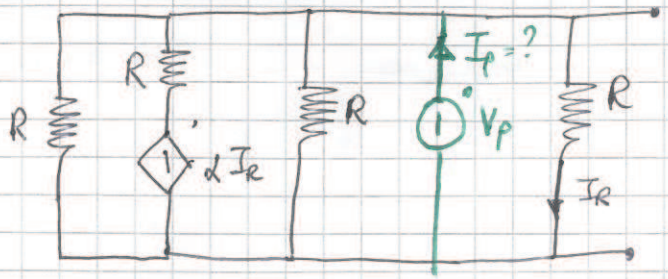
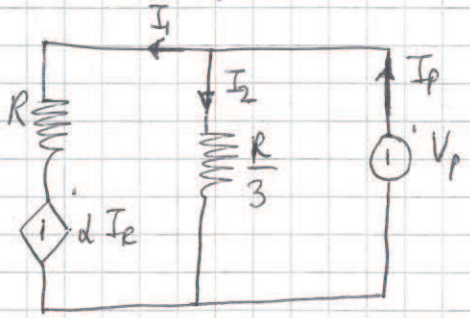
Risoluzione compito di Elettrotecnica 26.5.2018

ESERCIZIO 1

R_{TH}:



$I_R = \frac{V_p}{R}$. Semplifico il circuito considerando le 3 resistenze in parallelo



$I_p = I_1 + I_2$

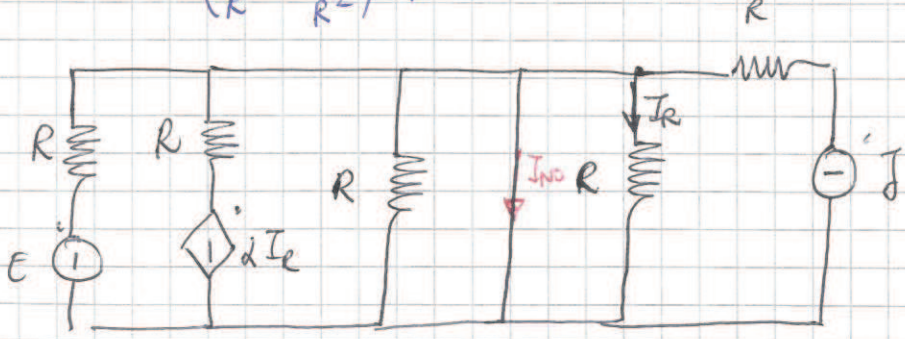
$I_1 = \frac{V_p - \alpha I_R}{R} = \frac{V_p - \alpha \frac{V_p}{R}}{R} = \frac{V_p}{R} - \frac{\alpha V_p}{R^2}$

$I_2 = \frac{V_p}{R/3} = \frac{3V_p}{R}$

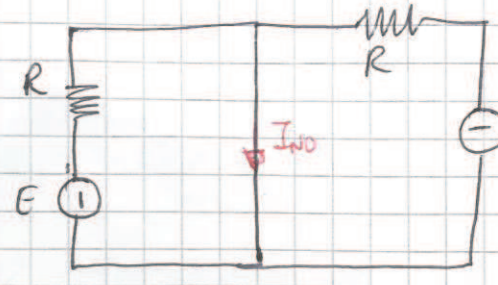
$I_p = \frac{V_p}{R} + \frac{3V_p}{R} - \frac{\alpha V_p}{R^2} = \frac{4V_p}{R} - \frac{\alpha}{R^2} V_p$

$R_{TH} = \frac{V_p}{I_p} = \frac{V_p}{\left(\frac{4}{R} - \frac{\alpha}{R^2}\right) V_p} = \left(\frac{4}{R} - \frac{\alpha}{R^2}\right)^{-1} = 2.8571\ \Omega$

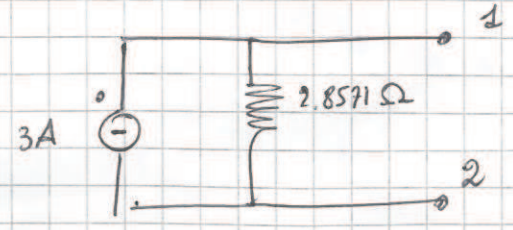
I_{NO}:



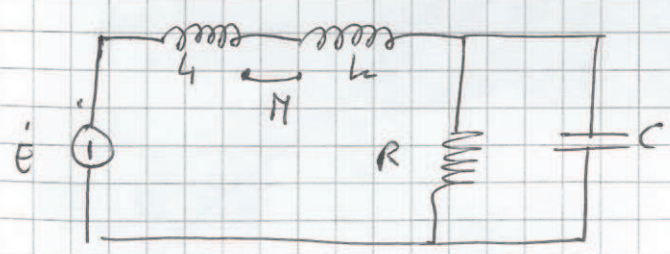
$\Rightarrow$ Si nota che $I_R = 0$, perciò $\alpha I_R = 0$



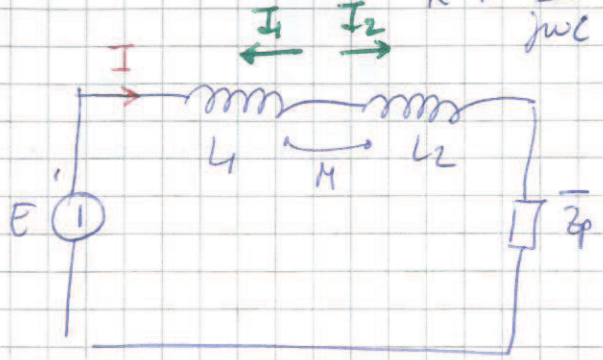
$I_{NO} = J + \frac{E}{R} = 3A$



ESERCIZIO 2



Consideriamo $\bar{Z}_p = \dfrac{\frac{R}{j\omega C}}{R + \frac{1}{j\omega C}} = 5 - 5j$



$$-\dot{E} + j\omega L_1 \dot{I} - j\omega M \dot{I} + j\omega L_2 \dot{I} - j\omega M \dot{I} + \bar{Z}_p \dot{I} = 0 \Rightarrow$$

$$\Rightarrow \dot{I} = \frac{\dot{E}}{j\omega L_1 + j\omega L_2 - 2j\omega M + \bar{Z}_p} = \frac{1.2195 + 0.9756}{} = 1.5617\, e^{j0.674}$$

$$Q = \omega L_1 I_1^2 + \omega L_2 I_2^2 + 2\omega M I_1 I_2 \cos(\alpha_1 - \alpha_2)$$

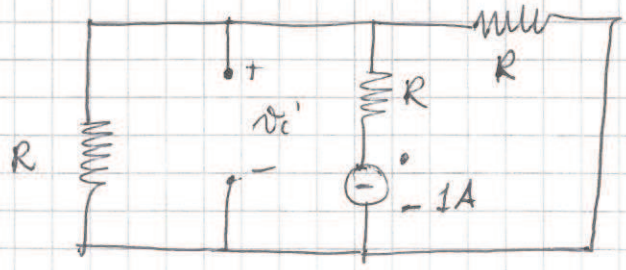
Considerando le correnti entranti nei contrassegni, $\dot{I}_1 = -\dot{I}$ e $\dot{I}_2 = \dot{I}$

Perciò $\alpha_1 = -\alpha_2$ e $Q = \omega L_1 I^2 + \omega L_2 I^2 - 2\omega M I^2 = 2.439\ \text{VAR}$

ESERCIZIO 3

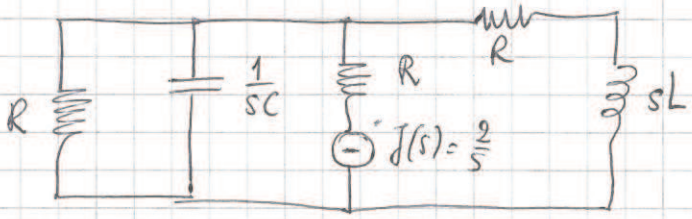
Usiamo sovrapposizione degli effetti

① $J'(t) = -1A$ costante



$v_c'(t) = R \cdot \frac{J}{2} = -30 \cdot \frac{1}{2} = -15\,V$

② $J''(t) = 2u(t)\ A$ Studiamo il circuito $\mathcal{L}$-trasformato <u>senza</u> condizioni iniziali



$$J(s) = \frac{2}{s} = V_A(s)\left[\frac{1}{R} + sC + \frac{1}{R+sL}\right] \Rightarrow$$

$$\Rightarrow V_A(s) = \frac{\frac{2}{s}}{\frac{1}{R} + sC + \frac{1}{R+sL}} = \frac{2R(R+sL)}{s\left[R+sL+sRC(R+sL)+R\right]} =$$

$$= \frac{2RLs + 2R^2}{s\left[s^2RLC + s(L+R^2C) + 2R\right]} = \frac{96s + 1800}{s\left[3\cdot10^{-5}s^2 + 0.1s + 60\right]} \Rightarrow$$

$$\Rightarrow v_A''(t) = v_c''(t) = \left(2.0084 \cdot e^{-2548.6t} - 32.0084 \cdot e^{-784.7t} + 30\right)u(t)$$

$$v_c(t) = v_c'(t) + v_c''(t) = -15 + \left(2.0084 \cdot e^{-2548.6t} - 32.0084 \cdot e^{-784.7t} + 30\right)u(t)$$

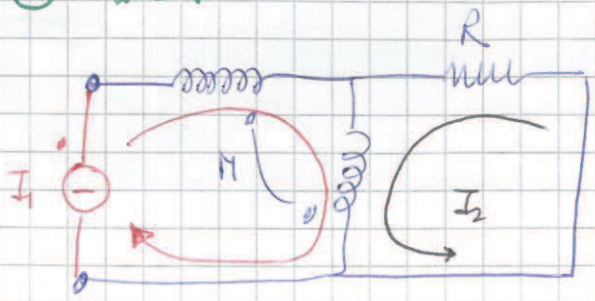
$\lim_{t\to 0^-} v_c(t) = \lim_{t\to 0^+} v_c(t) = -15\,V$

$\lim_{t\to+\infty} v_c(t) = 15\,V$

ESERCIZIO 4 ;

Parametri h : $\begin{cases} \dot{V}_1 = \bar{h}_{11}\dot{I}_1 + \bar{h}_{12}\dot{V}_2 \\ \dot{I}_2 = \bar{h}_{21}\dot{I}_1 + \bar{h}_{22}\dot{V}_2 \end{cases}$

① $\dot{V}_2 = \phi$



$$(R + j\omega L_2)\dot{I}_2 + j\omega L_2 \dot{I}_1 + j\omega M \dot{I}_1 = \phi$$

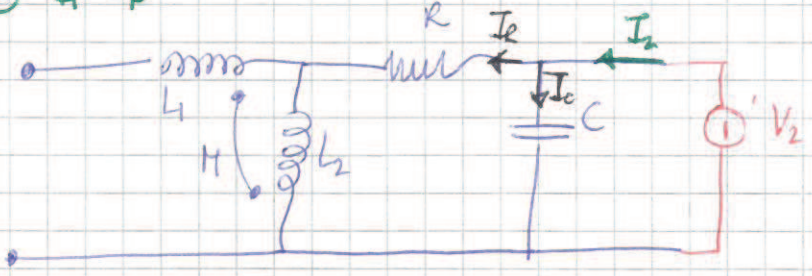
$$\dot{I}_2 = -\underbrace{\frac{j\omega L_2 + j\omega M}{R + j\omega L_2}}_{\bar{h}_{21}} \dot{I}_1$$

$\bar{h}_{21} = -1.2462 - 0.8308j$

$$\dot{V}_1 = j\omega L_1 \dot{I}_1 + j\omega M\left(\dot{I}_1 + \bar{h}_{21}\dot{I}_1\right) - R\dot{I}_2 = \left(j\omega L_1 + j\omega M + j\omega M \bar{h}_{21} - R\bar{h}_{21}\right)\dot{I}_1 \Rightarrow$$

$$\Rightarrow \bar{h}_{11} = 22.4308 + 15.3538j$$

② $\dot{I}_1 = \phi$



$$\dot{I}_2 = \dot{I}_R + \dot{I}_C = \frac{\dot{V}_2}{R + j\omega L_2} + \frac{\dot{V}_2}{\frac{1}{j\omega C}} =$$

$$= \dot{V}_2 \underbrace{\left[j\omega C + \frac{1}{R + j\omega L_2} \right]}_{\bar{h}_{22}}$$

$\bar{h}_{22} = 0.0308 + 0.2538j$

$$\dot{V}_1 = j\omega M \dot{I}_R + j\omega L_2 \dot{I}_R = j\omega(L_2 + M) \cdot \frac{\dot{V}_2}{R + j\omega L_2}$$

$$\bar{h}_{12} = \frac{j\omega(L_2 + M)}{R + j\omega L_2} = 1.2462 + 0.8308j$$

$$\bar{h} = \begin{bmatrix} 22.4308 + 15.3538j & 1.2462 + 0.8308j \\ -1.2462 - 0.8308j & 0.0308 + 0.2538j \end{bmatrix}$$

$\bar{h}_{12} = -\bar{h}_{21}$ ok! (visto che non ci sono generatori pilotati)