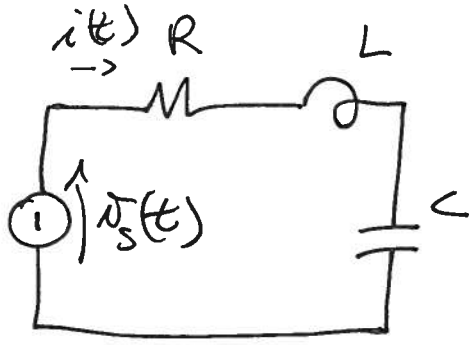
# ES 39




$v_s(t) = \sqrt{2}\ 100 \cos(1000t)\ V$

$R = 10\,\Omega$

$L = 20\,mH$

$C = 100\,\mu F$

Verificare che la potenza complessa si conserva

$\dot{V}_s = 100\,V$ , $\omega = 1000\ \frac{rad}{s}$

$X_L = j\omega L = 20\,\Omega$

$X_C = -\frac{1}{\omega C} = -10\,\Omega$

$$\dot{I} = \frac{\dot{V}_s}{R + j(X_L + X_C)} = 5 - j5\,A$$

$\dot{V}_R = R\,\dot{I} = 50 - j50\,V$

$\dot{V}_L = j X_L \dot{I} = 100 + j100\,V$

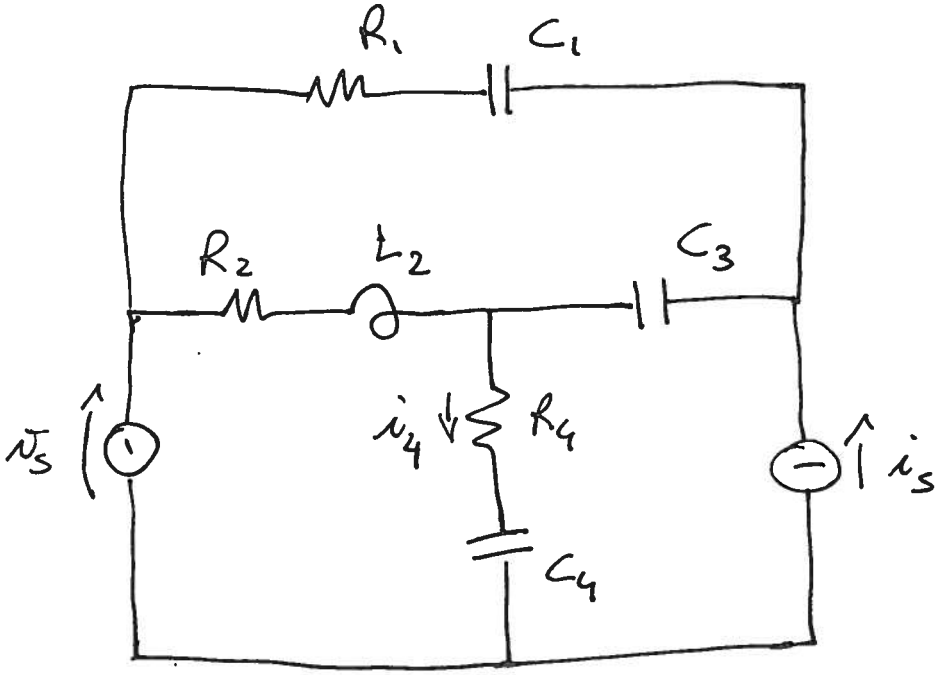
$\dot{V}_C = j X_C \dot{I} = -50 - j50\,V$

$\bar{S}_{V_s} = \dot{V}_s \dot{I}^* = 500 + j500\,VA$

$\bar{S}_R = \dot{V}_R \dot{I}^* = 500\,VA$ $\quad \bar{S}_C = \dot{V}_C \dot{I}^* = -j500\,VA$

$\bar{S}_L = \dot{V}_L \dot{I}^* = j1000\,VA$ $\quad \bar{S}_R + \bar{S}_L + \bar{S}_C = 500 + j500\,VA = \bar{S}_{V_s}$

# ES 40




$R_1 = R_2 = R_4 = 1\,\Omega$

$L_2 = 1\,H$

$C_1 = C_3 = C_4 = 1\,F$

$\omega_1 = 1\ rad/s$

$\omega_2 = 2\ rad/s$

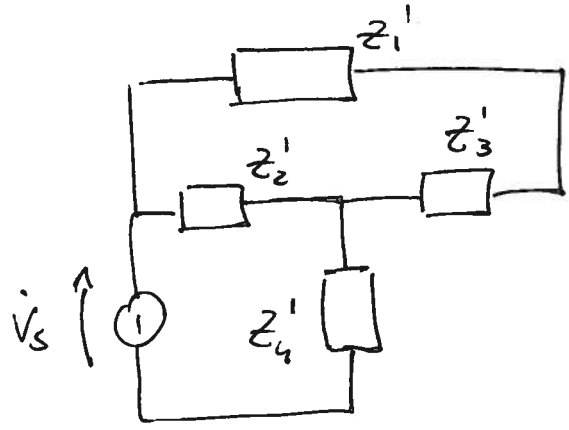
$$v_s(t) = 4\sqrt{2}\cos\left(\omega_1 t + \frac{\pi}{4}\right) V$$

$$i_s(t) = 5\cos\left(\omega_2 t + \frac{\pi}{2}\right) A$$

Calcolare la potenza erogata da $R_4$.

$i_s(t) = 0$

$$v_s(t) \rightarrow \dot{V}_s = 4\exp\left(j\frac{\pi}{4}\right) V = 2\left(\sqrt{2} + j\sqrt{2}\right) V$$

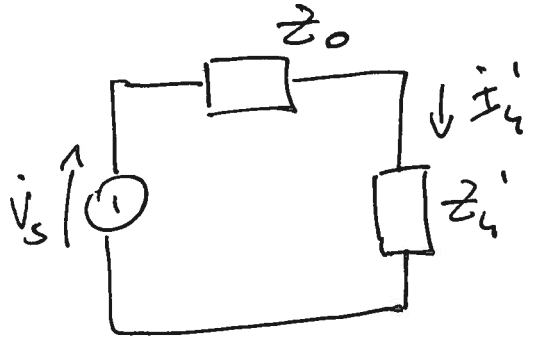



$$Z_1' = R_1 - j\frac{1}{\omega_1 C_1} = 1 - j\,\Omega$$

$$Z_2' = R_2 + j\omega_1 L_2 = 1 + j\,\Omega$$

$$Z_3' = -j\frac{1}{\omega_1 C_3} = -j\,\Omega$$

$$Z_4' = R_4 - j\frac{1}{\omega_1 C_4} = 1 - j\,\Omega$$




$$Z_0 = (Z_1' + Z_3') \parallel Z_2'$$

$$= \frac{Z_2''(Z_1' + Z_3')}{Z_1' + Z_2' + Z_3'} = \frac{7+j}{5}\ \Omega$$

$$\dot{I}_4' = \frac{\dot{V}_s}{Z_0 + Z_4'} = \frac{4+j4}{\sqrt{2}} \cdot \frac{1}{\frac{7+j}{5} + 1 - j} \text{ A} = \frac{1+j2}{\sqrt{2}}\ \text{A}$$

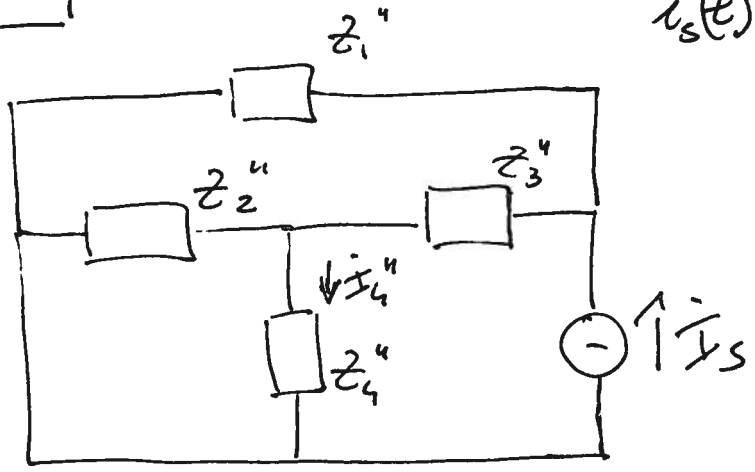
$$|\dot{I}_4'^{A'}| = \frac{\sqrt{5}}{\sqrt{2}}$$

$$\arg(\dot{I}_4') = \operatorname{atan}\left(\frac{2}{1}\right) = 1{,}11\ \text{rad}$$

$$i_{L_4}'(t) = \sqrt{5}\cos(\omega_1 t + 1{,}11)$$

$v_s(t) = 0$

$$i_s(t) \rightarrow \dot{I}_s = j\frac{5}{\sqrt{2}}\ \text{A}$$

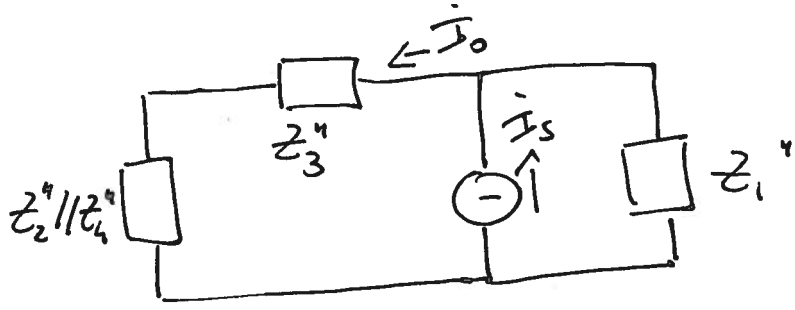



$$Z_1'' = R_1 - j\frac{1}{\omega_2 C_1} = 1 - j\frac{1}{2}\ \Omega$$

$$Z_2'' = R_2 + j\omega_2 L_2 = 1 + j2\ \Omega$$

$$Z_3'' = -j\frac{1}{\omega_2 C_3} = -j\frac{1}{2}\ \Omega$$

$$Z_4'' = R_4 - j\frac{1}{\omega_2 C_4} = 1 - j\frac{1}{2}\ \Omega$$




$$Z_0'' = Z_2''//Z_4'' + Z_3 = 1 - j\frac{1}{2}\ \Omega$$

$$\dot{I}_0'' = \dot{I}_S \frac{\frac{1}{Z_0''}}{\frac{1}{Z_0''} + \frac{1}{Z_1''}} = j\frac{5}{2\sqrt{2}}\ A$$

$$\dot{I}_4'' = \dot{I}_0'' \frac{Z_2''}{Z_2'' + Z_4''} = \frac{-1 + j2}{\sqrt{2}}\ A$$

$$|\dot{I}_4''| = \frac{\sqrt{5}}{\sqrt{2}}\ A \qquad i_4''(t) = \sqrt{5}\cos(\omega_2 t + 2{,}03)$$

$$\arg(\dot{I}_4'') = 2{,}03\ rad$$

$$i_4(t) = \sqrt{5}\cos(\omega_2 t + 1{,}11) + \sqrt{5}\cos(\omega_2 t + 2{,}03)$$

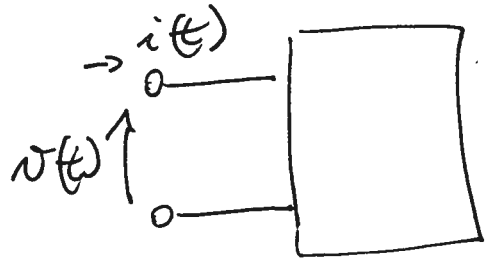
$$= \sqrt{5}\left[\cos(t + 1{,}11) + \cos(2t + 2{,}03)\right]$$

$$P_4' = R_4|\dot{I}_4'|^2 = \frac{5}{2}\ W$$

$$P_4'' = R_4|\dot{I}_4''|^2 = \frac{5}{2}\ W$$

$$P_4 = P_4' + P_4'' = 5\ W$$

## ES 45




$v(t) = 100\sqrt{2}\cos(\omega t)$ V

$P = 1{,}2$ kW

$\cos\varphi = 0{,}6$

$i(t) = ?$

$P = VI\cos\varphi \Rightarrow I = \dfrac{P}{V\cos\varphi} = 20$ A

$\dot{V} = 100$ V

$V = 100$ V

$\varphi_V = 0$ rad

$\varphi = \varphi_V - \varphi_I = -\varphi_I$

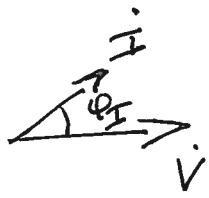
$\cos\varphi = 0{,}6 \qquad \varphi = \pm 0{,}9272$ rad

$i(t) = 20\sqrt{2}\cos(\omega t \pm 0{,}9272)$ A

BIPOLO OHMICO-CAPACITIVO

corrente in anticipo sulle Tensione

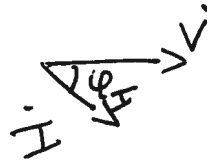
$\varphi_I = 0{,}9272$ rad



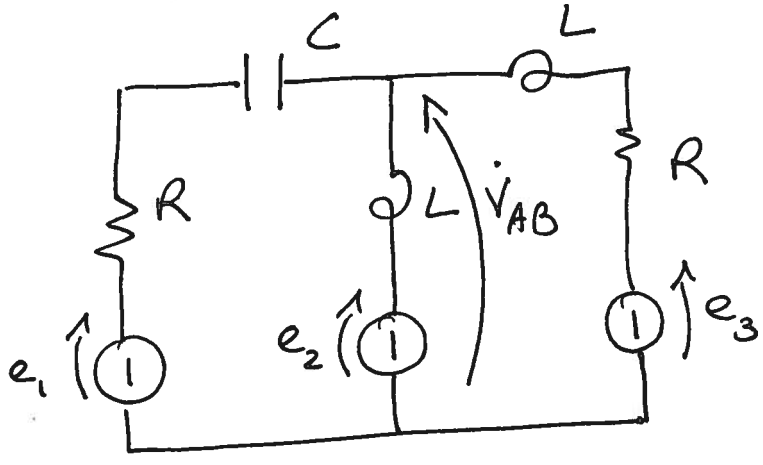

BIPOLO OHMICO-INDUTTIVO

corrente è in ritardo sulle Tensione

$\varphi_I = -0{,}9272$ rad




ES 46




Calcolare le potenze erogate dai generatori.

$R = 1\,\Omega$

$X_L = \omega L = 1\,\Omega$

$X_C = -\frac{1}{\omega C} = -1\,\Omega$

$\dot{E}_1 = 2\,V$

$\dot{E}_2 = \sqrt{2}\exp\left(-j\frac{\pi}{4}\right) V$

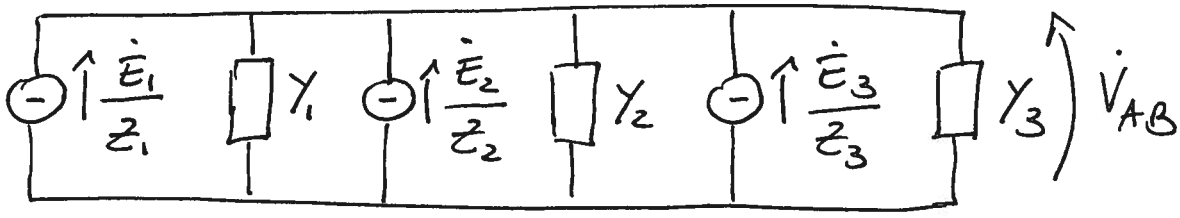
$= 1 - j\,V$

$\dot{E}_3 = 2\exp\left(j\frac{\pi}{2}\right) V = j2\,V$

$\dot{Z}_1 = R + jX_C = 1 - j\,\Omega$

$\dot{Z}_2 = j\omega L = jX_L = j\,\Omega$

$\dot{Z}_3 = R + jX_L = 1 + j\,\Omega$

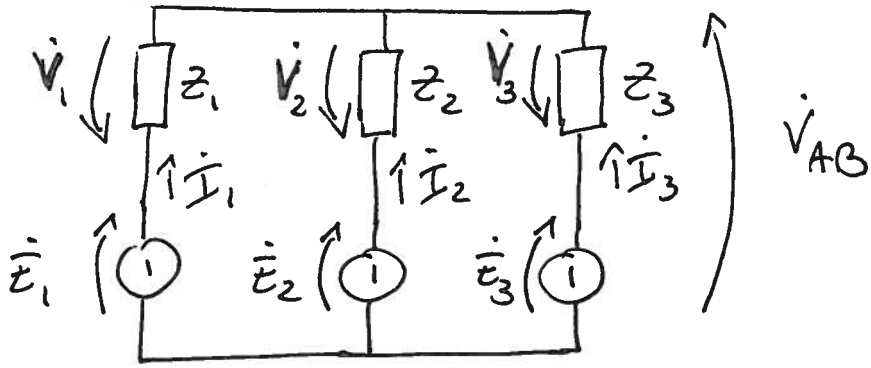



$$Y_1 = \frac{1}{Z_1} = \frac{1}{2} + j\frac{1}{2}\ S$$

$$Y_2 = \frac{1}{Z_2} = -j\ S$$

$$Y_3 = \frac{1}{Z_3} = \frac{1}{2} - j\frac{1}{2}\ S$$

$$\dot{V}_{AB} = \frac{\frac{\dot{E}_1}{Z_1} + \frac{\dot{E}_2}{Z_2} + \frac{\dot{E}_3}{Z_3}}{Y_1 + Y_2 + Y_3} = j\ V$$




$$\dot{V}_1 = \dot{E}_1 - \dot{V}_{AB} = 2 - j\ V$$

$$\dot{V}_2 = \dot{E}_2 - \dot{V}_{AB} = 1 - j2\ V$$

$$\dot{V}_3 = \dot{E}_3 - \dot{V}_{AB} = j\ V$$

$$\dot{I}_1 = Y_1 \dot{V}_1 = \frac{3}{2} + j\frac{1}{2}\ A$$

$$\dot{I}_2 = Y_2 \dot{V}_2 = -2 - j\ A$$

$$\dot{I}_3 = Y_3 \dot{V}_3 = \frac{1}{2} + j\frac{1}{2}\ A$$

$$\bar{A}_1 = \dot{E}_1 \dot{I}_1^* = 3 - j \text{ VA}$$

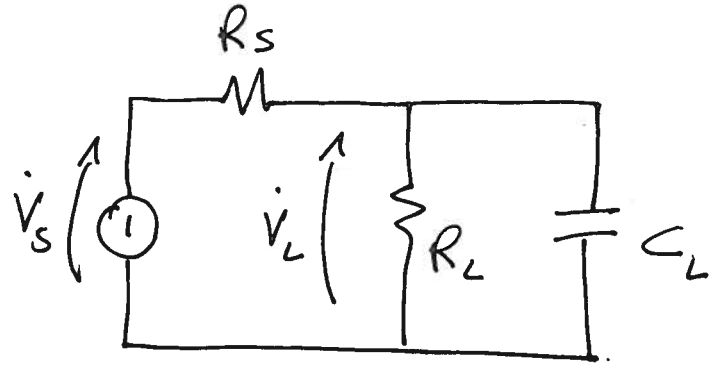
$$\bar{A}_2 = \dot{E}_2 \dot{I}_2^* = -1 + j3 \text{ VA}$$

$$\bar{A}_3 = \dot{E}_3 \dot{I}_3^* = 1 + j \text{ VA}$$

$$P_1 = \text{Re}\{\bar{A}_1\} = 3 \text{ W}$$
$$Q_1 = \text{Im}\{\bar{A}_1\} = -1 \text{ VAr}$$
$$P_2 = \text{Re}\{\bar{A}_2\} = -1 \text{ W}$$
$$Q_2 = \text{Im}\{\bar{A}_2\} = 3 \text{ VAr}$$
$$P_3 = \text{Re}\{\bar{A}_3\} = 1 \text{ W}$$
$$Q_3 = \text{Im}\{\bar{A}_3\} = 1 \text{ VAr}$$

} potenze EROGATE

## ES 47




$V_S = 220 \text{ V rms}$

$R_S = 2 \Omega$

$R_L = 16 \Omega$

$C = 100 \mu\text{F}$

$f = 50 \text{ Hz}$

Calcolare le potenze attive assorbite dal carico $R_L \| C_L$

$$Z_L = \left(-j \frac{1}{\omega C_L}\right) \| R_L = \frac{-j \frac{R_L}{\omega C_L}}{R_L - j \frac{1}{\omega C_L}} = 12{,}27 - j\, 6{,}42 \ \Omega$$

$$\dot{V}_L = \dot{V}_S \frac{Z_L}{R_S + Z_L} = 194,9 - j\,10,88\ V$$

$$= 195,25 \exp(-j\,0,0558)\ V$$

$$\dot{I}_L = \frac{\dot{V}_S}{R_S + Z_L} = 12,52 + j\,5,444\ A$$

$$= 13,658 \exp(j\,0,41)\ A$$

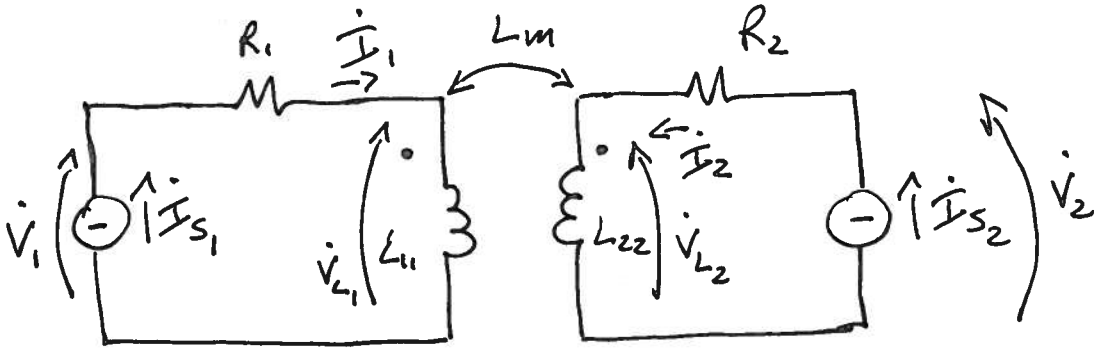
$$P_L = Re\{\dot{V}_L \dot{I}_L^*\} = 2,3827\ kW$$

oppure

$$\varphi_V - \varphi_I = \varphi = -0,0558 - 0,41 = -0,4658\ rad$$

$$P_L = V_L I_L \cos\varphi = 2,3827\ kW$$

## ES 48




$L_{11} = 0,5\ H$ $\quad R_1 = 2\,\Omega$ $\quad \dot{I}_{S_1} = 4\ A$

$L_{22} = 1\ H$ $\quad R_2 = 4\,\Omega$ $\quad \dot{I}_{S_2} = 5 \exp(-j\frac{\pi}{2})\ A$

$L_m = 0,3\ H$ $\quad \omega = 3\ rad/s$

Calcolare $\dot{V}_1$ e $\dot{V}_2$

$$\begin{cases} \dot{V}_{L_1} = j\omega L_{11}\dot{I}_{S_1} + j\omega L_m \dot{I}_{S_2} \\ \dot{V}_{L_2} = j\omega L_m \dot{I}_{S_1} + j\omega L_{22}\dot{I}_{S_2} \end{cases}$$

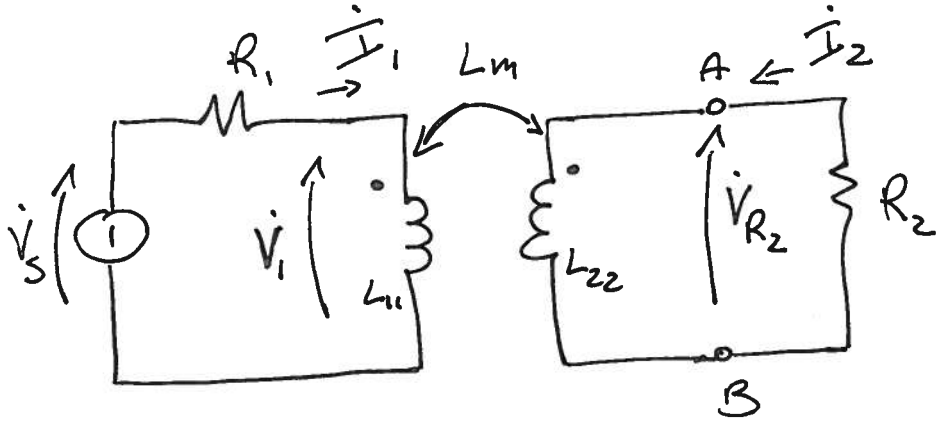
$$\dot{V}_1 = R_1\dot{I}_{S_1} + \dot{V}_{L_1} = (R_1 + j\omega L_{11})\dot{I}_{S_1} + j\omega L_m \dot{I}_{S_2}$$

$$\dot{V}_2 = R_2\dot{I}_{S_2} + \dot{V}_{L_2} = j\omega L_m \dot{I}_{S_1} + (R_2 + j\omega L_{22})\dot{I}_{S_2}$$

$$\dot{V}_1 = 12{,}5 + j6 \text{ V}$$

$$\dot{V}_2 = 15 - j16{,}4 \text{ V}$$

## ES 49




$\dot{V}_S = 2{,}5 + j2{,}5$ V

$X_{11} = 6\,\Omega$

$X_{22} = 12\,\Omega$

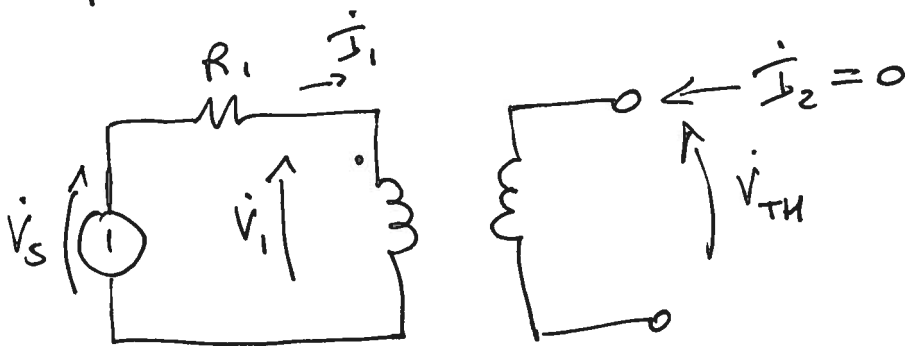
$X_m = 8\,\Omega$

$R_1 = 8\,\Omega$

$R_2 = 12\,\Omega$

Calcolare i parametri del circuito equivalente di Thévenin ai morsetti A-B e la Tensione $\dot{V}_{R_2}$ ai capi del resistore $R_2$.

$\dot{V}_{TH}$



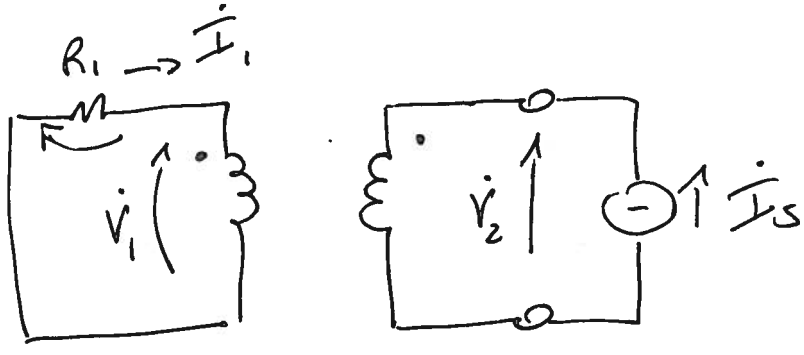

$$\dot{V}_1 = j X_{11} \dot{I}_1$$

$$\dot{V}_S = R_1 \dot{I}_1 + j X_{11} \dot{I}_1 = (R_1 + j X_{11}) \dot{I}_1$$

$$\dot{I}_1 = \frac{\dot{V}_S}{R_1 + j X_{11}}$$

$$\dot{V}_2 = \dot{V}_{TH} = j X_m \dot{I}_1 = j X_m \frac{\dot{V}_S}{R_1 + j X_{11}} = -0{,}4 + j\,2{,}8\ V$$

$Z_{TH}$




$$\dot{V}_1 = -R_1 \dot{I}_1$$

$$\begin{cases} \dot{V}_1 = j X_{11} \dot{I}_1 + j X_m \dot{I}_S \\ \dot{V}_2 = j X_m \dot{I}_1 + j X_{22} \dot{I}_S \end{cases}$$

$$(-R_1 - jX_{11})\dot{I}_1 = jX_m \dot{I}_S$$

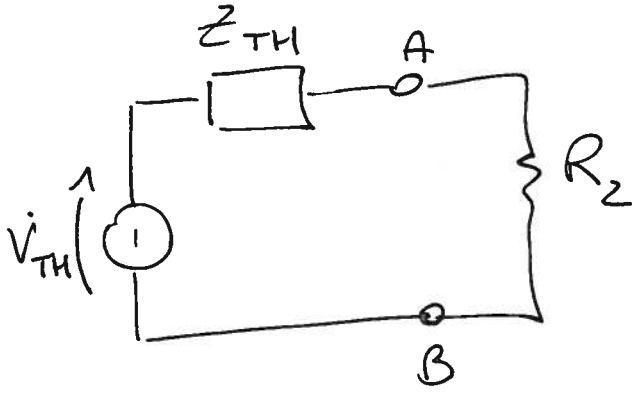
$$\dot{V}_2 = jX_m \frac{jX_m}{-R_1 - jX_{11}} \dot{I}_S + jX_{22}\dot{I}_S$$

$$= \left[\frac{X_m^2}{R_1 + jX_{11}} + jX_{22}\right]\dot{I}_S$$

$$Z_{TH} = \frac{\dot{V}_2}{\dot{I}_S} = \frac{X_m^2 + jX_{22}(R_1 + jX_{11})}{R_1 + jX_{11}} =$$

$$= \frac{X_m^2 - X_{11}X_{22} + jR_1X_{22}}{R_1 + jX_{11}}$$

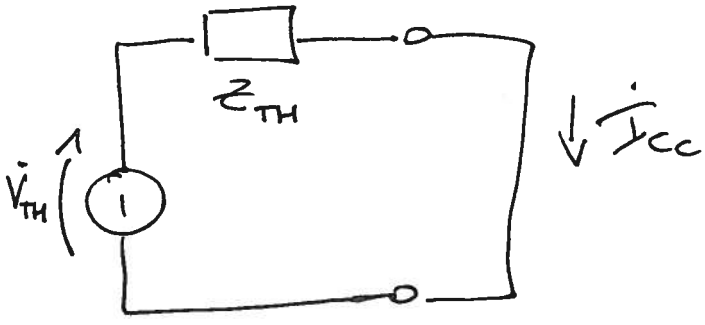
$$= 5{,}12 + j\,8{,}16\ \Omega$$



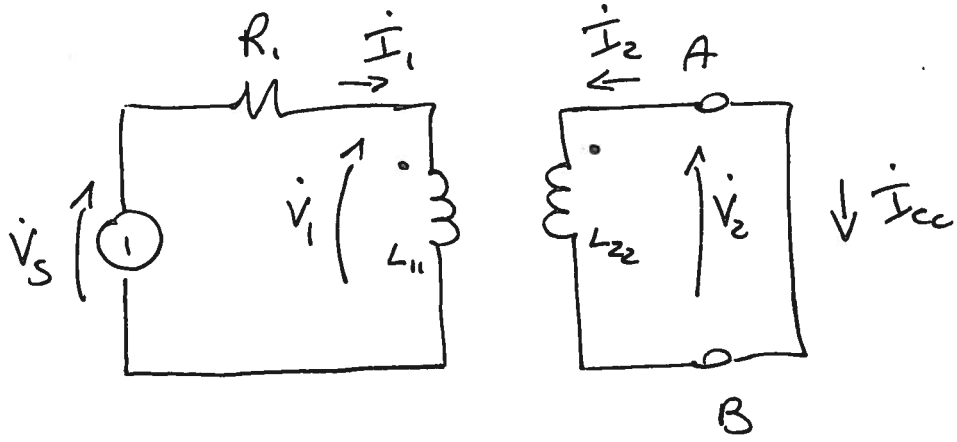

$$\dot{V}_{R_2} = \dot{V}_{TH}\frac{R_2}{Z_{TH} + R_2} = 0{,}534 + j\,1{,}708\ V$$

$\underline{Z}_{TH}$ → calcolata usando la corrente di corto circuito $\dot{I}_{cc}$

Infatti




$$\dot{V}_{TH} = \underline{Z}_{TH}\,\dot{I}_{cc} \Rightarrow \underline{Z}_{TH} = \frac{\dot{V}_{TH}}{\dot{I}_{cc}}$$




$$\dot{I}_2 = -\dot{I}_{cc} \quad , \quad \dot{V}_1 = \dot{V}_S - R_1\,\dot{I}_1$$

$$\dot{V}_2 = 0$$

$$\begin{cases} \dot{V}_1 = j X_{11}\,\dot{I}_1 - j X_m\,\dot{I}_{cc} \\ 0 = j X_m\,\dot{I}_1 - j X_{22}\,\dot{I}_{cc} \end{cases}$$

$$\dot{I}_1 = \frac{X_{22}}{X_m}\,\dot{I}_{cc} \qquad \dot{V}_S = (R_1 + j X_{11})\,\dot{I}_1 - j X_m\,\dot{I}_{cc}$$

$$\dot{V}_S = \left[ (R_1 + j X_{11}) \frac{X_{22}}{X_m} - j X_m \right] \dot{I}_{cc}$$

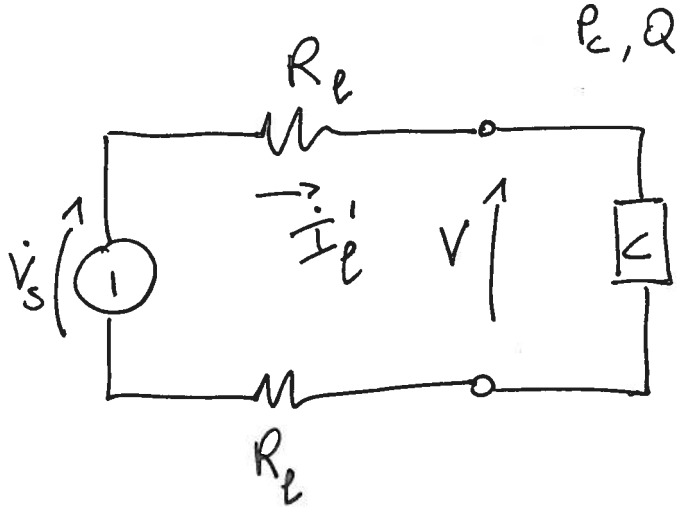
$$\dot{I}_{cc} = \frac{X_m \dot{V}_S}{X_{22}(R_1 + j X_{11}) - j X_m^2}$$

$$\mathcal{Z}_{TH} = \frac{\dot{V}_{TH}}{\dot{I}_{cc}} = \frac{j X_m \dot{V}_S}{R_1 + j X_{11}} \quad \frac{X_{22}(R_1 + j X_{11}) - j X_m^2}{X_m \dot{V}_S}$$

$$= \frac{j X_{22}(R_1 + j X_{11}) + X_m^2}{R_1 + j X_{11}}$$

$$= \frac{X_m^2 - X_{11} X_{22} + j R_1 X_{22}}{R_1 + j X_{11}}$$

# ES 50




$P_c = 1\ kW$

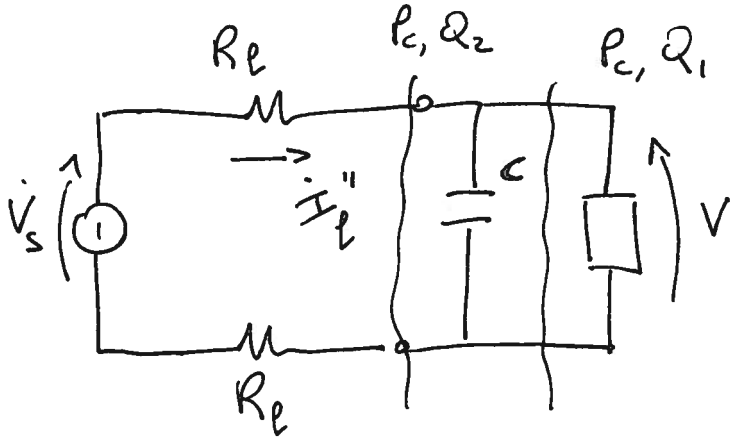
$\cos\varphi_1 = 0{,}7$ in ritardo

$R_l = 0{,}5\ \Omega$ $\quad f = 50\ Hz$

$V = 220\ V$ rms

Rifasare il carico con un condensatore in parallelo in modo da aumentare il fattore di potenza a $\cos\varphi_2 = 0{,}95$.

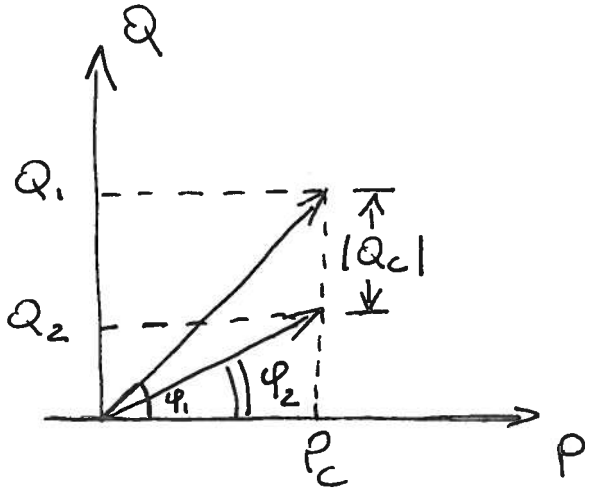
Calcolare inoltre la corrente di linea $I_l$ prima e dopo il rifasamento.




$Q_2 = Q_1 + Q_c$

$Q_2 < Q_1 \Rightarrow \Delta Q = Q_2 - Q_1 < 0$

$Q_c = \Delta Q < 0$



$\varphi_1 = \arccos(0{,}7) = 0{,}795 \text{ rad}$

$\varphi_2 = \arccos(0{,}95) = 0{,}3176 \text{ rad}$

$$Q_c = \frac{V^2}{X_c} = -\omega C V^2$$

$$|Q_c| = \omega C V^2$$

$$Q_1 = P_c \tan\varphi_1$$

$$Q_2 = P_c \tan\varphi_2$$

$$Q_c = Q_2 - Q_1$$

$$|Q_c| = Q_1 - Q_2 = \omega C V^2$$

$$C = \frac{P_c(\tan\varphi_1 - \tan\varphi_2)}{\omega V^2} = 0{,}4548\ \mu F$$

Prima del rifasamento

$$P_c = V I_l' \cos\varphi_1 \Rightarrow I_l' = \frac{P_c}{V\cos\varphi_1} = 6{,}493\ A$$

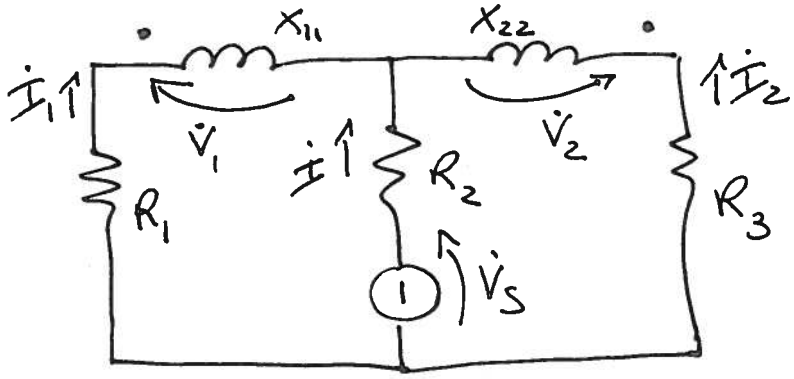
Dopo il rifasamento

$$P_c = V I_l'' \cos\varphi_2 \Rightarrow I_l'' = \frac{P_c}{V\cos\varphi_2} = 4{,}785\ A$$

Potenza dissipata

$P_d' = 2 R_l I_l'^2 = 42{,}17\ W$ $\qquad$ $P_d'' = 2 R_l I_l''^2 = 22{,}89\ W$

# ES 51




$\dot{V}_S = 10V$

$R_1 = R_3 = 1\Omega$

$R_2 = 2\Omega$

$X_{11} = X_{22} = 2\Omega$

$X_m = 1\Omega$

$\dot{I} = ?$

$$\begin{cases} \dot{V}_1 = jX_{11}\dot{I}_1 + jX_m\dot{I}_2 \\ \dot{V}_2 = jX_m\dot{I}_1 + jX_{22}\dot{I}_2 \end{cases}$$

$$\dot{I} = -(\dot{I}_1 + \dot{I}_2)$$

$$\dot{V}_S - R_2\dot{I} + \dot{V}_1 + R_1\dot{I}_1 = 0$$

$$\dot{V}_S - R_2\dot{I} + \dot{V}_2 + R_3\dot{I}_2 = 0$$

$$\dot{V}_1 = R_2\dot{I} - R_1\dot{I}_1 - \dot{V}_S = jX_{11}\dot{I}_1 + jX_m\dot{I}_2$$

$$\dot{V}_2 = R_2\dot{I} - R_3\dot{I}_2 - \dot{V}_S = jX_m\dot{I}_1 + jX_{22}\dot{I}_2$$

$$\dot{V}_S + (R_1 + R_2 + jX_{11})\dot{I}_1 + (R_2 + jX_m)\dot{I}_2 = 0$$

$$\dot{V}_S + (R_2 + jX_m)\dot{I}_1 + (R_2 + R_3 + jX_{22})\dot{I}_2 = 0$$

$$(3 + j2)\dot{I}_1 + (2 + j)\dot{I}_2 = -10$$

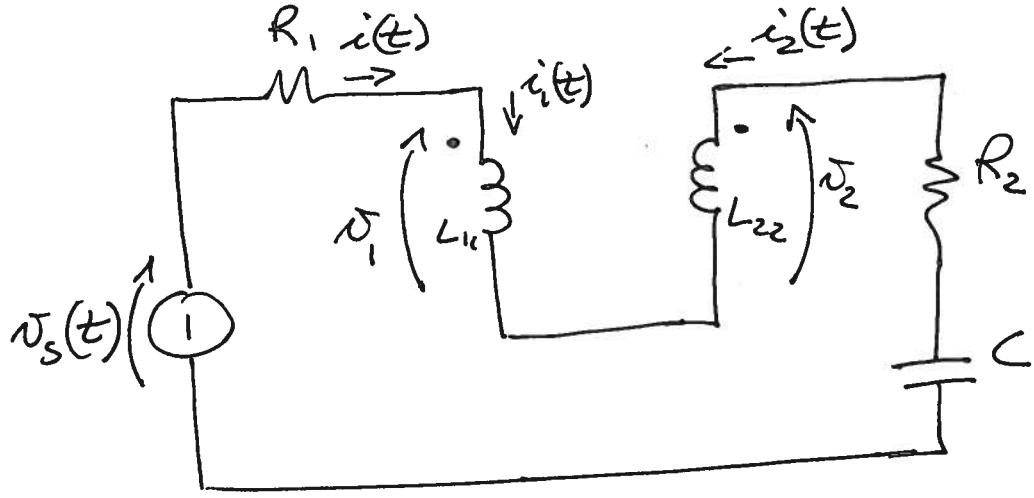
$$(2 + j)\dot{I}_1 + (3 + j2)\dot{I}_2 = -10$$

Risolvendo

$$\dot{I}_1 = \dot{I}_2 = -1{,}471 + j\,0{,}8824 \text{ A}$$

$$\dot{I} = 2{,}941 - j\,1{,}765 \text{ A}$$

## ES 52




$v_s(t) = 100\sqrt{2}\cos(\omega t)$ V

$\omega = 1000$ rad/s

$R_1 = 2\,\Omega$ $\quad L_{11} = 3$ mH

$R_2 = 3\,\Omega$ $\quad L_{22} = 2$ mH

$C = \frac{1}{5}$ mF $\quad L_m = 2$ mH

$i(t) = ?$

$X_C = -5\,\Omega$ $\quad X_{22} = 2\,\Omega$ $\quad \dot{V}_S = 100$ V

$X_{11} = 3\,\Omega$ $\quad X_m = 2\,\Omega$

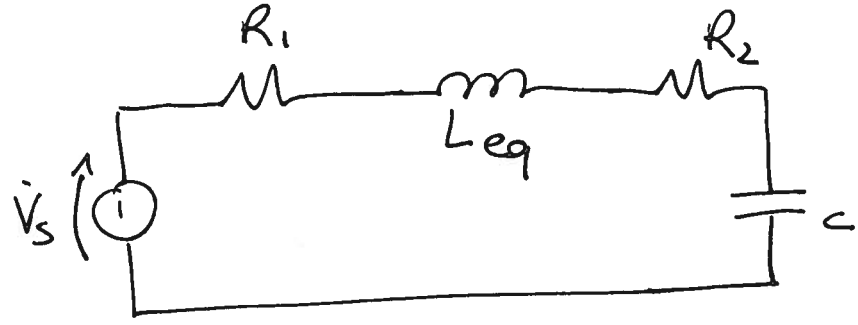
$\dot{I} = \dot{I}_1 = -\dot{I}_2$

$$\dot{V}_S = R_1\dot{I} + \dot{V}_1 - \dot{V}_2 + (R_2 + jX_C)\dot{I}$$

$$\begin{cases} \dot{V}_1 = jX_{11}\dot{I}_1 + jX_m\dot{I}_2 = j(X_{11} - X_m)\dot{I} \\ \dot{V}_2 = jX_m\dot{I}_1 + jX_{22}\dot{I}_2 = j(X_m - X_{22})\dot{I} \end{cases}$$

$$\dot{V}_S = \left[R_1 + R_2 + j\left(X_{11} - 2X_m + X_{22}\right) + jX_C\right]\dot{I}$$

Il mutuo induttore, infatti, è in serie controverse.
Il circuito potrebbe essere ridisegnato così:




$$X_{eq} = X_{11} + X_{22} - 2X_m = 1\,\Omega$$

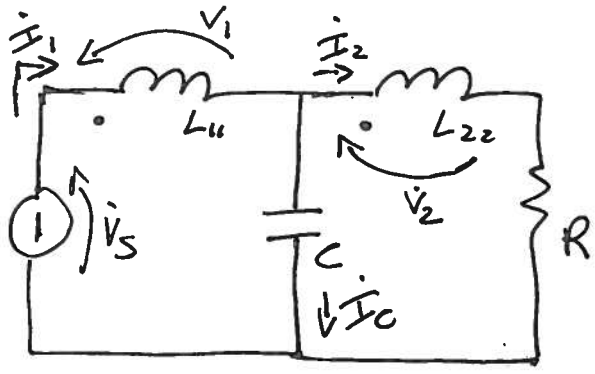
Risolvendo

$$\dot{I} = 15{,}62 \exp(j\,0{,}675)\ A$$

$$i(t) = \mathrm{Re}\left\{\sqrt{2}\,\dot{I}\exp(j\omega t)\right\}\ A$$

$$= 22{,}086 \cos(\omega t + 0{,}675)\ A$$

# ES 53




$V_S = 10\,V$ rms

$L_{11} = 3H$

$L_{22} = 2H$

$L_m = 1\,H$ $\quad C = \frac{1}{6}\,F$

$R = 4\,\Omega$

$\omega = 3\,\frac{rad}{s}$

Calcolare le potenze attive e le potenze reattive erogate dal generatore di tensione.

$X_{11} = 9\,\Omega \qquad X_m = 3\,\Omega$

$X_{22} = 6\,\Omega \qquad X_C = -2\,\Omega$

$$\begin{cases} \dot{V}_1 = j X_{11} \dot{I}_1 + j X_m \dot{I}_2 \\ \dot{V}_2 = j X_m \dot{I}_1 + j X_{22} \dot{I}_2 \end{cases}$$

$$\dot{I}_C = \dot{I}_1 - \dot{I}_2$$

$$\dot{V}_C = j X_C \dot{I}_C$$

$$\begin{cases} \dot{V}_C - \dot{V}_2 - R\dot{I}_2 = 0 \\ \dot{V}_C + \dot{V}_1 - \dot{V}_S = 0 \end{cases}$$

$$\begin{cases} j X_C \dot{I}_C - j X_m \dot{I}_1 - j X_{22} \dot{I}_2 - R\dot{I}_2 = 0 \\ j X_C \dot{I}_C + j X_{11} \dot{I}_1 + j X_m \dot{I}_2 - \dot{V}_S = 0 \end{cases}$$

$$\begin{cases} j(X_c - X_m)\dot{I}_1 - [R + j(X_c + X_{22})]\dot{I}_2 = 0 \\ j(X_c + X_{11})\dot{I}_1 + j(X_m - X_c)\dot{I}_2 - \dot{V}_s = 0 \end{cases}$$

$$\dot{I}_2 = \frac{j(X_c - X_m)}{R + j(X_c + X_{22})}\dot{I}_1 = \alpha \dot{I}_1$$

$$\dot{I}_1 = \frac{\dot{V}_s}{j(X_{11} + X_c) + j\alpha(X_m - X_c)} = 0,903 - j\,0,848\ A$$

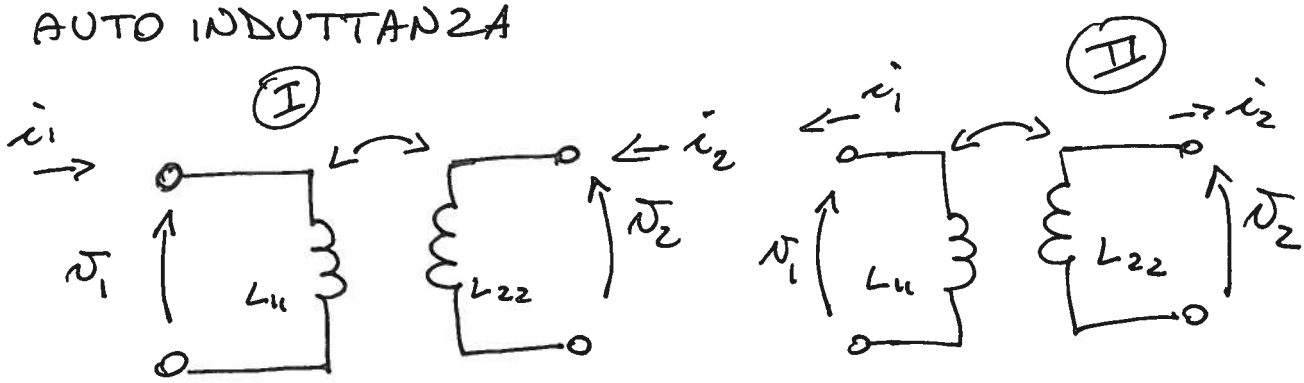
$$\bar{S} = \dot{V}_s \dot{I}_1^* = 9,03 + j\,8,48\ VA$$

$$P_{V_s} = 9,03\ W$$

$$Q_{V_s} = 8,48\ VAr$$

# INDUTTORI ACCOPPIATI

## SEGNO RELATIVO AL TERMINE DI AUTO INDUTTANZA




Indipendentemente dal • se ed un terminale v e i sono scelti secondo la convenzione degli utilizzatori il segno relativo alla autoinduttanze è positivo. Altrimenti è negativo

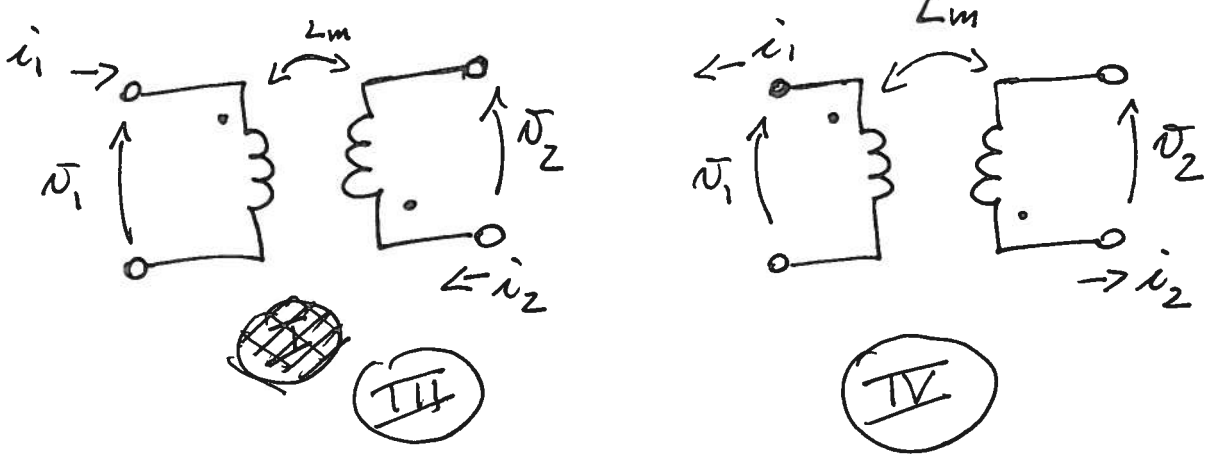
$$\begin{cases} v_1 = +L_{11}\dfrac{di_1}{dt} + \boxed{\cdots} \\ v_2 = \boxed{\cdots} + L_{22}\dfrac{di_2}{dt} \end{cases}$$

(I)

$$\begin{cases} v_1 = -L_{11}\dfrac{di_1}{dt} + \boxed{\cdots} \\ v_2 = \boxed{\cdots} - L_{22}\dfrac{di_2}{dt} \end{cases}$$

(II)

## SEGNO RELATIVO AL TERMINE DI MUTUA INDUTTANZA



Se la corrente entra nel Terminale col ·, la Tensione indotta sull'altro Terminale è positiva nel verso del ·. Altrimenti (se la corrente esce) la Tensione indotta sull'altro Terminale è negative nel verso del ·.

$$\begin{cases} v_1 = \boxed{\cdots} + L_m \dfrac{di_2}{dt} \\ v_2 = -L_m \dfrac{di_1}{dt} + \boxed{\cdots} \end{cases}$$

III

$$\begin{cases} v_1 = \boxed{\cdots} - L_m \dfrac{di_2}{dt} \\ v_2 = L_m \dfrac{di_1}{dt} + \boxed{\cdots} \end{cases}$$

IV