Last Name __________________ Last Name __________________ Matricola __________________

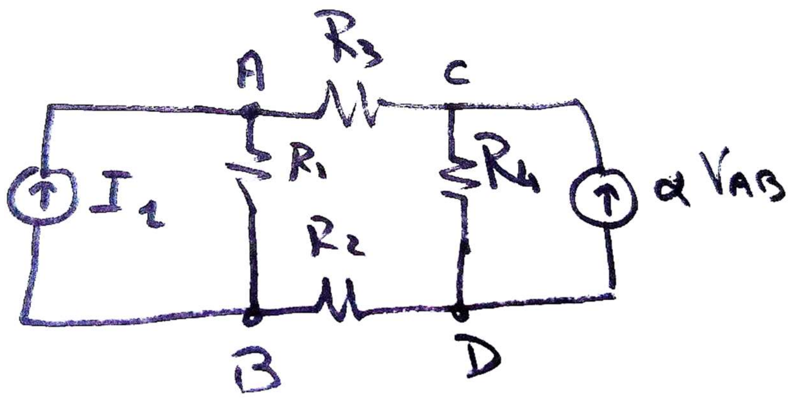
Messina, 20 December 2021

Exercise 1

Solve the given circuit below by using the node analysis and D as a reference node (A, B and C are the nodes 1, 2 and 3).

a) Write the G matrix in analytical form.

b) Compute the value of the voltage at the node A, B and C, using the following values for $R_1 = 1\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 10\ \Omega$, $R_4 = 2\ \Omega$, $I_1 = 2$ A, and $\alpha = 2$;



Exercise 2

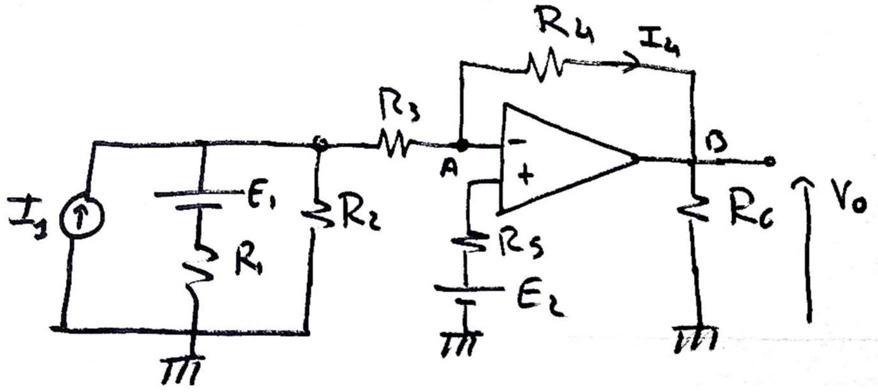
Solve the given circuit below.

a) Compute analytically the Thevenin Equivalent circuit from node A considering the positive node of the voltage Thevenin generator toward the node A.

b) Compute V_0 analytically.

c) Compute the value of V_0 considering the following parameters $R_1 = 5\ \Omega$, $R_2 = 1\ \Omega$, $R_3 = 5\ \Omega$, $R_4 = 2\ \Omega$, $R_5 = 4\ \Omega$, $R_6 = 1\ \Omega$, $I_1 = 5$ A, $E_1 = 2$ V and $E_2 = 4$ V.

d) Compute the value of I_4 considering the same values for the device reported in point c).



Exercise 3

Draw the circuit which can solve the following differential equation: $\frac{d^2 v_0}{dt^2} = -4\frac{dv_0}{dt} - 3v_0 + 2\sin(10t)$. The initial conditions are set to zero, use R and C in order that the product RC=1 s. Do not assign values to R and/or C.

Sign here ____

Exercise 1:

a)

b)

Exercise 2:

a)

b)

c)

d)

Exercise 3:

Solution 1

a)

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

b) V_A = 3.6364 V; V_B = 1.0909 V; V_C = 9.0909 V

Solution 2

a)

$$E_{TH}=\frac{I_1+E_1/R_1}{1/R_1+1/R_2}$$

$$R_{TH}=\frac{R_1R_2}{R_1+R_2}+R_3$$

b) V_0 is given by two contributions. Applying the superposition principle, one is from the inverting amplifier and one from non-inverting amplifier.

$$V_0=-E_{TH}\frac{R_4}{R_{TH}}+E_2(1+\frac{R_4}{R_{TH}})$$

c) V_0 = 3.8 V

d) $I_4=\dfrac{V_A-V_0}{R_4}=\dfrac{E_2-V_0}{R_4}=0.08A$

Solution 3