss elimination)
- Since we work with circuits there is <u>allways</u> a unique solution to the linear equation system.



Determine V_o First choose ground

Introduce node potentials V_1 and V_2 (At the node above ideal voltage source I know the potential is 60V)
(Note: if I know V_2 i can calculate $V_o = V_2 - 60V$

<u>Look at node 1</u> $\frac{60-V_1}{100} + \frac{0-V_1}{70} + \frac{V_2-V_1}{60} = 0$ (a)

<u>Look at node 2</u> $\frac{60-V_2}{900} + \frac{V_1-V_2}{60} + 800m + \frac{0-V_2}{300} = 0$ (b)

(a) $42(60-V_1) + 60(0-V_1) + 70(V_2-V_1) = 0$

(b) $60 - V_2 + 15(V_1-V_2) + 800m \cdot 900 + 3(0-V_2) = 0$

(a) $42 \cdot 60 - 42V_1 - 60V_1 + 70V_2 - 70V_1 = 0$

(b) $780 - V_2 + 15V_1 - 15V_2 - 3V_2 = 0$

$172V_1 - 70V_2 = 2520$ ← add

$15V_1 - 19V_2 = -780$ ($\cdot \frac{172}{15}$)

$\frac{-19 \cdot (-172)}{15} V_2 - 70V_2 = \frac{780 \cdot 172}{15} + 2520$

$\Rightarrow V_2 = 77,52V \Rightarrow V_o = V_2 - 60 = 17,52V$

$V_1 = 46,2V$

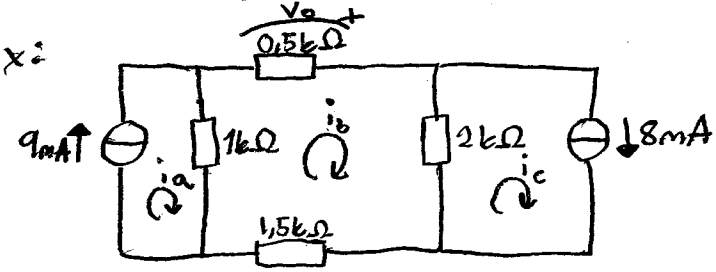
Mesh-Current-Method

① Introduce mesh-currents (I_a, I_b, I_c...) in all loops of the circuit.

② Use KVL in all loops. This gives as many equations as mesh currents.
- In common branches the current is expressed as difference between two mesh-currents.

③ Solve equation system.

Ex:



Determine V_o

$i_a = 9mA$, $i_c = 8mA$

KVL on loop b.

$$1k \cdot (i_a - i_b) - 0,5k i_b + 2k(i_c - i_b) - 1,5k i_b = 0$$

$$1k i_a - 1k i_b - 0,5k i_b + 2k i_c - 2k i_b - 1,5k i_b = 0 \Rightarrow 9 - 5k i_b + 16 = 0$$

$$\frac{25}{5} = i_b = 5mA$$

$$V_o = 0,5k \cdot (-5m) = -2,5V$$