

# Sintesi (progettazione)

## ① Esempio

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

Usiamo il DB a  $\pi$

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

$$\Rightarrow G_A = 0.6 - 0.2 = 0.4 \text{ S}$$

$$\Rightarrow G_B = 0.8 - 0.2 = 0.6 \text{ S}$$

## ② Esempio

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

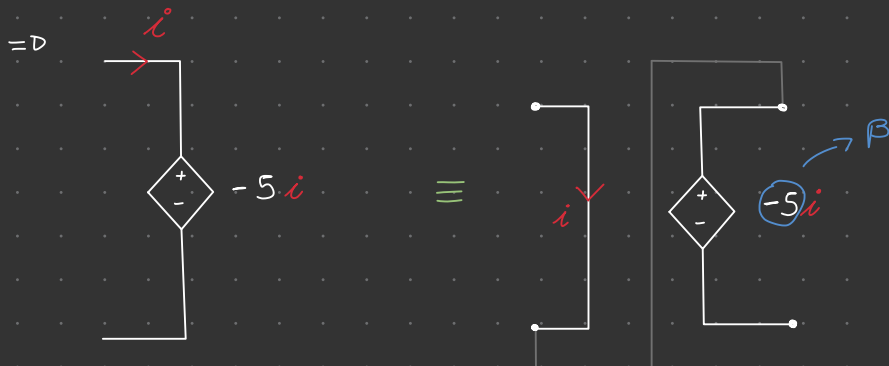
$$\Rightarrow \begin{aligned} G_A &= 0.8 \\ G_B &= 0.6 \end{aligned} \quad G_C = -0.2$$



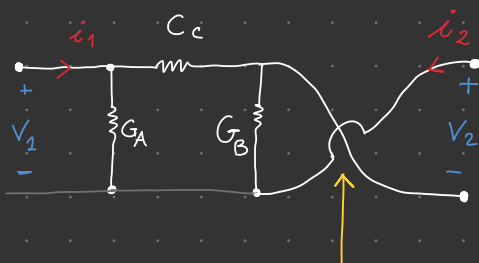
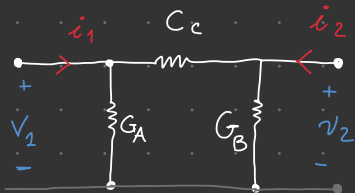
Come realizzare una resistenza negativa?

(a) Generatore controllato (Tensione in corrente)

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



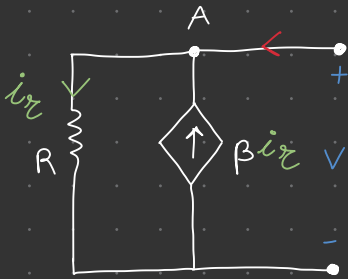
(b) Scambiare i morsetti



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

Scambio i morsetti

### ③ Esempio



$$\text{LKC}_A: -i + i_z - \beta i_z = 0$$

$$\Rightarrow i = i_z - \beta i_z$$

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

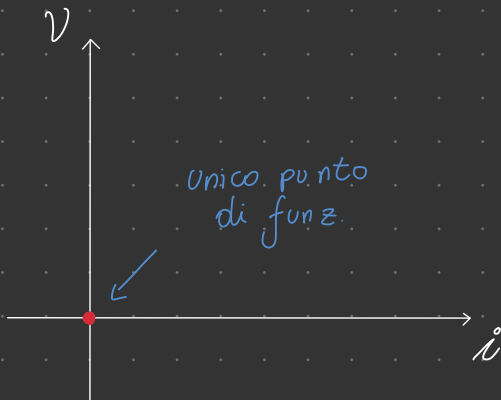
$$v = R \cdot i_R$$

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

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

$$\hookrightarrow \begin{cases} i = i_z (1 - \beta) = 0 \\ v = R i_R = 0 \end{cases}$$

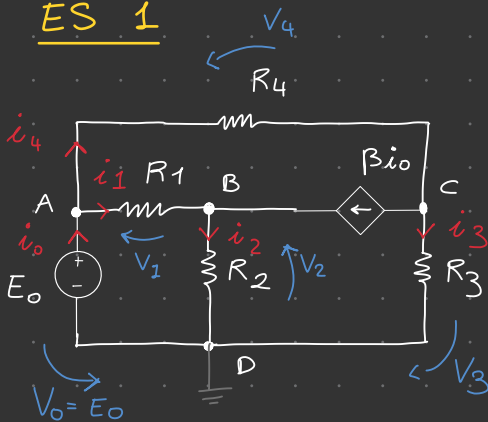
### BIPOLO NULLATORE



Simbolo

# ES 1

## Potenziali di Nodo



DATI

$$E_0 = 6V$$

$$R_1 = 20$$

$$R_2 = 40$$

$$R_3 = 50$$

$$R_4 = 100 \Omega$$

$$\beta = 2.4 \text{ A/A}$$

Pongo  $U_D = 0 \Rightarrow V_0 = U_A - U_D = U_A = E_0$

LKC

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

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

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)

$$-i_0 - G_1 U_B - G_4 U_C = G_1 E_0 - G_4 E_0 \Rightarrow i_0 + G_1 U_B + G_4 U_C = E_0 (G_1 + G_4)$$

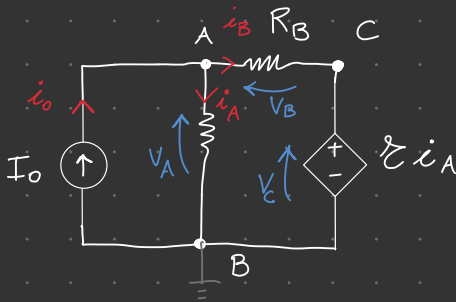
$$-G_1 U_A + G_1 U_B + G_2 U_B - \beta i_0 = 0$$

$$\Rightarrow U_B (G_1 + G_2) - \beta i_0 = G_1 E_0 \quad (2)$$

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

# Potenziali di Nodo con gen Controllati

ES 1:



DATI

$$I_0 = i_0 = 2 \text{ mA} = 2 \times 10^{-3} \text{ A}$$

$$R_A = 10 \text{ k}\Omega = 10 \times 10^3 \Omega$$

$$R_B = 6 \times 10^3 \Omega$$

$$\sum = 4000 \Omega$$

Q:  $V_A$

Pongo  $V_B = 0$

LKC

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

$$\begin{aligned} \text{A: } i_B + i_A - i_0 &= 0 \Rightarrow I_0 = i_A + i_B \\ \text{B: } i_0 - i_A - i_B &= 0 \Rightarrow I_0 = i_A + i_B \end{aligned}$$

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

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

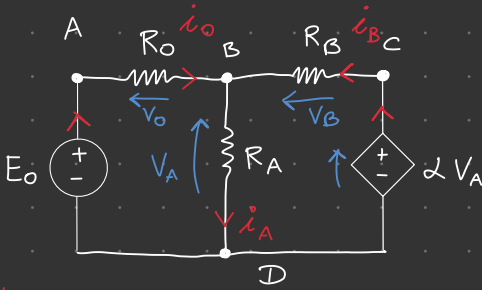
Siccome  $U_C = \sum i_A = \sum G_A V_A = \sum G_A U_A$

$$\Rightarrow i_B = G_B U_A - G_B \sum G_A U_A$$

$$\Rightarrow I_0 = i_A + i_B = G_A U_A + G_B U_A - \sum G_A G_B U_A$$

$$\Rightarrow U_A (G_A + G_B - \sum G_A G_B) = I_0 \Rightarrow U_A = V_A = \frac{I_0}{G_A + G_B - \sum G_A G_B} = 10 \text{ A}$$

ES 2



DATI

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

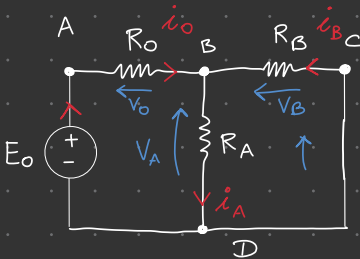
B  $R_A = 2 \times 10^3 \Omega$

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

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

Q:  $i_B = ?$

C'



$$i_0 = \frac{E_0}{R_{eq}}$$

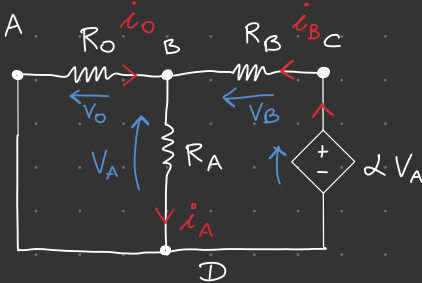
$$R_{eq} = (R_B \parallel R_A) + R_0 = 2200 \Omega$$

$= 2.7 \text{ mA}$   $i_0$

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

$i_B'$

C''



$$i_B = \frac{R_{eq}}{2V_A}$$

$$R_{eq} = (R_0 \parallel R_A) + R_B = 666.67 \Omega$$