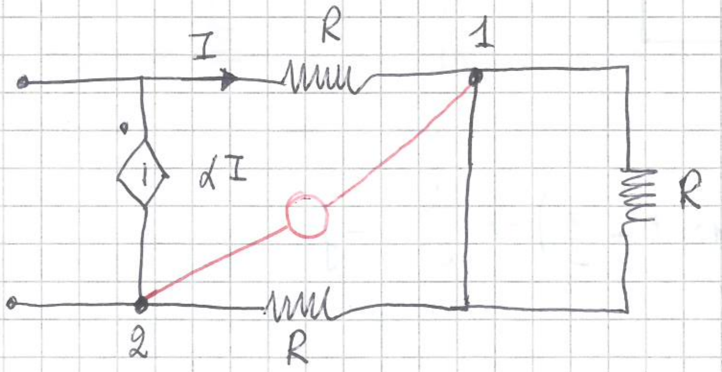
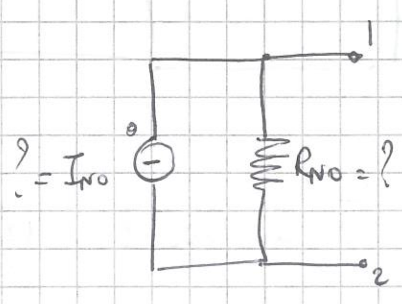
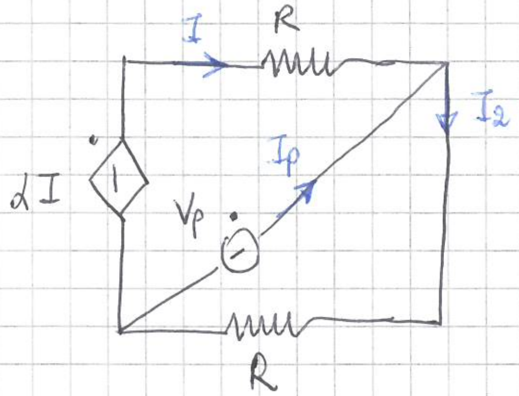
Soluzione compito 12·9·2018 - Ingegneria Informatica

① Calcolo R_{NO}:





R a destra è in parallelo ad un corto circuito. Scegliamo un generatore di prova di tensione



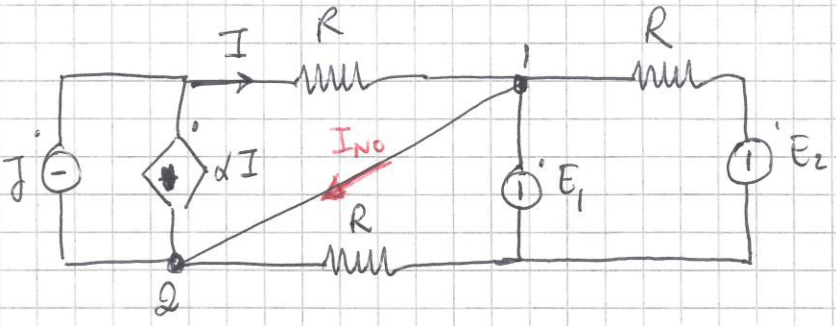
$$I_p = -I + I_2 = -\frac{\alpha I - V_p}{R} + \frac{V_p}{R} \Rightarrow$$

$$\Rightarrow \begin{cases} R I_p = -\alpha I + V_p + V_p \Rightarrow \\ I = \dfrac{\alpha I - V_p}{R} \Rightarrow R I = \alpha I - V_p \Rightarrow I = \dfrac{V_p}{\alpha - R} \end{cases}$$

$$\Rightarrow I_p = -\frac{V_p}{\alpha - R} + \frac{V_p}{R} \Rightarrow I_p = V_p\left(-\frac{1}{\alpha-R} + \frac{1}{R}\right) \Rightarrow R_{NO} = \left(-\frac{1}{\alpha-R} + \frac{1}{R}\right)^{-1} =$$

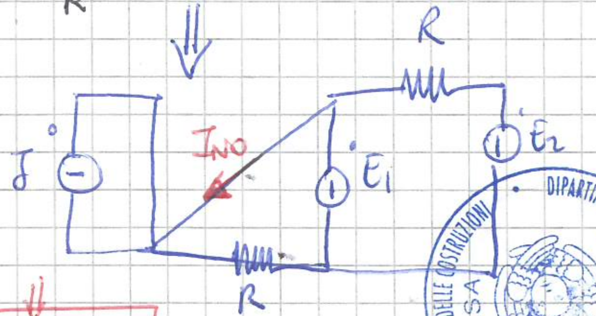
$$= \left(\frac{1}{5} + \frac{1}{10}\right)^{-1} = \left(\frac{3}{10}\right)^{-1} = \boxed{3.33\,\Omega}$$

② Calcolo I_{NO}



$$I = \frac{\alpha I}{R} \Rightarrow I = \emptyset$$

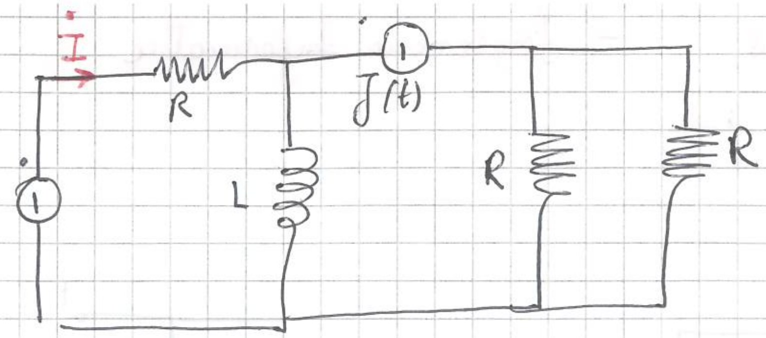
$$\Downarrow$$



$$\Downarrow$$

$$\boxed{I_{NO} = E_1/R = 1A}$$

(2)



$\dot{E} = 10$

$J(t) = \sqrt{2}\ \text{sen}(1000t) = \sqrt{2}\cos\left(1000t - \frac{\pi}{2}\right) \Rightarrow \dot{J} = -j$

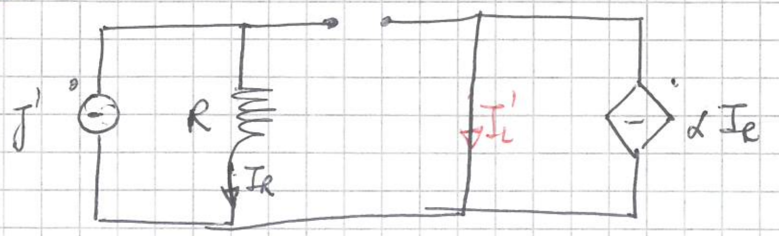
Per la sovrapposizione degli effetti:

$$\dot{I} = \frac{\dot{E}}{R + j\omega L} - \dot{J} \cdot \frac{j\omega L}{R + j\omega L} = \emptyset$$

$$Q = \Im m\left\{\dot{E} \cdot \dot{I}^{*}\right\} = \emptyset \ \text{VAR}.$$

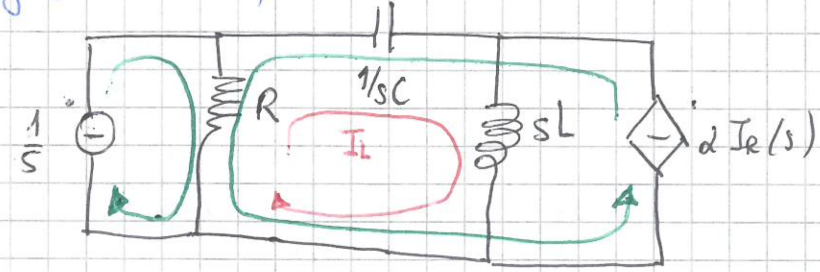
③ Utilizziamo la sovrapposizione degli effetti

$J'(t) = 1A$ costante



$I_R = 1A \Rightarrow I_L'(t) = 0.5A$ (costante)

$J''(t) = 1 \cdot u(t)$



$$\begin{cases} \left(R + \frac{1}{sC} + sL\right) I_L(s) - R \cdot \frac{1}{s} - \left(R + \frac{1}{sC}\right) \alpha I_R(s) = 0 \\ I_R(s) = \frac{1}{s} + \alpha I_R(s) - I_L(s) \Rightarrow \frac{1}{2} I_R(s) = \frac{1}{s} - I_L(s) \Rightarrow I_R(s) = \frac{2}{s} - 2 I_L(s) \end{cases}$$

$$\left(R + \frac{1}{sC} + sL\right) I_L(s) - R \cdot \frac{1}{s} - \left(R + \frac{1}{sC}\right) \cdot \left(\frac{1}{s} - I_L(s)\right) = \phi \Rightarrow$$

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

$$\Rightarrow I_L(s) = \frac{\frac{2R}{s} + \frac{1}{s^2 C}}{2R + sL + \frac{2}{sC}} = \frac{2RCs + 1}{s^3 LC + 2RCs^2 + 2s} = \frac{2RCs + 1}{s\left[LCs^2 + 2RCs + 2\right]}$$

$$= \frac{0.004s + 1}{s\left[2 \cdot 10^{-7} s^2 + 0.004s + 2\right]} \Rightarrow i_L''(t) = \left(-1.0406 \cdot e^{-19487t} + 0.5406 \cdot e^{-513t} + 0.5\right) u(t)$$

$$i_L(t) = 0.5 + \left(-1.0406 \cdot e^{-19487t} + 0.5406\, e^{-513t} + 0.5\right) u(t)$$

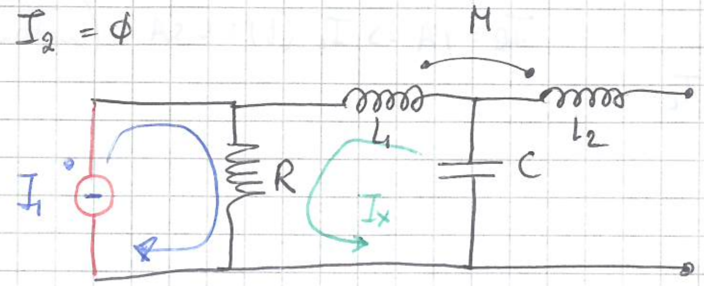
$$\lim_{t \to \phi^-} i_L(t) = \lim_{t \to \phi^+} i_L(t) = 0.5A$$

$$\lim_{t \to +\infty} i_L(t) = 1A \quad \text{ok!}$$

④ $\dot{V}_1 = \bar{z}_{11} \dot{I}_1 + \bar{z}_{12} \dot{I}_2$

$\dot{V}_2 = \bar{z}_{21} \dot{I}_1 + \bar{z}_{22} \dot{I}_2$

① $\dot{I}_2 = \phi$



$$\left(j\omega L_1 + R + \frac{1}{j\omega C}\right) \dot{I}_x + R\dot{I}_1 = \phi \Rightarrow$$

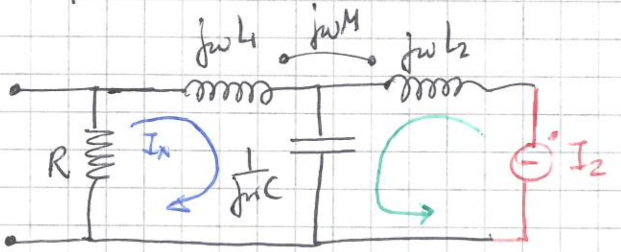
$$\Rightarrow \dot{I}_x = -\frac{R}{j\omega L_1 + R + \frac{1}{j\omega C}} \dot{I}_1 = (-0.04 - 0{,}1959j)\dot{I}_1 = \alpha \dot{I}_1$$

$$\dot{V}_1 = R\dot{I}_1 + R\cdot\alpha\dot{I}_1 = (R+\alpha R)\dot{I}_1 \Rightarrow \bar{z}_{11} = R + \alpha R = (9{,}6002 - 1{,}9592j)\,\Omega$$

$$\dot{V}_2 = -j\omega M \dot{I}_x - \frac{1}{j\omega C}\dot{I}_x = -\left(j\omega M + \frac{1}{j\omega C}\right)\cdot \alpha \dot{I}_1 \Rightarrow$$

$$\Rightarrow \bar{z}_{21} = -\left(j\omega M + \frac{1}{j\omega C}\right)\alpha = (9{,}5414 - 1{,}9472j)\,\Omega$$

② $\dot{I}_1 = \phi$



$$\left(R + j\omega L_1 + \frac{1}{j\omega C}\right)\dot{I}_x + \frac{1}{j\omega C}\dot{I}_2 + j\omega M \dot{I}_2 = \phi \Rightarrow \dot{I}_x = -\frac{\frac{1}{j\omega C} + j\omega M}{R + j\omega L_1 + \frac{1}{j\omega C}} \dot{I}_2 \Rightarrow$$

$$\Rightarrow \dot{I}_x = (-0.9541 + 0.1947j)\dot{I}_2 = \alpha \dot{I}_2$$

$$\dot{V}_1 = -R\dot{I}_x = -\alpha R \dot{I}_2 \Rightarrow \bar{z}_{12} = -\alpha R = (9.5414 - 1.9472j)\,\Omega$$

$$\dot{V}_2 = j\omega L_2 \dot{I}_2 + j\omega M \alpha \dot{I}_2 + \frac{1}{j\omega C}(1+\alpha)\dot{I}_2 \Rightarrow \bar{z}_{22} = j\omega L_2 + j\omega M\alpha + \frac{1}{j\omega C}(1+\alpha) =$$

$$= 9.4830 - 1.5335j$$