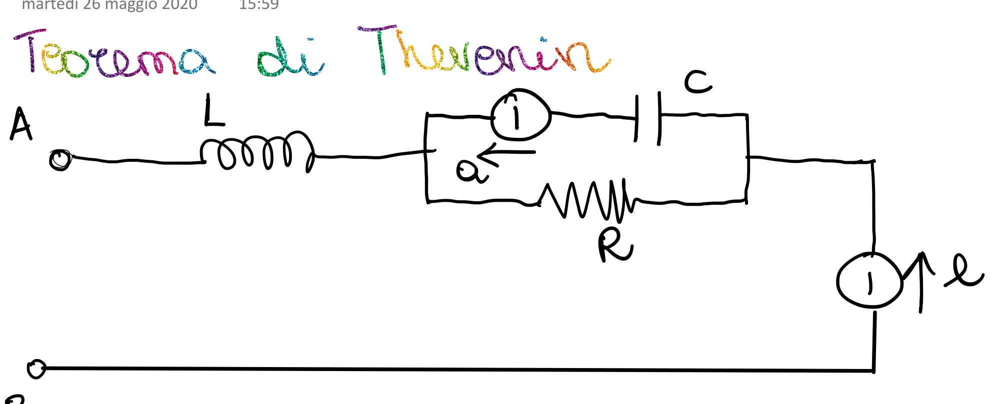
REGIME SINUSOIDALE

martedì 26 maggio 2020 15:59

Teorema di Thevenin



Trovare il circuito equivalente di Thevenin ai morsetti AB.

$E_{eff} = 18$ $\angle \bar{E} = 0$ $A_{eff} = 12A$ $f = 50Hz$

$\delta = \pi/6$ $L = 1H, C = 200\mu F, R = 10\Omega$

Per i generatori ci vengono dati i VALORI EFFICACI. Da un punto di vista energetico la tensione sinusoidale $v(t)$ produce gli stessi effetti di una tensione continua di valore pari a $V_{efficace} \to V_{eff}$.

$V_{eff} = 230\ V$ RETE ITALIANA

$\bar{E} = 18$ (fase zero) $\angle \bar{A} = \delta = \pi/6$

$\bar{A} = 12\, e^{j\pi/6} = 12\left(\cos\frac{\pi}{6} + j \operatorname{sen} \pi/6\right) =$

$= 12\left(\frac{\sqrt{3}}{2} + j\frac{1}{2}\right) = 10{,}39 + j6$

Sono fasori riferiti ai valori efficaci

$\bar{V} = V_{eff}\, e^{j\alpha}$ riferito al V. e.

$\bar{V} = V_M\, e^{j\alpha}$ " al valore MASSIMO

$V_{eff} = \frac{V_M}{\sqrt{2}}$ per grandezze sinusoidali

Disegnare il circuito nel dominio dei fasori. Cerco le impedenze

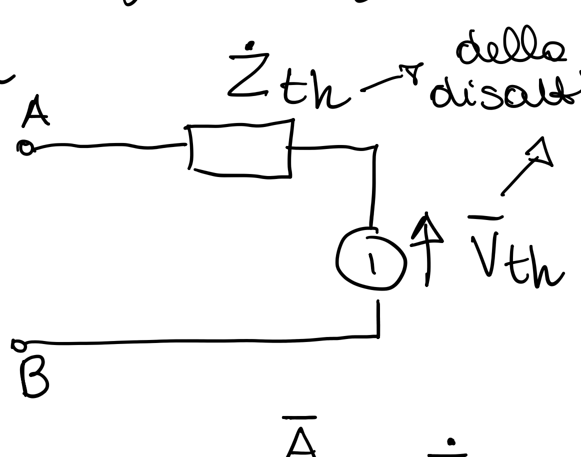
$\dot{Z}_L = j\omega L = j2\pi f L = j2\pi \cdot 50 \cdot 1 =$

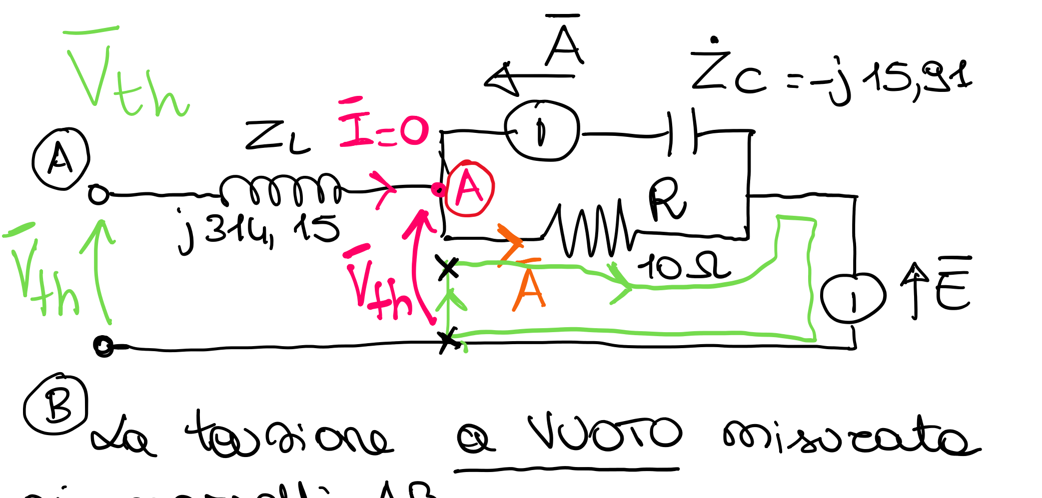
$= j314{,}15\ \Omega$

$\dot{Z}_R = R = 10\ \Omega;$

$\dot{Z}_C = \frac{1}{j\omega C} = \frac{1}{j2\pi f C} = \frac{1}{j2 \cdot \pi\, 50 \cdot 200 \cdot 10^{-6}} =$

$-j\,15{,}91\ \Omega$

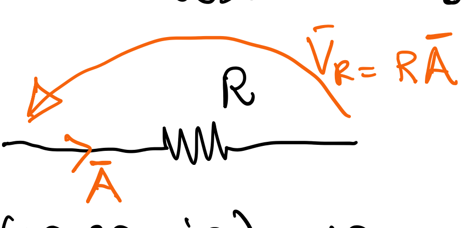




La tensione a VUOTO misurata ai morsetti AB.

Nella Z_L non circola corrente ($\bar{I} = 0$) $\Rightarrow$ la corrente $\bar{A}$ si richiude tutta su R

La LKT nel percorso chiuso verde: (Non è una maglia)

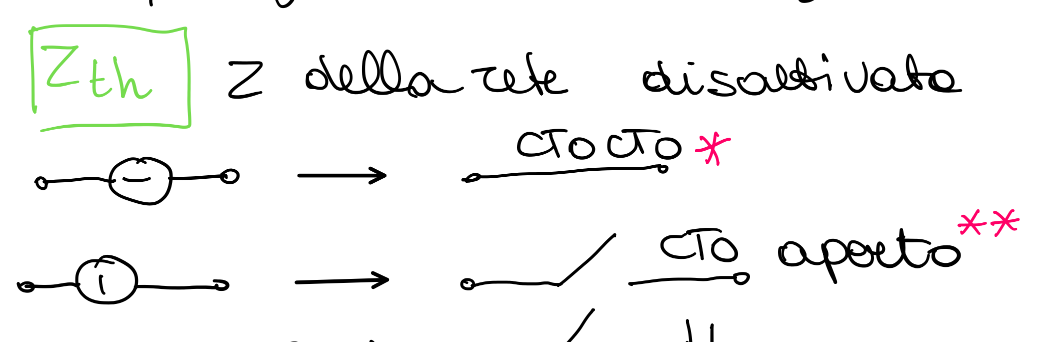


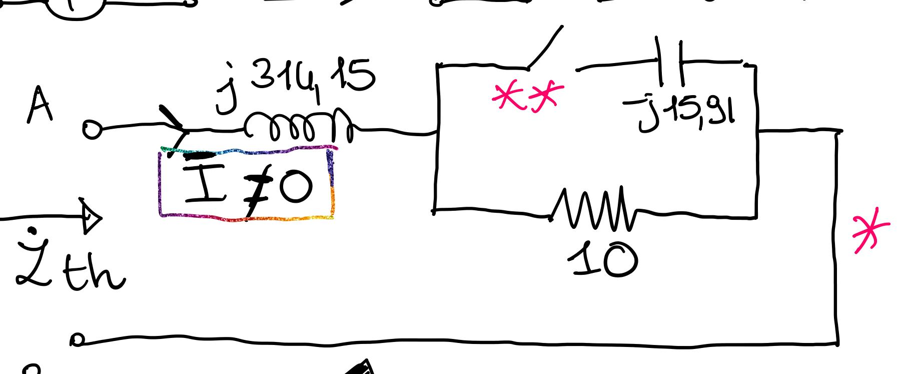
$\bar{V}_{th} - R\bar{A} - \bar{E} = 0$

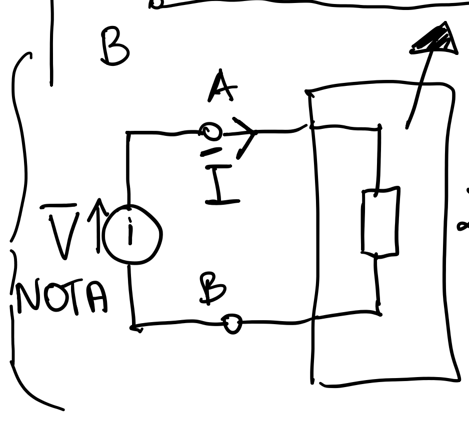
$\bar{V}_{th} = R\bar{A} + \bar{E} = 10(10{,}39 + j6) + 18 =$

$= 103{,}9 + j60 + 18 = 121{,}9 + j60$

Z_{th} Z della rete disattivata







METODO DEL GEN. ARBITRARIO

$\bar{V} = \dot{Z}_{th}\, \bar{I}$

$\dot{Z}_{th} = \bar{V}/\bar{I}$

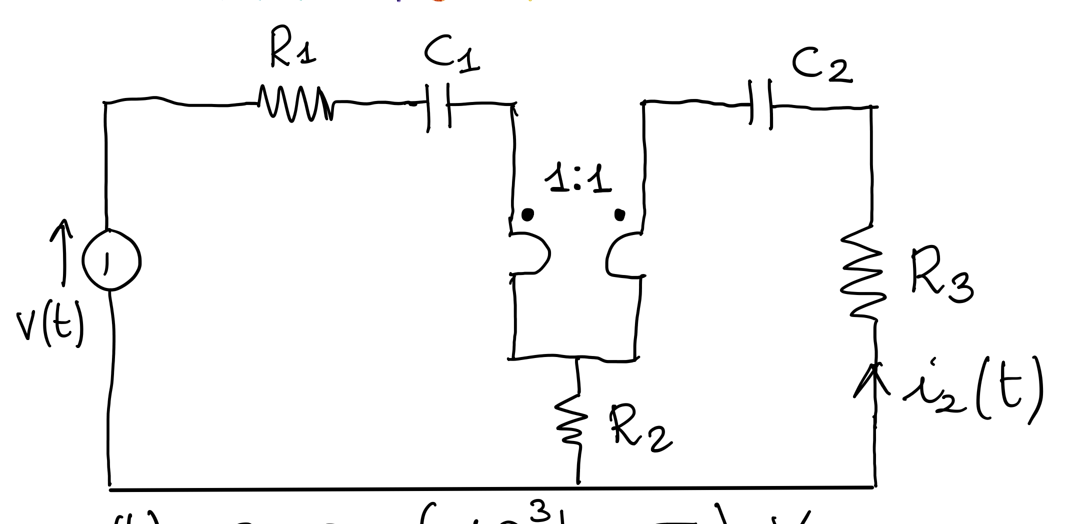
ad esempio $\bar{V} = 1$. Trovo $\bar{I}$, e poi trovo $\dot{Z}_{th}$

$\dot{Z}_{th} = Z_L + R = j314{,}15 + 10 =$

$= 10 + j314{,}15$

METODO DEGLI ANELLI e FASORI

TRASFORMATORE IDEALE



$v(t) = 24\ \operatorname{sen}\left(10^3 t + \frac{\pi}{2}\right)\ V$

$R_1 = 1\Omega,\ R_2 = R_3 = 2\Omega,\ C_1 = 1\ mF$

$C_2 = 0{,}5\ mF,\ i_2(t) = ?$

$\omega = 10^3\ rad/s$

$v(t) = 24 \operatorname{sen}\left(10^3 t + \frac{\pi}{2}\right) = 24\cos(10^3 t)$

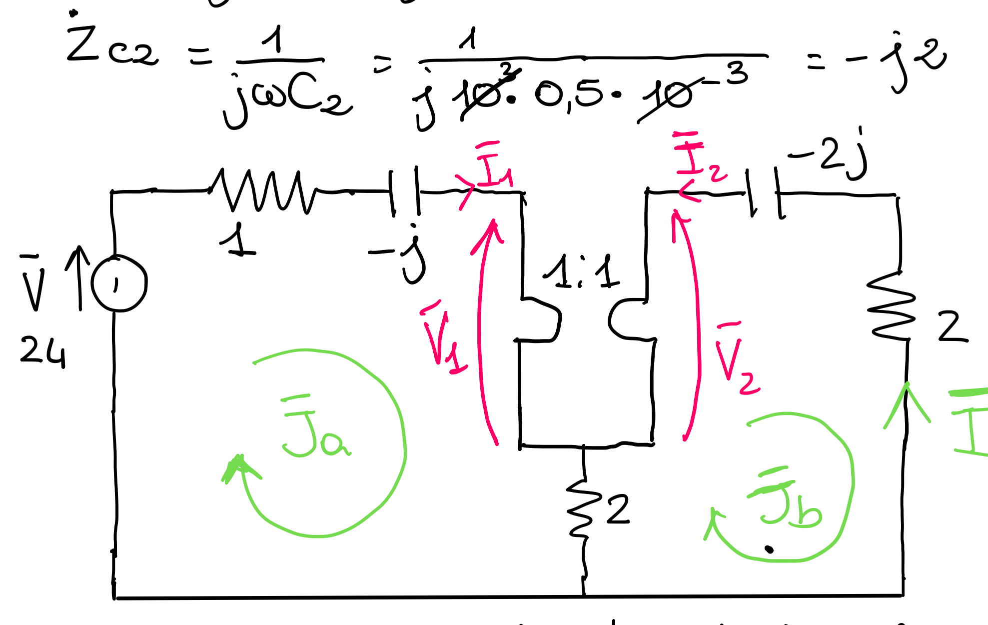
$\bar{V} = 24 \angle 0 = 24$ è riferito al valore massimo.

$\left(V_{eff} = \frac{24}{\sqrt{2}} \angle 0 = 16{,}97\right)$

$\dot{Z}_{R1} = R_1 = 1,\ \dot{Z}_{R2} = \dot{Z}_{R3} = 2,$

$\dot{Z}_{C1} = \frac{1}{j\omega C_1} = \frac{1}{j\,10^3 \cdot 10^{-3}} = -j$

$\dot{Z}_{C2} = \frac{1}{j\omega C_2} = \frac{1}{j\,10^3\, 0{,}5 \cdot 10^{-3}} = -j2$



Le equazioni del trasf. ideale

$\bar{V}_1 : \bar{V}_2 = 1:1$

$\begin{cases} \bar{V}_1 = \bar{V}_2 \\ \bar{I}_1 = -\bar{I}_2 \end{cases}$ ha introdotto nuove incognite;

$\bar{J}_a = \bar{I}_1 \quad \bar{J}_b = -\bar{I}_2$

Le eq^{ni} del trasf. diventano

$\begin{cases} \bar{V}_1 = \bar{V}_2 \\ \bar{J}_a = -(-\bar{J}_b) \end{cases}$ $\bar{J}_a = \bar{J}_b$

(a) $\bar{J}_a(3-j) - \bar{J}_b \cdot 2 = 24 - \bar{V}_1$ ($\bar{J}_b \to \bar{J}_a$)

(b) $-2\bar{J}_a + \bar{J}_b(4-2j) = \bar{V}_2$ ($\bar{J}_b \to \bar{J}_a$, $\bar{V}_2 \to \bar{V}_1$)

incognite $\bar{J}_a$ e $\bar{V}_1$

$\begin{cases} \bar{J}_a(1-j) + \bar{V}_1 = 24 \\ (2-2j)\bar{J}_a - \bar{V}_1 = 0 \end{cases}$

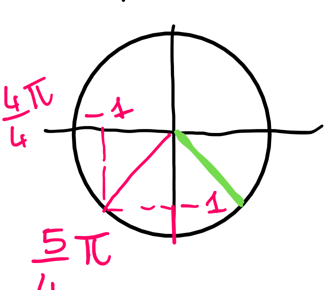
$\bar{J}_a(3-3j) + // = 24 \qquad \bar{J}_a = \frac{24}{3-3j}$

$\bar{J}_a = \frac{8}{1-j} = \frac{8(1+j)}{(1-j)(1+j)} = \frac{8(1+j)}{2}$

$= 4(1+j)$

$\bar{I}_2 = -\bar{J}_b = -\bar{J}_a = -4(1+j) =$

$= 4\sqrt{1^2+1^2}\ \angle \operatorname{atan}\frac{-1}{-1} = 4\sqrt{2}\ \angle \operatorname{atan}(1)$



$= 4\sqrt{2}\ \angle 45° =$ NO!

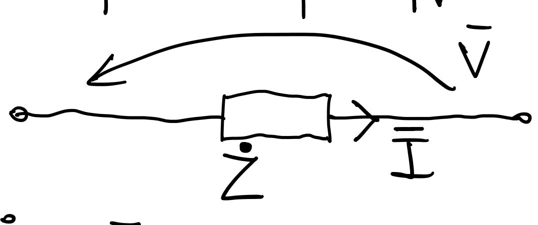
$= 4\sqrt{2}\ \angle \pi/4$

$= 4\sqrt{2}\ \angle \pi/4 + \pi = 4\sqrt{2}\ \angle \frac{5}{4}\pi$

$i_2(t) = 4\sqrt{2}\cos\left(10^3 t + \frac{5}{4}\pi\right)\ A$

FATTORE DI POTENZA

$\cos\varphi \qquad \varphi = \varphi_V - \varphi_I$



$\dot{Z} = \frac{\bar{V}}{\bar{I}}$

$\dot{Z} = \frac{\bar{V}}{\bar{I}} = \frac{|\bar{V}|}{|\bar{I}|} = \frac{V\ \angle\bar{V}}{I\ \angle\bar{I}} = \frac{V}{I}\ \angle \varphi_V - \varphi_I$ (φ)

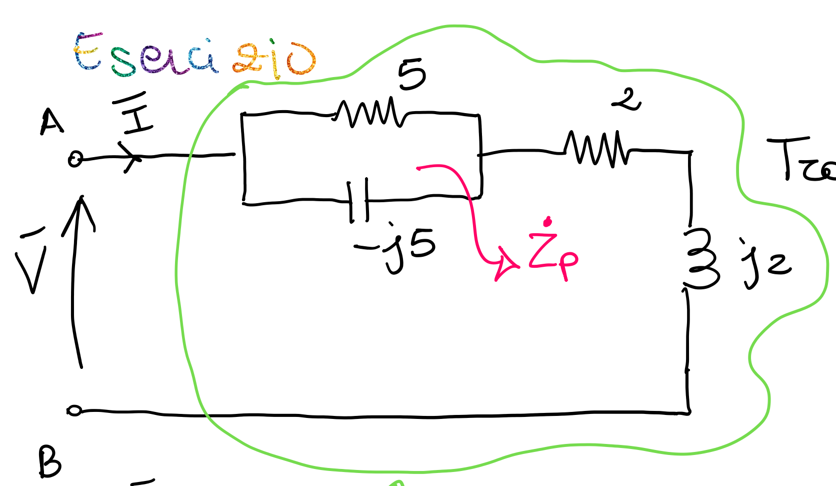
$= \frac{V}{I}\, e^{j\varphi}$

$\varphi = \varphi_V - \varphi_I =$ fase di $\dot{Z}$

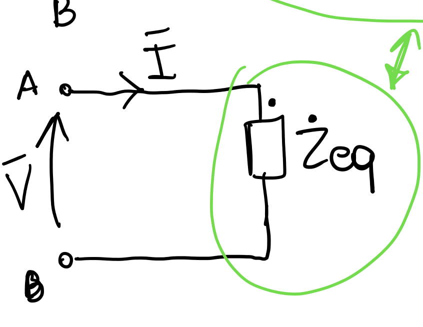
caratteristica del bipolo

$\varphi_R = 0 \qquad \varphi_L = \frac{\pi}{2} \qquad \varphi_C = -\frac{\pi}{2}$

Esercizio



Trovare $\cos\varphi$



$\varphi = \varphi_V - \varphi_I = \angle \dot{Z}_{eq}$

$\cos\varphi$ fattore di potenza

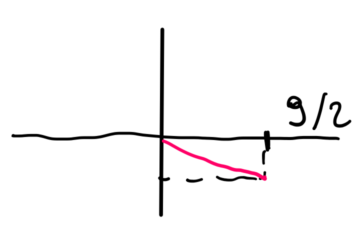
$\dot{Z}_{eq} = 2 + j2 + Z_P$

$\dot{Z}_P = \frac{1}{Y_P} \qquad Y_P = Y_1 + Y_2 = \frac{1}{5} + \frac{1}{-j5} = \frac{1}{5} + \frac{j}{5}$

$= \frac{1}{5}(1+j) \qquad Z_P = \frac{1}{Y_P} = \frac{5}{1+j} = \frac{5}{2}(1-j)$

$\dot{Z}_{eq} = 2 + j2 + \frac{5}{2} - \frac{5}{2}j = 4{,}5 - 0{,}5j = \frac{9-j}{2}$

$= \frac{1}{2}\sqrt{9^2+1^2}\ \angle \operatorname{atan}(-1/9) = 4{,}53\ \angle -0{,}11$



$-6{,}3$

$-\frac{6{,}3}{180} \cdot \pi = -0{,}11\ rad$ (φ)

$\cos\varphi = 0{,}99$ (fattore di potenza)