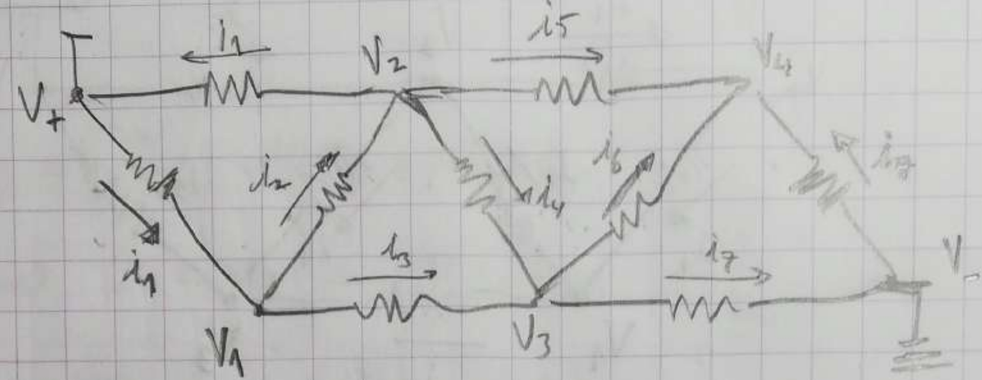
N=4 :



Corrientes:

V_1: $i_1 - i_2 - i_3 = 0$

V_2: $i_1 - i_2 + i_4 + i_5 = 0$

V_3: $i_3 + i_4 - i_6 - i_7 = 0$

V_4: $i_5 + i_6 + i_7 = 0$

Voltajes:

$V_2 - V_+ = V_+ - V_1 = i_1$

$V_1 - V_2 = i_2$

$V_1 - V_3 = i_3$

$V_2 - V_3 = i_4$

$V_2 - V_4 = i_5$

$V_3 - V_4 = i_6$

$V_3 - V_- = V_- - V_4 = i_7$

$V_1 + V_2 = 2V_+ \quad \dots (1)$

$V_3 + V_4 = 2V_- = 0 \dots (2)$

$i_1 - V_1 + V_2 - V_1 + V_3 = 0$

$i_1 - 2V_1 + V_2 + V_3 = 0 \quad \dots (3)$

$i_1 - V_1 + V_2 + V_2 - V_3 + V_2 - V_4 = 0$

$i_1 - V_1 + 3V_2 - V_3 - V_4 = 0 \dots (4)$

$\boxed{-2V_1 + 2V_2 + V_3 = V_+}$

$V_+ - 2V_1 + 3V_2 - V_3 - V_4 = 0$

$\boxed{2V_1 - 3V_2 + V_3 + V_4 = V_+}$

$V_1 - V_3 + V_2 - V_3 - V_3 + V_4 - i_7 = 0$

$V_1 + V_2 - 3V_3 + V_4 - i_7 = 0 \quad \dots (5)$

$V_2 - V_4 + V_3 - V_4 + i_7 = 0$

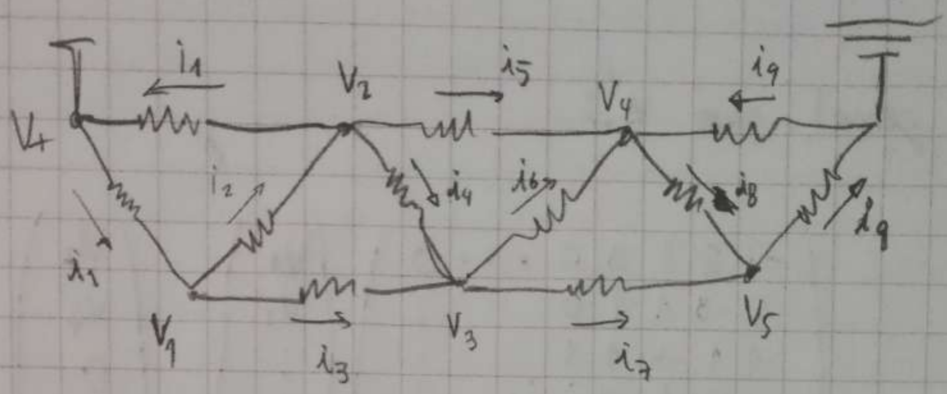
$V_2 + V_3 - 2V_4 + i_7 = 0 \dots (6)$

$\boxed{V_1 + V_2 - 3V_3 + 2V_4 = V_-}$

$\boxed{V_2 + 2V_3 - 2V_4 = V_-}$

$$\begin{pmatrix} -2 & 2 & 1 & 0 \\ 2 & -3 & 1 & 1 \\ 1 & 1 & -3 & 2 \\ 0 & 1 & 2 & -2 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \end{pmatrix} = \begin{pmatrix} V_+ \\ V_+ \\ 0 \\ 0 \end{pmatrix}$$

$N=5$



V_1: $i_1 - i_2 - i_3 = 0$

V_2: $i_1 - i_2 + i_4 + i_5 = 0$

V_3: $i_3 + i_4 - i_6 - i_7 = 0$

V_4: $i_5 + i_6 - i_8 + i_9 = 0$

V_5: $i_7 + i_8 - i_9 = 0 \longrightarrow V_3 - V_5 + V_4 - V_5 - V_- + V_4 = 0$

$i_7 = V_3 - V_5$

$i_8 = V_4 - V_5$

$i_9 = V_5 - V_- = V_- - V_4$

$\boxed{-2V_1 + 2V_2 + V_3 = V_+}$

$\boxed{V_3 + 2V_4 - 2V_5 = V_-}$

$\boxed{2V_1 - 3V_2 + V_3 + V_4 = V_+}$

$\cancel{V_1} - \cancel{V_3} + \cancel{V_2} - \cancel{V_3} - \cancel{V_3} + V_4 - \cancel{V_3} + V_5 = 0$

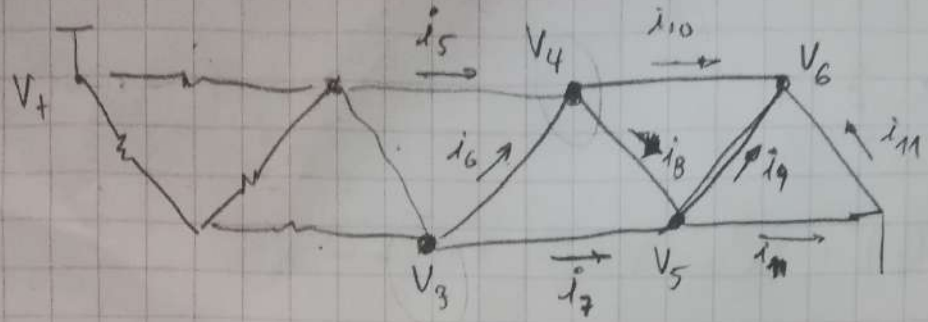
$\boxed{V_1 + V_2 - 4V_3 + V_4 + V_5 = 0}$

$\cancel{V_2} - \cancel{V_4} + \cancel{V_3} - \cancel{V_4} - \cancel{V_4} + V_5 + i_9 = 0$

$\boxed{V_2 + V_3 - 3V_4 + 2V_5 = V_- = 0}$

$$\boxed{\begin{pmatrix} -2 & 2 & 1 & 0 & 0 \\ 2 & -3 & 1 & 1 & 0 \\ 1 & 1 & -4 & 1 & 1 \\ 0 & 1 & 1 & -3 & 2 \\ 0 & 0 & 1 & 2 & -2 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \end{pmatrix} = \begin{pmatrix} V_+ \\ V_+ \\ 0 \\ 0 \\ 0 \end{pmatrix}}$$

$N = 6$



$V_4: \quad i_5 + i_6 - i_8 - i_{10} = 0 \qquad i_9 = V_5 - V_6$

$V_5: \quad i_7 + i_8 - i_9 - i_{11} = 0 \qquad i_{10} = V_4 - V_6$

$V_6: \quad i_9 + i_{10} + i_{11} = 0 \qquad i_{11} = V_5 - V_- = V_- - V_6$

$V_1: \quad -2V_1 + 2V_2 + V_3 = V_+$

$V_2: \quad 2V_1 - 3V_2 + V_3 + V_4 = V_+$

$V_3: \quad V_1 + V_2 - 4V_3 + V_4 + V_5 = 0$

$V_4: \quad \cancel{V_2} - \cancel{V_4} + \cancel{V_3} - \cancel{V_4} - \cancel{V_4} + V_5 - \cancel{V_4} + V_6 = 0$

$V_4: \quad \boxed{V_2 + V_3 - 4V_4 + V_5 + V_6 = 0}$

$V_5: \quad \cancel{V_3} - \cancel{V_5} + \cancel{V_4} - \cancel{V_5} - \cancel{V_5} + V_6 + - V_- + V_6 = 0$

$\boxed{V_3 + V_4 - 3V_5 + 2V_6 = V_-}$

$V_6: \quad V_5 - V_6 + V_4 - V_6 + V_5 - V_- = 0$

$\boxed{V_4 + 2V_5 - 2V_6 = V_-}$

$N=6: \quad \begin{pmatrix} -2 & 2 & 1 & 0 & 0 & 0 \\ 2 & -3 & 1 & 1 & 0 & 0 \\ 1 & 1 & -4 & 1 & 1 & 0 \\ 0 & 1 & 1 & -4 & 1 & 1 \\ 0 & 0 & 1 & 1 & -3 & 2 \\ 0 & 0 & 0 & 1 & 2 & -2 \end{pmatrix} \begin{pmatrix} V_1 \\ V_2 \\ V_3 \\ V_4 \\ V_5 \\ V_6 \end{pmatrix} = \begin{pmatrix} V_+ \\ V_+ \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$

En general para n:

$$\begin{pmatrix}
-2 & 2 & 1 & 0 & 0 & \cdots & & & 0 \\
2 & -3 & 1 & 1 & 0 & & & & \vdots \\
1 & 1 & -4 & 1 & 1 & & & & \vdots \\
\vdots & 1 & 1 & -4 & \ddots & \ddots & & & \vdots \\
\vdots & & \ddots & \ddots & \ddots & 1 & 1 & 0 \\
\vdots & & & & \ddots & 1 & -4 & 1 & 1 \\
 & & & & & 1 & 1 & -3 & 2 \\
0 & \cdots & & & & 0 & 1 & 2 & -2
\end{pmatrix}
\begin{pmatrix} V_1 \\ V_2 \\ \vdots \\ \vdots \\ \\ \\ \\ V_n \end{pmatrix}
=
\begin{pmatrix} V_+ \\ V_+ \\ 0 \\ \vdots \\ \vdots \\ \\ \\ 0 \end{pmatrix}$$

Pregunta 3

$$x''(t) + (x^2-1)\,x'(t) + x(t) = 0$$

Queremos 2 EDOs de 1er orden:

Sea $\dfrac{dx}{dt} = y_1$ (1ra ecuación)

$$\frac{dy_1}{dt} = x''(t) = -(x^2-1)\underbrace{\frac{dx}{dt}}_{y_1} - x$$

$$\frac{dy_1}{dt} = (1-x^2)\,y_1 - x$$

$\therefore$ sea $\bar{y}' = \left(\dfrac{dx}{dt}, \dfrac{dy_1}{dt}\right)$

$$\boxed{\bar{y}' = \left(y_1, (1-x^2)y_1 - x\right) = f[t,(x,y_1)]}$$