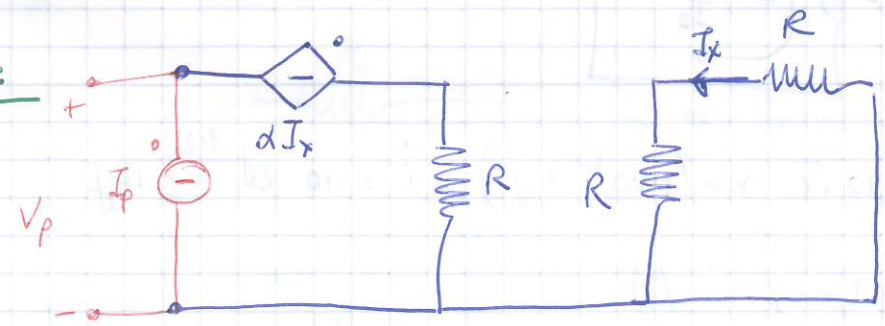
Compito di Ingegneria Informatica 6.6.2018

ESERCIZIO 1

R_{TH}:



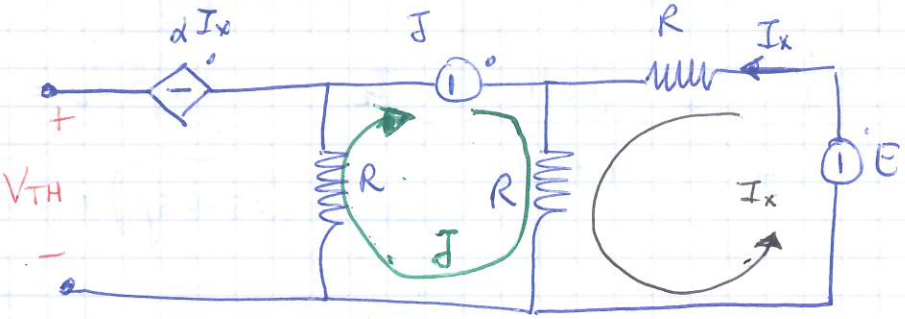
$I_x = 0$

$\alpha I_x = 0$

$V_p = -\alpha I_x + R I_p = R I_p$

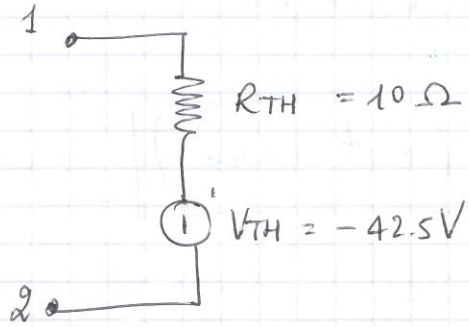
$R_{TH} = \frac{V_p}{I_p} = R = 10\,\Omega$

V_{TH}:

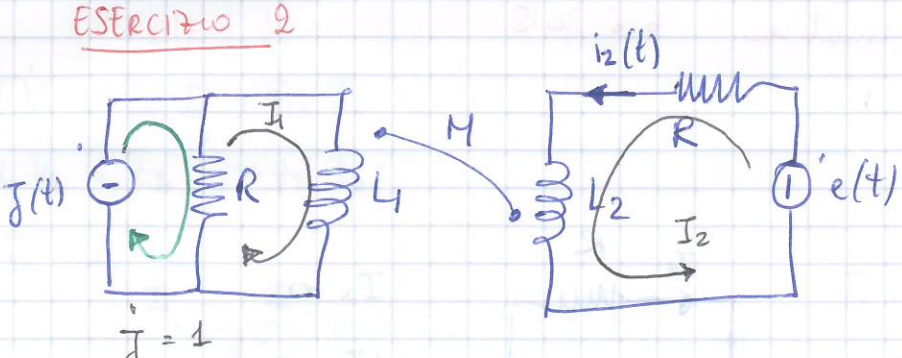


$E = 2RI_x + RJ \Rightarrow I_x = \frac{E - RJ}{2R} = \frac{50 - 20}{20} = 1.5\,A$

$V_{TH\,x} = -\alpha I_x - RJ = -15 \cdot 1.5 - 20 = -22.5 - 20 = -42.5\,V$



ESERCIZIO 2



$$e(t) = 10\sqrt{2}\cos(1000t) = 10\sqrt{2}\,\text{sen}\left(1000t + \frac{\pi}{2}\right) \Rightarrow \dot{E} = 10 \cdot e^{j\,\pi/2} = 10j$$

$$\begin{cases} (R + j\omega L_1)\dot{I}_1 - R\dot{J} - j\omega M \dot{I}_2 = \phi \quad (i) \\ -\dot{E} + (R + j\omega L_2)\dot{I}_2 - j\omega M \dot{I}_1 = \phi \quad (ii) \end{cases}$$

Dalla (i): $\dot{I}_1 = \dfrac{R\dot{J}}{R + j\omega L_1} + \dfrac{j\omega M}{R + j\omega L_1}\dot{I}_2 = \underbrace{\alpha}_{} + \underbrace{\beta}_{}\dot{I}_2 =$

$$= (0.5 - 0.5j) + (0.5 + 0.5j)\dot{I}_2$$

Dalla (2):

$$-\dot{E} + (R + j\omega L_2)\dot{I}_2 - \alpha \cdot j\omega M - \beta j\omega M \dot{I}_2 = 0$$

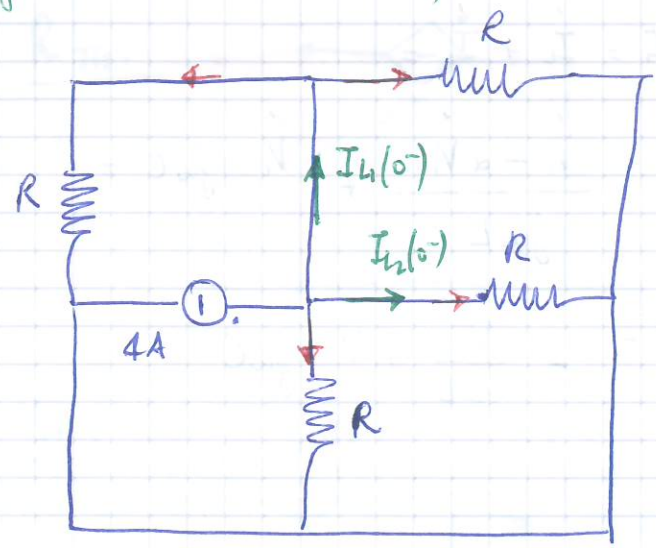
$$\dot{I}_2 = \frac{\dot{E} + \alpha j\omega M}{R + j\omega L_2 - j\omega M \beta} = 0.692 + 0.539j =$$

$$= 0.877 \cdot e^{j\,0.661}$$

$$\boxed{i_2(t) = 0.8771 \cdot \sqrt{2} \cdot \text{sen}(1000t + 0.661)}$$

ESERCIZIO 3

Risolviamo per tempi negativi usando condizioni iniziali (a causa della presenza di un tasto)

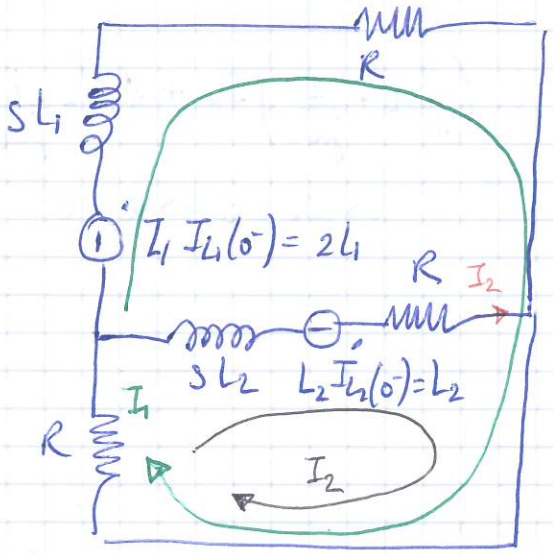


Le resistenze sono tutte e 4 in parallelo al generatore di corrente, e quindi, per la regola partitore di corrente, le correnti in rosso sono tutte uguali e 1A.

Allora $I_{L_1}(0^-) = 2A$

$I_{L_2}(0^-) = 1A$

$t > 0$



$$\begin{cases} 2L_1 = (2R + sL_1) I_1(s) + R I_2(s) & (i) \\ L_2 = (2R + sL_2) I_2(s) + R I_1(s) & (ii) \end{cases} \Rightarrow$$

$\Rightarrow$ Dalla (ii)

$$I_1(s) = \frac{L_2}{R} - \frac{(2R + sL_2) I_2(s)}{R}$$

Sostituisco nella (i)

$$2L_1 = (2R + sL_1) \cdot \frac{L_2}{R} - \frac{(2R + sL_1)(2R + sL_2)}{R} \cdot I_2(s) + R I_2(s) \Rightarrow$$

$$\Rightarrow 2RL_1 - (2R + sL_1) L_2 = \left[R^2 - (2R + sL_1)(2R + sL_2) \right] I_2(s) \Rightarrow$$

$$\Rightarrow I_2(s) = \frac{sL_1L_2 + 2RL_2 - 2RL_1}{s^2 L_1 L_2 + s(2RL_1 + 2RL_2) + 3R^2} = \frac{0.02\,s + 6}{0.02\,s^2 + 18s + 2700}$$

$$i_2(t) = \left(0.7887 \cdot e^{-709.8076\,t} + 0.2113 \cdot e^{-190.1924\,t} \right) u(t)$$

$$i_2(t) = \begin{cases} 1\,A, & t < 0 \\ 0.7887 \cdot e^{-709.8076\,t} + 0.2113\, e^{-190.1924\,t}, & t \geq 0 \end{cases}$$

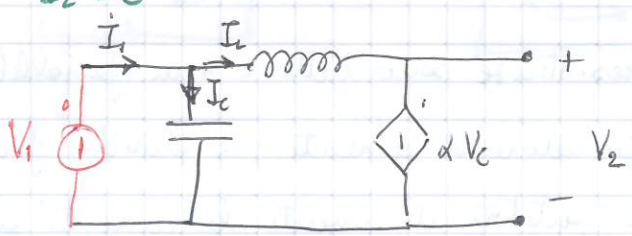
$\lim_{t \to 0^-} i_2(t) = \lim_{t \to 0^+} i_2(t)$

$\lim_{t \to \infty} i_2(t) = 0$ ✓

ESERCIZIO 4

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

① $\dot{I}_2 = 0$

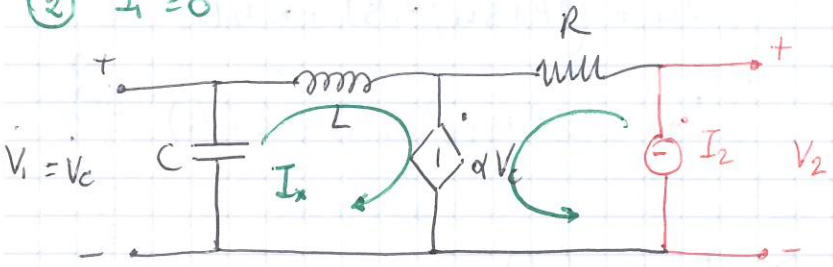


$$\dot{I}_1 = \dot{I}_L + \dot{I}_C = \frac{\dot{V}_1 - \alpha\dot{V}_1}{j\omega L} + \dot{V}_1 \cdot j\omega C = -\frac{\dot{V}_1}{j\omega L} + \dot{V}_1 \cdot j\omega C$$

$$\bar{Z}_{11} = \left(-\frac{1}{j\omega L} + j\omega C\right)^{-1} = -2.5j$$

$$\dot{V}_2 = +2\dot{V}_1 = +2\bar{Z}_{11}\dot{I}_1 \Rightarrow \bar{Z}_{21} = 2\bar{Z}_{11} = -5j$$

② $\dot{I}_1 = 0$



$$\left(j\omega L + \frac{1}{j\omega C}\right)\dot{I}_x + \alpha\cdot\left(-\frac{1}{j\omega C}\right)\dot{I}_x = 0$$

$$\Rightarrow \dot{I}_x = 0 \Rightarrow V_C = 0$$

$$\dot{V}_1 = 0 \Rightarrow \bar{Z}_{12} = 0$$

$$\dot{V}_2 = R\dot{I}_2 \Rightarrow \bar{Z}_{22} = R = 10\,\Omega$$

$$\bar{Z} = \begin{bmatrix} -2.5j & 0 \\ -5j & 10 \end{bmatrix}$$

$$\begin{cases} \dot{V}_1 = -2.5j\,\dot{I}_1 & (i) \\ \dot{V}_2 = -5j\,\dot{I}_1 + 10\dot{I}_2 & (ii) \\ \dot{V}_2 = -10\,\dot{I}_2 & (iii) \\ \dot{V}_1 = \dot{E} = 10 & (iv) \end{cases}$$

Dalla (i) e dalla (iv) $\Rightarrow \dot{I}_1 = \dfrac{\dot{V}_1}{-2.5j} = \dfrac{10}{-2.5j} = 4j$

$$\bar{S} = \dot{E}\cdot\dot{I}_1^{*} = 10\cdot(-4j) = -40j$$

$\Rightarrow$ $\boxed{P = 0}$

$\Rightarrow$ $Q = -40$