Sintesi (progettazione)

(1) Esempio

$$\underline{\underline{G}} = \begin{bmatrix} 0.6 & -0.2 \\ -0.2 & 0.8 \end{bmatrix}$$

Usiamo il DB a π

$$\Rightarrow \underline{\underline{G}}_{\pi} = \begin{bmatrix} G_A + G_C & -G_c \\ -G_c & G_B + G_C \end{bmatrix} \Rightarrow \begin{cases} G_A + G_C = 0.6 \\ +G_C = +0.2 \; S \\ G_B + G_C = 0.8 \end{cases}$$

$$\Rightarrow G_A = 0.6 - 0.2 = 0.4 \; S$$

$$\Rightarrow G_B = 0.8 - 0.2 = 0.6 \; S$$

(2) Esempio

$$\underline{\underline{G}}_{\pi} = \begin{bmatrix} 0.6 & 0.2 \\ 0.2 & 0.8 \end{bmatrix} \Rightarrow \begin{array}{l} G_A + G_C = 0.6 \\ -G_C = 0.2 \Rightarrow G_C = -0.2 \\ G_B + G_C = 0.8 \end{array}$$

$$\Rightarrow G_A = 0.8$$
$$G_B = 0.6$$

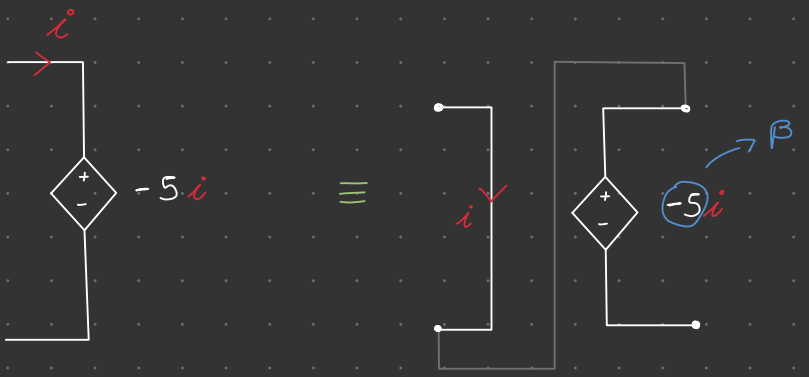
$$G_C = -0.2$$

Come realizzare una resistenza negativa?

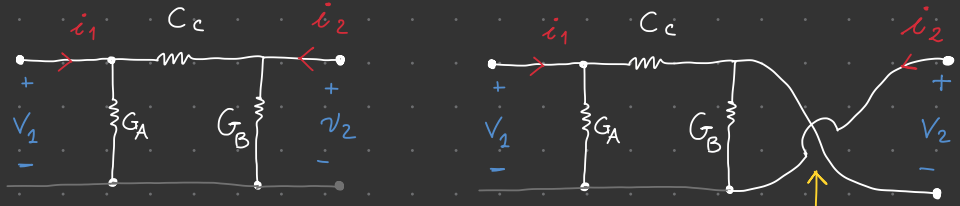
(a) Generatore controllato (Tensione in corrente)

Se $G_c = -0.2 \Rightarrow G_c = \frac{1}{R_c} \Rightarrow R_c = -5\,\Omega$ c.u.

$\Rightarrow$

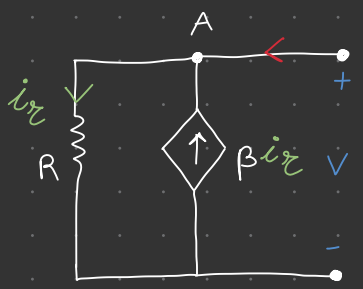


(b) Scambiare i morsetti



$$\Rightarrow \underline{\underline{G}}'_{\pi} = \begin{bmatrix} G_A + G_c & +G_c \\ +G_c & G_B + G_c \end{bmatrix}$$

③ Esempio



$$LKC_A: \quad -i + i_2 - \beta i_2 = 0$$

$$\Rightarrow i = i_2 - \beta i_2$$

$$\Rightarrow \boxed{i = i_2 (1-\beta)} \Rightarrow i_2 = \frac{i}{1-\beta}$$

$$\boxed{V = R \cdot i_R}$$

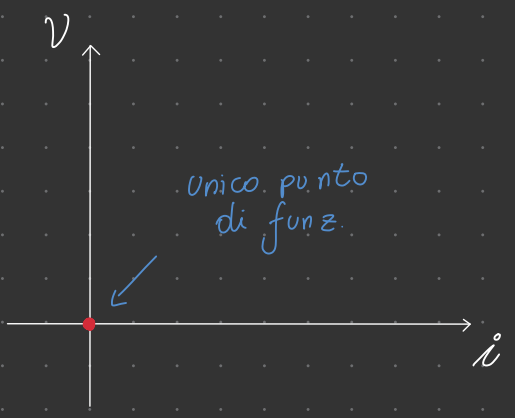
$$\Rightarrow \quad V = \underbrace{\left(\frac{R}{1-\beta}\right)}_{R_{EQ}} \cdot i$$

- $\beta < 0 \rightarrow R_{eq} > 0 \rightarrow$ Bipolo passivo
- $\beta > 0 \rightarrow R_{eq} < 0 \rightarrow$ Bipolo ATTIVO
- $\beta = 1 \rightarrow i = i_2(1-1) = 0 \quad \forall V$ circuito Aperto
- $\beta = 1$ AND $R = 0$

$$L \rightarrow \begin{cases} i = i_2 (1 - \beta) = 0 \\ V = R\, i_R = 0 \end{cases}$$

($1 - \beta \to 0$, $R \to 0$)

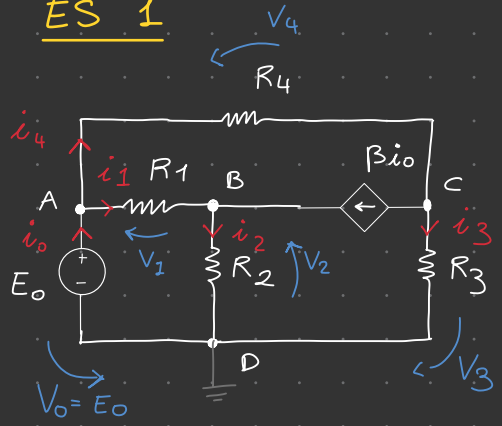
BIPOLO NULLATORE



Simbolo

ES 1

Potenziali di Nodo



DATI

$E_0 = 6\,V$

$R_1 = 2\,\Omega$

$R_2 = 4\,\Omega$

$R_3 = 5\,\Omega$

$R_4 = 100\,\Omega$

$\beta = 2.4 \ A/A$

Pongo $U_D = 0 \Rightarrow V_0 = U_A - U_D = \boxed{U_A = E_0}$

LKC

$$\begin{cases} A: -i_0 + i_1 + i_4 = 0 \\ B: -i_1 + i_2 - \beta i_0 = 0 \\ C: \beta i_0 + i_3 - i_4 = 0 \end{cases} \Rightarrow i_0 = i_1 + i_4$$

$$\begin{cases} E_0 = U_A \\ V_1 = U_A - U_B \\ V_2 = U_B \\ V_3 = U_C \\ V_4 = U_A - U_C \end{cases}$$

Rel Car

$$\begin{cases} i_0 = i_0 \\ i_1 = G_1 V_1 \\ i_2 = G_2 V_2 \\ i_3 = G_3 V_3 \\ i_4 = G_4 V_4 \end{cases} \Rightarrow \begin{cases} U_A = E_0 \\ i_1 = G_1 (U_A - U_B) \\ i_2 = G_2 U_B \\ i_3 = G_3 U_C \\ i_4 = G_4 (U_A - U_C) \end{cases}$$

$\Rightarrow$ Rel Car $\rightarrow$ LKC

(1)

$$-i_0 - G_1 U_B - G_4 U_C = G_1 E_0 - G_4 E_0 \rightarrow \boxed{i_0 + G_1 U_B + G_4 U_C = E_0 (G_1 + G_4)}$$

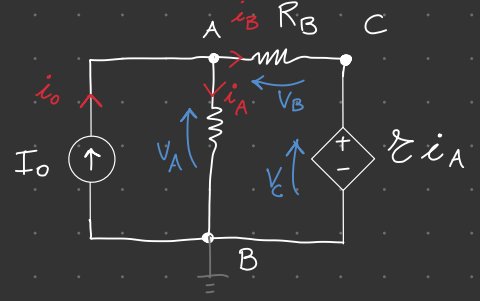
$$-G_1 U_A + G_1 U_B + G_2 U_B - \beta i_0 = 0$$

LO $\boxed{U_B (G_1 + G_2) - \beta i_0 = G_1 E_0}$ (2)

$$\boxed{\beta i_0 + U_C (G_3 + G_4) = G_4 E_0} \quad (3)$$

Potenziali di Nodo con gen Controllati

ES 1:



DATI

- X $I_o = i_o = 2\,mA = 2 \times 10^{-3} A$
- A $R_A = 10\,k\Omega = 10 \times 10^3\,\Omega$
- B $R_B = 6 \times 10^3\,\Omega$
- C $\mathcal{E} = 4000\,\Omega$

Q: V_A

Pongo $V_B = 0$

$$\begin{cases} V_A = U_A \\ V_B = U_C - U_A \\ V_C = U_C = \mathcal{E} i_A \end{cases}$$

LKC

$$\begin{cases} A: i_B + i_A - i_o = 0 \Rightarrow I_o = i_A + i_B \\ B: i_o - i_A - i_B = 0 \Rightarrow I_o = i_A + i_B \end{cases}$$

(I_o)

$\rightarrow V = R \cdot i \Rightarrow i = G \cdot V$

$$\Rightarrow \begin{cases} i_A = G_A V_A \\ i_B = G_B V_B \end{cases} \Rightarrow \begin{cases} i_A = G_A U_A \\ i_B = G_B (U_A - U_C) \end{cases}$$

Siccome $U_C = \mathcal{E} i_A = \mathcal{E} G_A V_A = \mathcal{E} G_A U_A$ (U_C)

$$\rightarrow i_B = G_B U_A - G_B \mathcal{E} G_A U_A$$

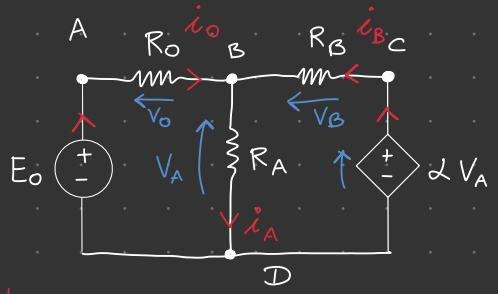
$$\Rightarrow I_o = i_A + i_B = G_A U_A + G_B U_A - \mathcal{E} G_A G_B U_A$$

$$\Rightarrow U_A (G_A + G_B - \mathcal{E} G_A G_B) = I_o \rightarrow U_A = V_A = \frac{I_o}{G_A + G_B - \mathcal{E} G_A G_B}$$

(A^{-1} B^{-1} C A^{-1} B^{-1})

$$= 10\,A$$

ES 2



DATI

A $R_0 = 1 \times 10^3\ \Omega$ X $E_0 = 6\ V$

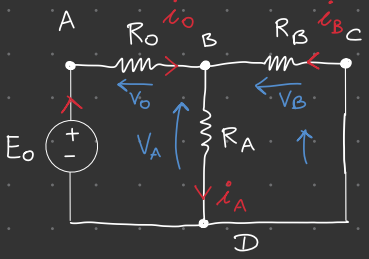
B $R_A = 2 \times 10^3\ \Omega$

C $R_B = 3 \times 10^3\ \Omega$

$\alpha = 4\ \frac{V}{V}$

Q: $i_B = ?$

C'

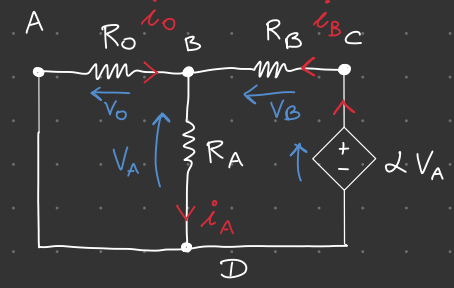


$i_0 = \frac{E_0}{Req}$ $\quad Req = (R_B \| R_A) + R_0 = 2200\ \Omega$

$= 2.7\ mA$ $\quad i_0$ ✓

$\rightarrow |i_B| = -i_0 \cdot \frac{R_A}{R_A + R_B} = -1.09\ mA$ $\quad i_B'$

C''



$i_B = \frac{Req}{\alpha V_A}$ $\quad Req = (R_0 \| R_A) + R_B = 666.67\ \Omega$