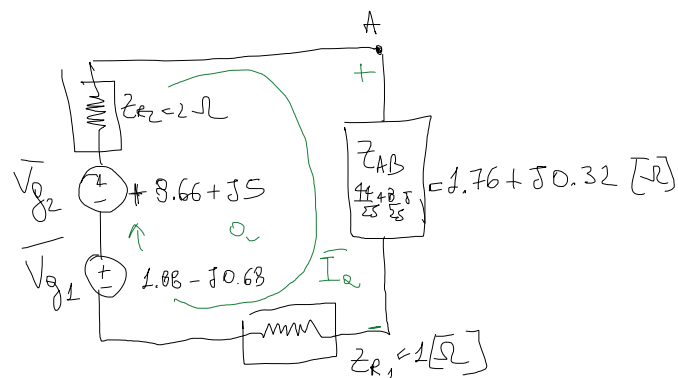


FASOR

$$\vec{I}_g = 5e^{j30^\circ} = 5[\cos(30^\circ) + j\sin(30^\circ)]$$
$$\vec{I}_g = 4.33 + j2.5 \quad [A]$$
$$\vec{V}_g = 2e^{j20^\circ} = 2[\cos(20^\circ) - j\sin(20^\circ)]$$
$$\vec{V}_g = 1.88 - j0.68 \quad [V]$$
$$Z_{R_1} = 3 \quad [\Omega]$$
$$Z_{L_1} = j\omega L$$
$$= j100 \text{ mH/s} \cdot 1040^{-3}$$
$$Z_{R_2} = 1 \quad [\Omega]$$
$$Z_{L_2} = j\omega L$$
$$Z_{L_2} = 1 \quad [\Omega]$$


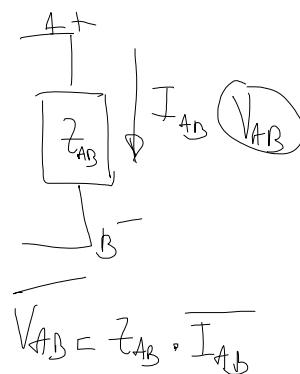
$$\textcircled{2} \quad \overline{I_2} (z_{r2} + z_{AB} + z_{r1}) - \overline{V_{g1}} - \overline{V_{g2}} = 0$$

$$\overline{I_2} = \frac{\overline{V_{g2}} + \overline{V_{g2}}}{Z_{R2} + Z_{4B} + Z_{R1}}$$

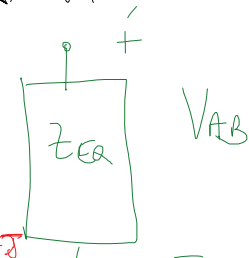
$$I_2 = \frac{188 - j0.68 + 8.46 + j5}{2 + 1.76 + j0.32 + 1} = \frac{10.44 + j4.32}{4.76 + j0.32} \cdot \frac{(4.76 - j0.32)}{(4.76 - j0.32)} = \frac{10.44 + j4.32}{4.76 + j0.32} \cdot \frac{(4.76 - j0.32)}{(4.76 - j0.32)}$$

$$\frac{49.69 - 33.34 + 20.56 + 1.30}{22.75} = \frac{51.07 + 17.22}{22.75} = 224 + 70.75 \quad [A]$$

$$\overline{V}_{AB} = (2.14 + j0.45) \cdot (2.76 + j0.328) = 3.94 + j0.7$$



Passiva      Preattiva?



$$Z_{EQ} = Z_{R3} + Z_{L1} = 3 + j$$

$\bar{S} = P + jQ = \frac{1}{2} \bar{V} \bar{I}^*$   
 $\bar{V} = Z \cdot \bar{I} \Rightarrow \frac{\bar{V}}{Z} = \bar{I}$

$$S_{I_g} = \frac{1}{2} \sqrt{I_g^*} = \frac{1}{2} (-13.73 + j9.205) (-55) = 344.55 + j23 \text{ [VA]}$$

$$V_g(t) = |V_{I_g}| \cos(\omega t + \arg(\bar{V}_{I_g})) \Rightarrow \sqrt{43.78^2 + 8.20^2} = 46.57 \text{ [V]}$$

$$\phi_{I_g} = \tan^{-1} \left\{ \frac{9.20}{-13.98} \right\} + 180^\circ = 146.27^\circ$$

$$V_{I_f}(t) = 16.57 \cos(\omega t + 146.27^\circ) \text{ [V]}$$

$$\overline{V} = \overline{V}_C \Rightarrow \overline{V} = \overline{V}_C = \frac{1}{\sqrt{2}} V$$

$$\overline{S_c} = \frac{1}{2} \frac{|V|^2}{\epsilon^*}$$

$$\overline{S_c} = \frac{1}{2} \frac{10.95}{2.5} \approx -52.75 [VA]$$

## Esercizi

Soluzione

Trasformiamo i generatori in fasori e i componenti in impedenze.

$V_1 = 2 \angle -20^\circ \text{ V}$ ,  $1.88 - j0.68 \Omega$

$V_2 = 5 \angle 30^\circ \text{ V}$ ,  $1.13 + j2.2 \Omega$

Impedenza del ramo  $R_1$

$Z_1 = R_1 + j\omega L_1 = 3 + j \cdot 100 \cdot 100 \cdot 10^{-3} = 3 + j1$

Handwritten notes on the diagram:

- RETE DI TENSIONE (with an arrow pointing to the left branch)
- RETE DI TENSIONE (with an arrow pointing to the right branch)
- $I_1$  (near the top of the central branch)
- $I_2$  (near the top of the right branch)
- $I_3$  (near the bottom of the central branch)
- $I_4$  (near the bottom of the right branch)
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- $I_{99}$  (near the bottom of the central branch)
- $I_{100}$  (near the bottom of the right branch)

## Esercizi

**Soluzione (continua)**

Trasformiamo il generatore di corrente reale in un tensore reale e facciamo il parallelo tra  $Z_1$  e  $Z_2$

$$Y_2 = I_2 \cdot Z_2 = 4,23 + j2,5 \quad 2,66 = j5 \cdot Y_2$$

$$Z_2 = j0,2 \quad \frac{(3+j)}{3} = 1,76 + j0,22$$

$$\frac{(3+j)}{3+j} = 4$$

Calcoliamo la corrente che scorre nella maglie

$$I_2 = I_1 + I_2 = \frac{1,188 - j0,051 + j5,66 - j5}{1 + 2 + (1,76 + j0,32)}$$

$$= 2,268 - j0,7555 \text{ A}$$

Calcoliamo la caduta di tensione su  $Z_2$  che

$$V_{Z_2} = I_2 \cdot Z_2 = (1,76 + j0,32) \cdot (2,265 + j0,7555)$$

$$= 3,74 + j2,05 \text{ V}$$

$$V_{AB} = V_{Z_2} = 3,74 + j2,05 \text{ V}$$

Generatore equivalente

The diagram shows the equivalent circuit for finding the current through the short circuit. It consists of a voltage source  $V_1 = 10V$  in series with a resistor  $R_1 = 10\Omega$ . This is in parallel with a branch containing a resistor  $R_2 = 2\Omega$  in series with a voltage source  $V_2 = 20V$ . The output terminals A and B are short-circuited. A current source  $I_2 = 4,23A$  is in parallel with the output terminals. The current through the short circuit is labeled  $I_2$ . The voltage across the short circuit is  $V_{AB}$ .

## Esercizi

**Soluzione (continua)**

Quindi  $P_{av} = P_{max} = 3,74 + j,05 \text{ V}$

**Ripartiamo dal dominio del tempo**

$$i = (1,919 \cos(2\pi 50t) + 4,26)$$

$$\phi = \tan^{-1} \left( \frac{2,85}{1,919} \right) = 28,73^\circ$$

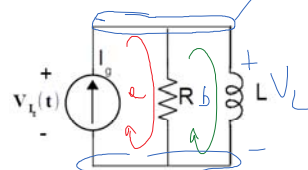
$$v_{AB}(t) = 4,26 \cos(100\pi + 28,73^\circ) \text{ V}$$

Per calcolare la potenza complessa sull'impedenza  $Z_2$  basta usare la formula

$$S = \frac{1}{2} \frac{|V_{AB}|^2}{Z_2} = \frac{1}{2} \frac{(4,26)^2}{-j1} = 2,72 + j0,91 \text{ VA}$$

Quindi la potenza attiva e quella reattiva sono rispettivamente

$$P = 2,72 \text{ W}$$


$$Q = 0,91 \text{ VAR}$$


Esercizio n° 2 (10 punti)  
Il circuito in figura si trova in regime sinusoidale.  
Determinare: (1) la potenza generata dal generatore di corrente; (2) la potenza assorbita dal generatore di corrente  $I_g$ .  
DATI:  $I_g = k_C \cos(\omega t + 90^\circ)$  [A]  
[mH],  $\omega = 2000$  [rad/s]

$k_C = 5 \text{ kN}$

Circuit Symbols

$y(t) \rightarrow \bar{y} = K e^{j\omega t} = j\omega K [A]$   
 $R \rightarrow Z_R = R = K_R [A]$   
 $L \rightarrow Z_L = j\omega L = jX_L [A]$



The diagram shows a simple AC circuit. On the left is an AC voltage source represented by a circle with a vertical arrow pointing upwards, labeled  $\bar{y}$ . This source is connected in series with two rectangular blocks representing impedances. The first block is labeled  $Z_1$  and the second block is labeled  $Z_2$ . The circuit is a single loop.

Partito di C. Conscience

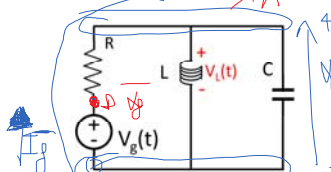


$$\overline{V}_{f6} = \overline{I}_f \cdot Z_y = 3K_c \cdot \frac{K_N \cdot 3L}{K_N + 3L} = \frac{-6K_N K_c}{K_N + 3L} =$$

$$\begin{aligned} \bar{S}_{ij} &= \frac{1}{2} \bar{V}_i \cdot \bar{T}_j^A = \frac{1}{2} \cdot \frac{2k_u k_v}{k_u + 34} \cdot (-3u_c) = -2 \\ &= \frac{32 k_u k_v^2}{k_u + 34} = \frac{8 k_u k_v^2 + 32 k_v^3 k_v^2}{k_v^2 + 16} [w] + 3 [vA] \end{aligned}$$

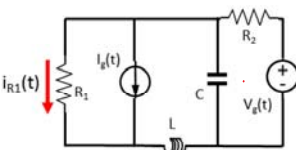
$$v_{ig}(t) = |\sqrt{z_g}| \cos(\omega t + \text{Arg}(v_{ig})) = \frac{4k_{ig}k_e}{\sqrt{k_{ig}^2 + 4}} \cos(\omega t + \pi - \text{atg} \frac{4}{k_{ig}}) [\sqrt{z_g}]$$

**Esercizio n° 2 (12 punti)**



Esercizio n° 2 (12 punti)  
Il circuito in figura si trova in regime permanente sinusoidale.  
Determinare: (1) la potenza apparente e il fattore di potenza del generatore di tensione  $V_g(t)$ ; (2) la potenza complessa scambiata dal condensatore C; (3) la tensione nel tempo  $V_C(t)$  ai capi dell'induttore L.  
DATI:  $V_g(t) = k_S \sin(\omega t)$  [V],  $R = 2 \, \Omega$ ,  $L = k_C$  [mH],  $C = 500 \, \mu\text{F}$   $\omega = 1000$  [rad/s]

$$\overline{V_{RL}} = \overline{V_L}$$



**Esercizio n° 2 (12 punti)**  
Il circuito in figura si trova in regime permanente sinusoidale.

Determinare: (1) la potenza apparente e il fattore di potenza del generatore di corrente  $I_d(t)$ ; (2) verificare la conservazione della potenza attiva; (3) la corrente  $i_2(t)$  che scorre nella resistenza  $R_1$ .

DATI:  $V_d(t) = k_e \cos(\omega t)$  [V],  $I_d(t) = 3 \cos(\omega t + \pi/2)$  [A],  $R_1 = R_N$  [Ω],  $R_2 = 3$  [Ω],  $L = 2$  [mH],  $C = 100$  [μF],  $\omega = 2000$  [rad/s].

$$\textcircled{D} \rightarrow -\bar{I}_V g + \frac{V_g - E_A}{Z_R} = 0 \Rightarrow I_V = \frac{V_g - V_{E_L}}{Z_R}$$

$$e_n = -1,84 - 2,76j \text{ [V]} = V_1$$

$$V_L(t) = \operatorname{Re} \left\{ \bar{V}_L e^{j\omega t} \right\} = |V_L| \cos(\omega t + \angle \{V_L\}) = 3.31 \cos(\omega t + 56.30^\circ)$$

$$I_V = \frac{V_0 - V_{eL}}{R_R} = \frac{(-1.84 + 2.76 \text{ V}) + (-4 \text{ V})}{2} = \frac{+1.84 - 4 \text{ V}}{2} = 0.97 - 0.62 \text{ V}$$

$$P_{\text{COMPRESSA}} \overline{V_g} = \frac{1}{2} V_g \cdot I_g^* = \frac{1}{2} (-4J) \cdot (0.97 + 0.62J) = 1.24 - 1.94J \quad [VA]$$

$$P.F. = \frac{\operatorname{Re}\{S_{\text{eff}}\}}{|S_{\text{eff}}| \rightarrow \text{PAPPARENTE } |S_{\text{eff}}|} = \frac{P_{\text{ATTIVA}}}{2.30} = \frac{1.24}{2.30} = 0.53 = \cos \phi$$

$$1 + j1.32 - 0.24 = \boxed{3.70 + j2.03} \text{ [V]}$$

$$\frac{-2.03}{(3-j)} = \frac{(6.95 + 2.06)(3+j)}{3-j} = \frac{20.55 + 6.18 + 6.95j + 2.06j}{9+1} = \frac{26.73 + j8.91}{10} = 2.67 + j0.89 \text{ [VA]}$$

$\uparrow$   
 $P_{\text{ATTIVA}} = \text{Re}\{S\} = 2.67 \text{ [W]}$   
 $\downarrow$   
 $P_{\text{REATTIVA}} = 0.89 \text{ [VAR]}$

$$\overline{S} = \overline{P} + j\overline{Q}$$

$$P_{\text{ATTIVA}} = \text{Re}\{S\} = 2.67 \text{ [W]}$$

$$2.67 + j0.89 \text{ [VA]}$$

$$P_{\text{REATTIVA}} = 0.89 \text{ [VAR]}$$