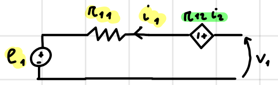
5.1 GENERATORI PILOTATI

Consideriamo $A\underline{v}+B\underline{i}+\underline{c}=0$. Se esiste la base corrente allora:

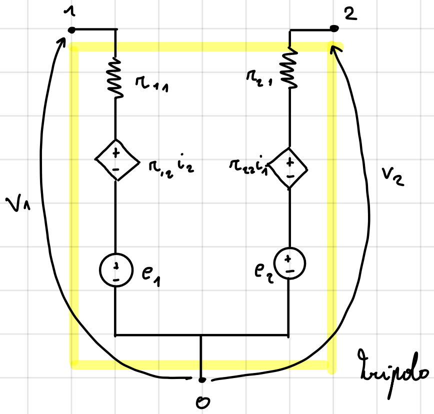
$$\underline{v} = \underbrace{-A^{-1}B}\,\underline{i}\ \underbrace{-A^{-1}\underline{c}} \Rightarrow |A|\neq 0 \longrightarrow \begin{cases} v_1 = r_{11}i_1 + r_{12}i_2 + e_1 \longrightarrow \text{Thevenin}\\ v_2 = r_{21}i_1 + r_{22}i_2 + e_2 \end{cases}$$

$$= R\,\underline{i} + \underline{e}$$

La parte evidenziata (porta 1) rassomiglia ad un circuito equivalente di Thevenin più un extra. L'extra è un GENERATORE DI TENSIONE CONTROLLATO IN CORRENTE:

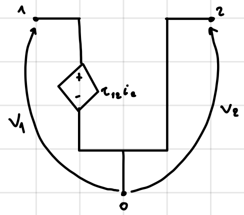


Il ha particolarità di essere legato alla corrente della seconda porta, mentre gli altri sono legati alla prima. La rappresentazione di entrambe le porte sarà:



Il circuito può essere semplificato ponendo $V_2=0$:

$$r_{11}=r_{22}=r_{21}=0 \qquad e_1=e_2=0 \longrightarrow$$



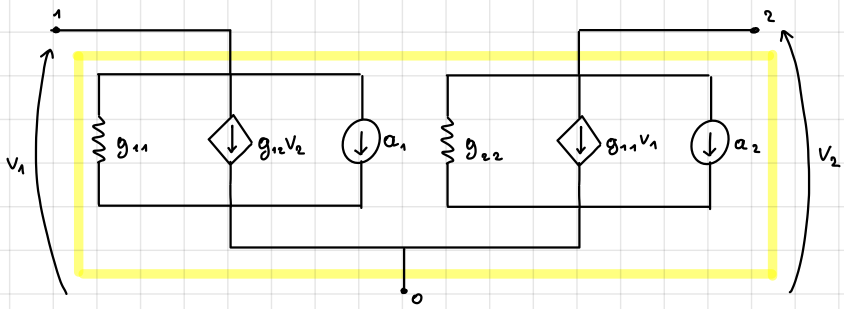
La potenza assorbita sarà: $p_a = V_1 i_1 + \cancel{V_2 i_2} = V_1 i_1$

Se esiste la base tensione:

$$\underline{i} = \underbrace{-B^{-1}A}\,\underline{v}\ \underbrace{-B^{-1}\underline{c}} \Rightarrow |B|\neq 0 \longrightarrow \begin{cases} i_1 = g_{11}v_1 + g_{12}v_2 + a_1\\ i_2 = g_{21}v_1 + g_{22}v_2 + a_2 \end{cases}$$

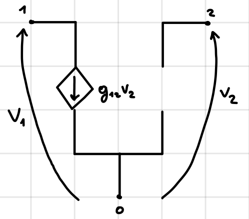
$$= G\,\underline{v} + \underline{a}$$

La matrice R contiene resistenze, mentre G contiene conduttanze. Quindi: $R^{-1}=G$. Ci siamo trovati in una situazione duale alla precedente.



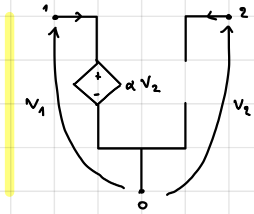
Semplificando come sopra ($i_2=0$)

$g_{11} = g_{22} = g_{21} = 0 \qquad a_1 = a_2 = 0 \quad \longrightarrow$



La potenza assorbita sarà: $p_a = V_1 i_1 + \cancel{V_2 i_2} = G_1 V_1 V_2$

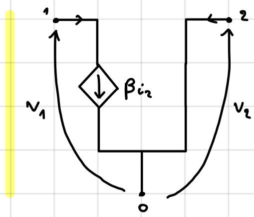
Se esiste la base mista, otterremo altri 2 componenti pilotati:



base ibrida (i_1, v_2)

$$\begin{cases} V_1 = \alpha V_2 \\ i_2 = 0 \end{cases}$$

$p_a = V_1 i_1 = \alpha V_2 i_1$



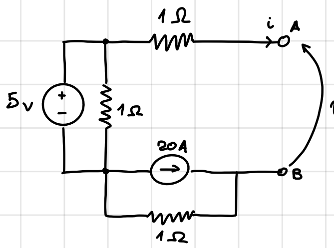
base ibrida (V_1, i_2)

$$\begin{cases} i_1 = \beta i_2 \\ V_2 = 0 \end{cases}$$

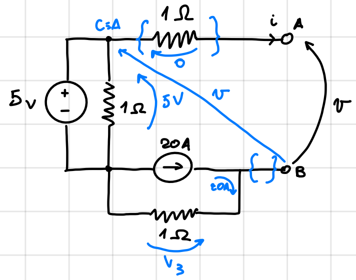
$p_a = V_1 i_1 = \beta V_1 i_2$

Esercitazione

Esercizio 5 (prec. es.)

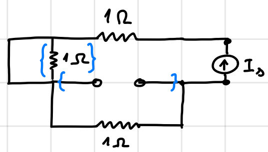


Thevenin:



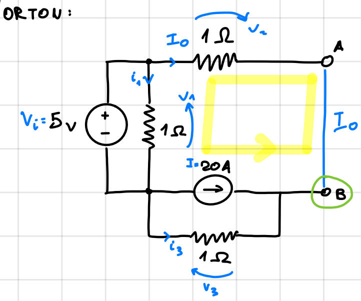
$V_3 = I \cdot R_3 = 20\ V$

$V_{EQ} = 5 - 20 = -15\ V$



$\rightarrow \quad R_{EQ} = 1\Omega + 1\Omega = 2\Omega \quad \Rightarrow \quad V = 2\Omega \cdot i - 15\ V$

Norton:

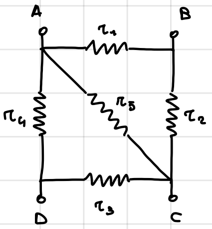


$$\begin{cases} I_o + i_3 + I = 0 \\ V_i = V_2 - V_3 \end{cases} \qquad V_i = V_1$$

$I_o = -7{,}5\ A$

$R_{eq} = 2\ \Omega$

ESERCIZIO 1



$r_? = 1\,\Omega$

R_{AB}:

$r_{34} = r_3 + r_4 = 2\,\Omega$

$r_{345} = \dfrac{r_{34} \cdot r_5}{r_{34} + r_5} = \dfrac{2}{3}\,\Omega$

$r_{2345} = r_2 + r_{345} = \dfrac{5}{3}\,\Omega$

$r_{12345} = \dfrac{r_1 \cdot r_{2345}}{r_1 + r_{2345}} = \dfrac{5}{\cancel{3}} \, \dfrac{\cancel{3}}{8} = \dfrac{5}{8}\,\Omega$

R_{AC}:

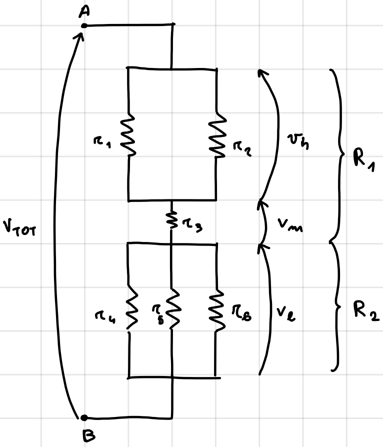
$r_{34} = 2\,\Omega$

$r_{12} = 2\,\Omega$

$r_{1234} = 1\,\Omega$

$r_{12345} = \dfrac{1}{2}\,\Omega$

ESERCIZIO 3



$R_1 = \dfrac{1}{2} + 1 = \dfrac{3}{2}\,\Omega$

$R_2 = \dfrac{1}{3}\,\Omega$

$\longrightarrow$

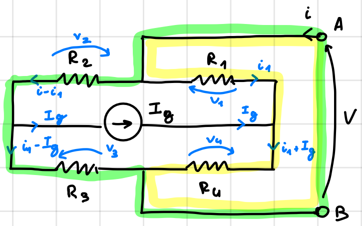
$V_e = V_{TOT} \cdot \dfrac{R_2}{R_1 + R_2} = \dots = \dfrac{20}{11}\ V$

$V_{hm} = V_{TOT} \cdot \dfrac{R_1}{R_1 + R_2} = \dots = \dfrac{90}{11}\ V$

$V_h = V_{hm} \cdot \dfrac{R_1 - r_3}{R_1} = \dots = 2{,}73\ V$

$V_m = V_{hm} \cdot \dfrac{r_3}{R_1} = \dots = 5{,}45\ V$

ESERCIZIO 5



Thevenin e Norton ?

$V = V_1 + V_4 = R_1 i_1 + R_4 (i_1 + I_g) \longrightarrow i_1 = \dfrac{V - R_4 I_g}{R_1 + R_4}$

$V = V_2 + V_3 = \dots = (R_2 + R_3)\, i - \dfrac{R_2 + R_3}{R_1 + R_4} + \dfrac{(R_2 + R_3) R_4}{R_1 + R_4} I_g - R_4 I_g$

$\longrightarrow$ NORTON: $i = \left(\dfrac{1}{R_1 + R_3} + \dfrac{1}{R_1 + R_4} \right) V + \left(\dfrac{R_2}{R_2 + R_3} - \dfrac{R_4}{R_1 + R_4} \right) I_g$

Thevenin: $V = \dfrac{(R_2 + R_3)(R_1 + R_4)}{R_1 + R_2 + R_3 + R_4} \cdot i + \dfrac{R_2 R_4 - R_1 R_3}{R_1 + R_2 + R_3 + R_4} I_g$