Last Name __________________ Last Name __________________ Matricola __________________

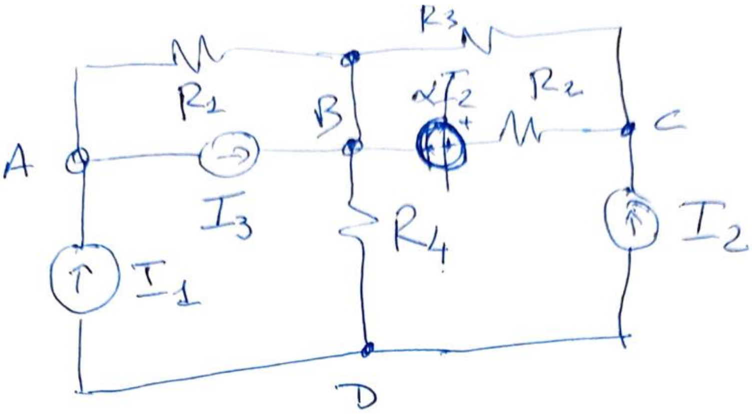
Messina, 29 June 2022

Exercise 1

Solve the given circuit below by using the node analysis considering D as a reference node.

a) Write the G matrix in analytical form.

b) Compute the value of the nodal voltage V_A, V_B and V_C using the following values for $R_1 = 1\ \Omega$, $R_2 = 4\ \Omega$, $R_3 = 2\ \Omega$, $R_4 = 2\ \Omega$, $I_1 = 2$ A, $I_2 = 1$ A, $I_3 = 4$ A, and $\alpha = 4\ \Omega$; [Help: Consider the equivalence between voltage and current generators before to apply the node analysis]

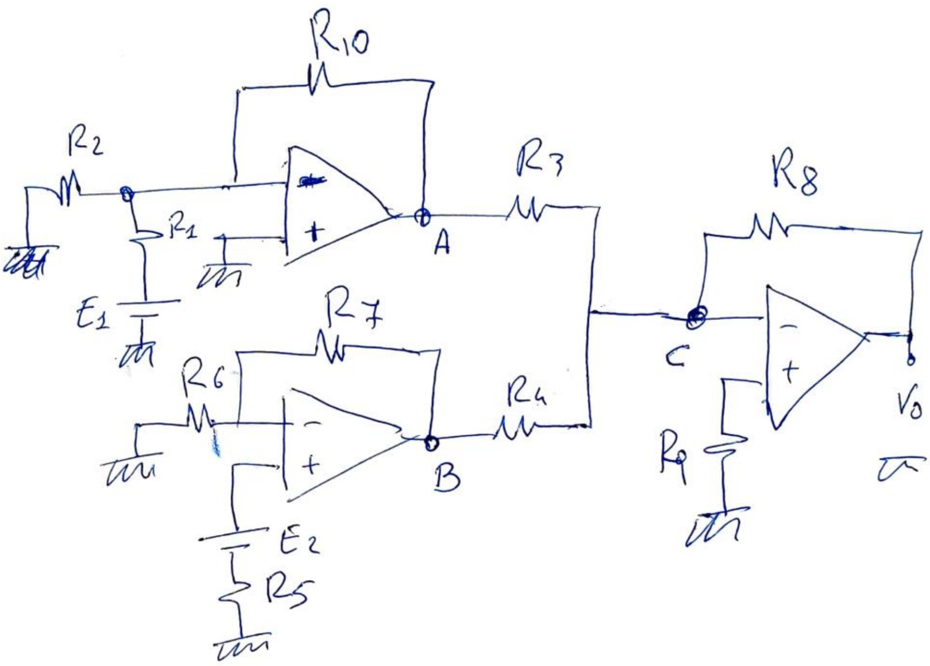


Exercise 2

Solve the given circuit below.

a) Compute analytically the expression of the $V_{A,}$ V_B and V_0.

b) Compute the value of V_0 considering the following parameters $R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 4\ \Omega$, $R_4 = 6\ \Omega$, $R_5 = 100\ \Omega$, $R_6 = 8\ \Omega$, $R_7 = 9\ \Omega$, $R_8 = 12\ \Omega$, $R_9 = 5\ \Omega$, $R_{10} = 10\ \Omega$, $E_1 = 2$ V, and $E_2 = -3$ V.



Exercise 3

a) For a given an RL circuit with R=0.5mΩ and L=0.5 H. Compute the current flowing into the inductor L after 200 μs $i_L(200\ \mu s)$ considering that the current at t=0s flowing into the inductor is equal to 1A ($i_L(0)$=5A).

Sign here ____

Exercise 1:

a)

b)

Exercise 2:

a)

b)

Exercise 3:

a)

Solution 1

a) Considering the equivalence between current and voltage generators, we have that the branch with the controlled voltage generator and the resistance R_2 in series are equivalent to a controlled current generator with a coefficient equal to α/R_2 with in parallel the same resistance R_2. Mind that the term is with the current generator is a know value.

$$\begin{pmatrix} G_1 & -G_1 & 0 \\ -G_1 & G_1+G_2+G_3+G_4 & -G_2-G_3 \\ 0 & -G_2-G_3 & G_2+G_3 \end{pmatrix}\begin{pmatrix} V_A \\ V_B \\ V_C \end{pmatrix} = \begin{pmatrix} I_1 - I_3 \\ I_3 - \alpha G_2 I_2 \\ \alpha G_2 I_2 + I_2 \end{pmatrix}$$

b) $V_A = 4$ V; $V_B = 6$ V; $V_C = 8.667$V

Solution 2

a) The voltage V_A, V_B and V_0 are given by

$V_A = \left(\frac{E_1 R_2}{R_1+R_2}\right)\frac{-R_{10}}{(R_{10}+R_1R_2/(R_1+R_2))}$ (inverting amplifier); $V_B = E_2\left(1+\frac{R_7}{R_6}\right)$ (noninverting amplifier);

$V_0 = V_A\left(-\frac{R_8}{R_3}\right)+V_B\left(-\frac{R_8}{R_4}\right)$ (inverting amplifier where you add the inputs).

b) V_A= -1.25 V; V_B= -5.25 V; V_0=14.25 V;

Solution 3

$$\tau = R/L = 0.1ms$$
$$t = 200\mu s$$
$$i_L(t) = i_L(0)e^{-t/\tau} = 4.0937V$$