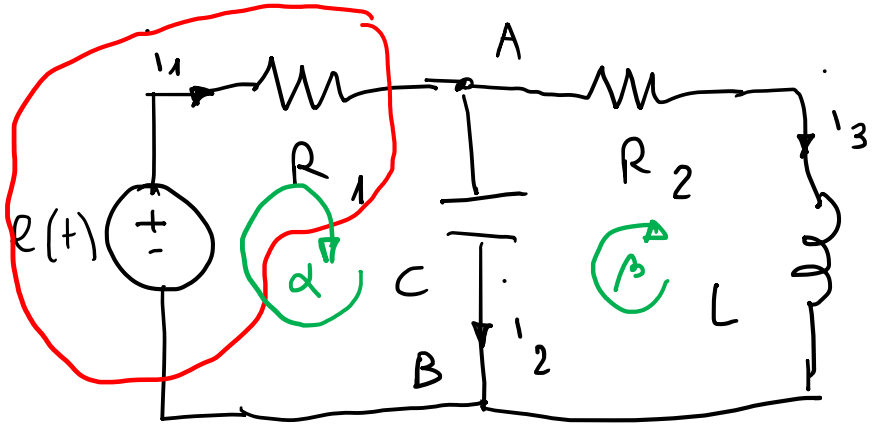


e(t) RIFERIMENTO ANGOLI DI FASE

$$\underline{E} = \frac{E_M}{\sqrt{2}} e^{j0} = \frac{E_M}{\sqrt{2}} = \frac{10}{\sqrt{2}} = 7.071$$

$$\omega = 2\pi f = 2\pi \times 50 = 314.2 \ \frac{rad}{s}$$

$$L = 4\ mH = 4 \times 10^{-3}\ H$$

$$\underline{Z}_1 = R_1 \qquad \underline{Z}_{R_2} = R_2 = 3$$

$$\underline{Z}_1 = 2$$

$$\underline{Z}_L = j\omega L = j \times 314.2 \times 4 \times 10^{-3} = j\,1.257$$

$$\underline{Z}_3 = \underline{Z}_{R_2} + \underline{Z}_L = 3 + j\,1.257$$

$$C = 0.2\ mF = 0.2 \times 10^{-3}\ F$$

$$\underline{Z}_2 = \underline{Z}_C = -\frac{j}{\omega C} = -\frac{j}{314.2 \times 0.2 \times 10^{-3}} = -j\,15.91$$

$N_{NODI} = 2 \qquad (N_{NODI} - 1) = 1$ LKC.

$N_{RAMI} = 3 \qquad (N_{RAMI} - N_{NODI} + 1) = 2$ LKT

N_{RAMI} EQ. COST.

A) $-\underline{I}_1 + \underline{I}_2 + \underline{I}_3 = 0$

α) $-\underline{E} + \underline{Z}_1 \underline{I}_1 + \underline{Z}_2 \underline{I}_2 = 0$

β) $-\underline{Z}_2 \underline{I}_2 + \underline{Z}_3 \underline{I}_3 = 0$

} 3 EQ. IN 3 INC. $\underline{I}_1, \underline{I}_2, \underline{I}_3$

$$\underline{I}_1 = 1.291 - j\,0.1603 \qquad i_1(t) = I_{1m}\cos(\omega t + \alpha_1)$$

$$\omega = 2\pi f = 314.2 \ \frac{rad}{s}$$

$$I_{1e} = |\underline{I}_1| = \frac{I_{1m}}{\sqrt{2}} \qquad I_{1m} = \sqrt{2}\ I_{1e} = \sqrt{2} \times 1.301 = 1.84 \ A$$

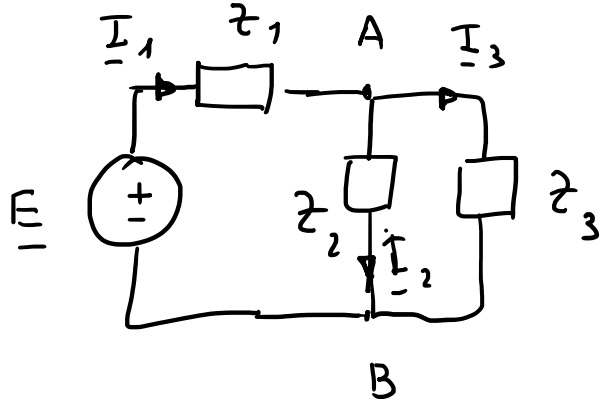
$$I_{1e} = |\underline{I}_1| = \sqrt{1.291^2 + 0.1603^2} = 1.301 \ A$$

$$\underline{I}_1 = I_{1e}\, e^{j\alpha_1} = \overbrace{I_{1e}\cos\alpha_1}^{1.291} + j\,\overbrace{I_{1e}\sin\alpha_1}^{-0.1603}$$

$$\begin{cases} \cos\alpha_1 = \dfrac{1.291}{1.301} = 0.9923 \\ \sin\alpha_1 = -\dfrac{0.1603}{1.301} = -0.1232 \end{cases} \Rightarrow \alpha_1 = \sin^{-1}(-0.1232) =$$

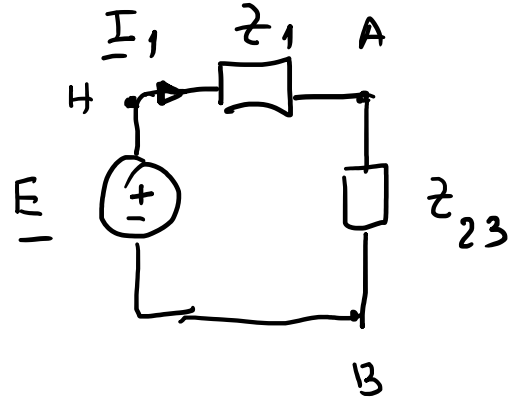
$$= -0.1235 \ rad$$

$$= -7.076^\circ$$



$$Z_{23} = \frac{Z_2 Z_3}{Z_2 + Z_3} = \frac{-j15.91 \times (3 + j1.257)}{-j15.91 + 3 + j1.257} =$$

$$= 3.395 + j\,0.6699$$

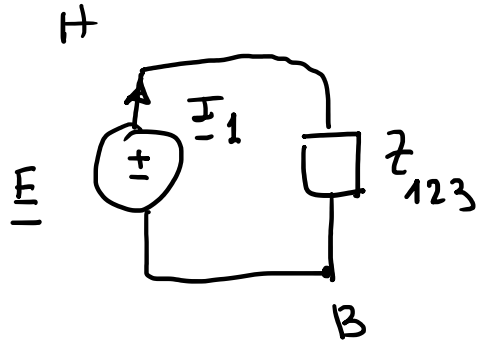


$$\underline{I}_2 = \frac{\underline{V}_{AB}}{Z_2} = \frac{4.43 + j\,0.3206}{-j15.91} = -0.02 + j\,0.2822$$

$$\underline{I}_3 = \frac{\underline{V}_{AB}}{Z_3} = \frac{4.43 + j\,0.3206}{3 + j1.257} = 1.311 - j\,0.4425$$

$$\underline{V}_{AB} = Z_{23}\,\underline{I}_1 = (3.395 + j\,0.6699) \times (1.291 - j\,0.1603) =$$

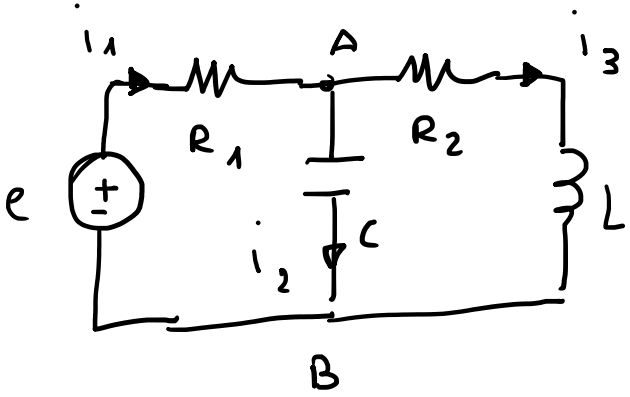
$$= 4.43 + j\,0.3206$$



$$\underline{I}_1 = \frac{\underline{E}}{Z_{123}} = \frac{7.071}{5.395 + j\,0.6699} = 1.291 - j\,0.1603$$

$$Z_{123} = Z_1 + Z_{23} = 2 + 3.395 + j\,0.6699 =$$

$$= 5.395 + j\,0.6699$$



$$N_E = \underline{E}\ \underline{I}_1^{*} = P_E + jQ_E$$

$$N_E = 7.071 \times (1.291 + j\,0.1603) = 9.129 + j\,1.133$$

$$P_E = 9.129\ W\ ,\ Q_E = 1.133\ VAR$$

$$P_{R_1} = R_1 I_{1e}^2 = 2 \times 1.301^2 = 3.385\ W$$

$$I_{1e} = |\underline{I}_1| = \sqrt{1.291^2 + 0.1603^2} = 1.301\ A$$

$$P_{R_2} = R_2 I_{2e}^2 = 3 \times 1.384^2 = 5.746\ W$$

$$I_{2e} = |\underline{I}_2| = \sqrt{0.02^2 + 0.2822^2} = 0.2829\ A$$

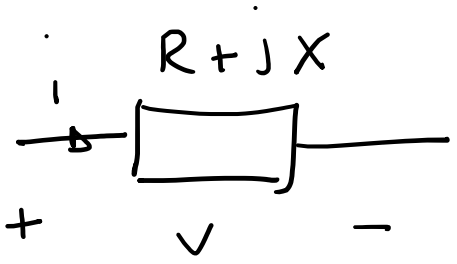
$$P_{R_1} + P_{R_2} = P_E \qquad P_{R_1} + P_{R_2} = 9.131\ W$$

$$Q_L = \omega L I_{3e}^2 = 1.257 \times 1.384^2 = 2.408\ VAR$$

$$I_{3e} = |\underline{I}_3| = \sqrt{1.311^2 + 0.4425^2} = 1.384\ A$$

$$Q_C = -\frac{1}{\omega C} I_{2e}^2 = -15.91 \times 0.2829^2 = -1.273\ VAR$$

$$Q_L + Q_C = 1.135\ VAR \qquad Q_L + Q_C = Q_E$$

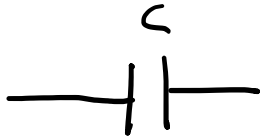


$$\underline{N}_{ASS} = \underline{V}\,\underline{I}^{*} = R I_e^2 + jX I_e^2$$

$$P_{ASS} = R I_e^2 \qquad Q_{ASS} = X I_e^2$$

$$N_{EROGATA} = -N_{ASS} = -R I_e^2 - jX I_e^2$$

$$P_{EROGATA} = -R I_e^2 \qquad Q_{EROGATA} = -X I_e^2$$



$$X = -\frac{1}{\omega C} \qquad Q_{ASS} = -\frac{1}{\omega C} I_e^2 < 0$$

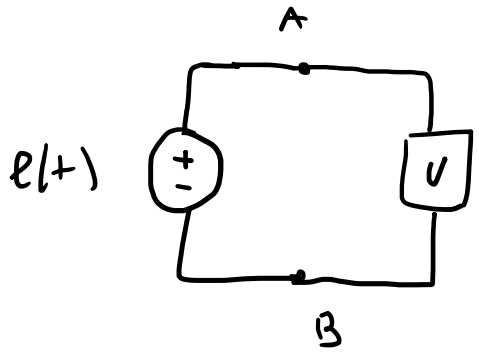
$$Q_{EROGATA} = \frac{1}{\omega C} I_e^2 > 0$$

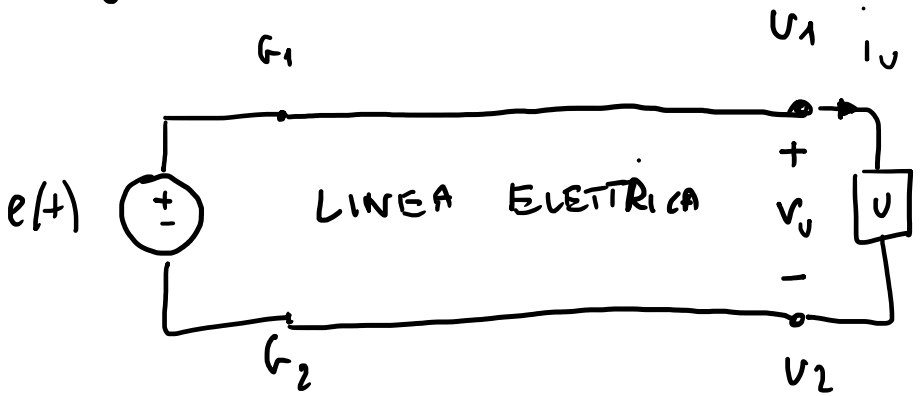
RIFASAMENTO

$e(t) = E_{eM} \cos(\omega t)$

$f = 50$ Hz

$E_e = 230$ V

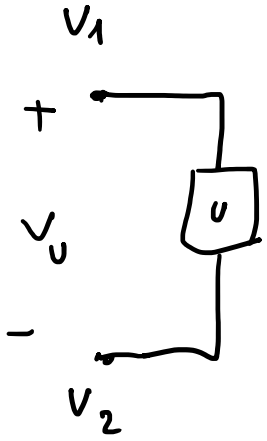




$$P_U = V_{U,e} \, I_{U,e} \cos(\varphi_U)$$

$$I_{U,e} = \frac{P_U}{V_{U,e} \cos(\varphi_U)}$$

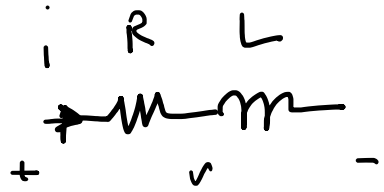
$$Q_U = V_{Ue} \, I_{Ue} \sin(\varphi_U)$$



$V_{U,e}$, P_U , $\cos\varphi_U$

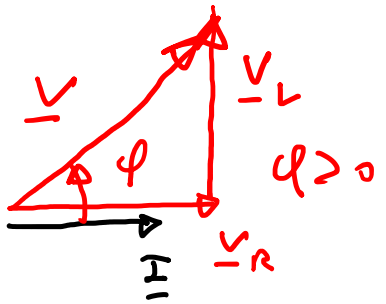
$\varphi_V > 0$

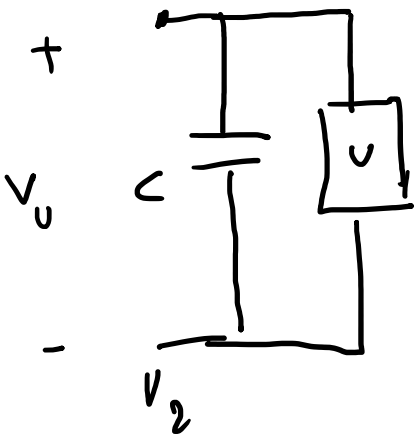
$\alpha_V - \alpha_I > 0$



OHMICO - INDUTTIVO

$\underline{V} = \underline{V}_R + \underline{V}_L$

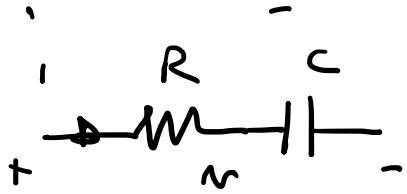




C = CAPACITÀ DI RIFASAMENTO

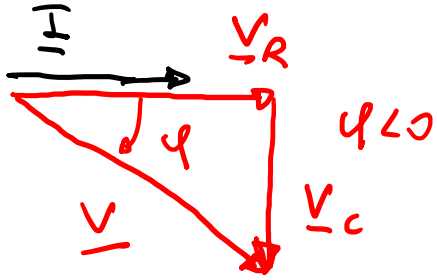
$P_U' = \cancel{P_q} + P_U$

$Q_U' = Q_C + Q_U$



OHMICO - CAPACITIVO

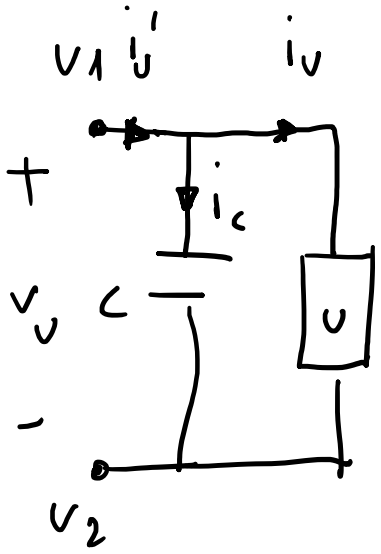
$\underline{V} = \underline{V}_R + \underline{V}_C$



$P = V_e I_e \cos\varphi$

$Q = V_e I_e \sin\varphi$

$\tan\varphi = \frac{Q}{P}$



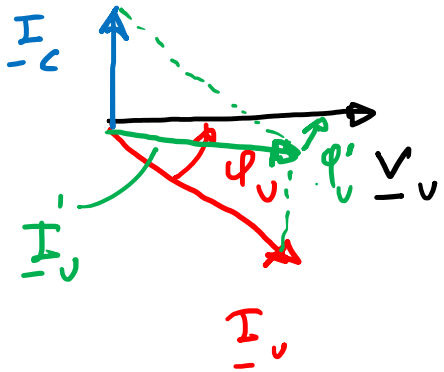
$$P_V' = P_V \qquad Q_V = P_V \cdot \tan\varphi_V$$

$$Q_V' = Q_C + Q_V \qquad Q_V' = P_V' \tan\varphi_V'$$

$$\underline{I}_C = \frac{\underline{V}_V}{-\frac{j}{\omega C}} = j\omega C\, \underline{V}_V \qquad I_{Ce} = |\underline{I}_C| = \omega C V_{V,e}$$

$$\underline{I}_V' = \underline{I}_V + \underline{I}_C$$

$$Q_C = -\frac{1}{\omega C} I_{Ce}^2 = -\frac{1}{\omega C} \omega^2 C^2 V_{V,e}^2 = -\omega C V_{V,e}^2$$



$$P_V' \tan\varphi_V' = -\omega C V_{V,e}^2 + P_V \tan\varphi_V$$

$$\boxed{C = \frac{P_V(\tan\varphi_V - \tan\varphi_V')}{\omega V_{V,e}^2}}$$

$$\cos\varphi_V' = 0.95$$

$$\varphi_V' = \cos^{-1}(0.95)$$

$$I_{V,e}'^2 = \frac{P_V}{V_{V,e}\cos(\varphi_V')}$$