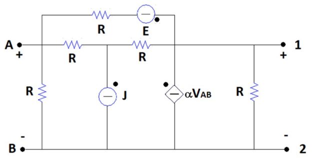
16/01/2018

venerdì 4 dicembre 2020 10:20

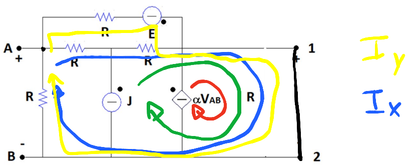
ES 1

1) Determinare il **circuito equivalente di Norton** fra i punti **1** e **2** del circuito in figura.



E = 20 V;
J = 1 A;
R = 10 Ω;
α = 0.25 A/V.

I_{No}



$$V_{AB} = -(I_x + I_y)\,R$$

$$\begin{cases} 3R I_x + R I_y + R J = 0 \\ E = 2R I_y + R I_x \implies I_y = \dfrac{E - R I_x}{2R} \end{cases}$$

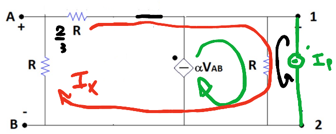
$$3R I_x + \frac{E - R I_x}{2} + R J = 0 \implies \qquad I_x = \frac{-\frac{E}{2} - RJ}{3R - R/2} = -0{,}8\,A$$

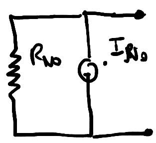
$$I_y = 1{,}4$$

$$V_{AB} = -(0{,}6)\,R = -6\ V$$

$$I_{No} = J + \alpha V_{AB} + I_x + I_y = 1 - 1{,}5 - 0{,}8 + 1{,}4 = 0{,}1 A$$

R_{No}





$$V_{AB} = -I_x R$$

$$V_p = R(I_p + \alpha V_{AB} + I_x) \implies R\left(I_p + \alpha R\left(\frac{I_p}{8/3 - R\alpha}\right) - \frac{I_p}{8/3 - R\alpha}\right) = V_p$$

$$\frac{8}{3} R I_x + R \alpha V_{AB} + R I_p = 0$$

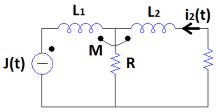
$$\frac{8}{3} I_x \cancel{R} - R^{\cancel{2}}\alpha I_x + \cancel{R} I_p = 0$$

$$\frac{V_p}{I_1} = R_{No} = \left(R + \frac{\alpha R^2}{8/3 - R\alpha} - \frac{R}{8/3 - R\alpha}\right) = 100\ \Omega$$

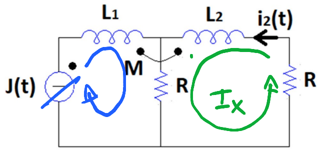
$$I_x = \frac{-I_p}{8/3 - R\alpha}$$

ES 2

2) Determinare la **potenza reattiva erogata dal generatore di corrente J(t)** e **l'andamento temporale della corrente $i_2(t)$** nel secondo induttore (con il verso mostrato in figura).



$J(t) = \sqrt{2}\sin(1000t)$ A;
R = 10 Ω;
L_1 = 10 mH;
L_2 = 20 mH.
M = 14 mH;



$$\begin{cases} V_J = j\omega L_1 \dot{J} + j\omega M I_x + \dot{J} R + I_x R = 5{,}4 + 0{,}6\,i \\ 2R I_x + j\omega L_2 I_x + j\omega M \dot{J} + \dot{J} R = 0 \end{cases}$$

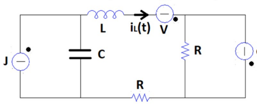
$$I_x = \frac{-\dot{J}\,(j\omega M + R)}{2R + j\omega L_2} = -0{,}6 - 0{,}18 = 0{,}608\sqrt{2}\, e^{-2{,}98t}$$

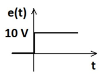
$$i_2(t) = 0{,}608\sqrt{2}\,(\sin 1000t - 2{,}98)$$

$$Q_J = I_M\{V_J \cdot J^*\} = 0{,}6 \text{ VAR}$$

ES 3

3) Determinare l'andamento temporale della corrente $i_L(t)$ per $-\infty < t < +\infty$, considerando l'**andamento a gradino della tensione del generatore e(t)**, come in figura. Il circuito è ipotizzato a regime per tempi negativi.

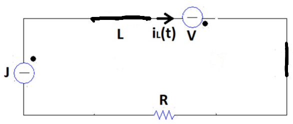




J = 1 A (costante);
V = 10V (costante);
R = 100 Ω;
L = 10 mH;
C = 10 μF;

$$e(t) = e'(t) + e''(t) = 0 + 10\mu(t)$$

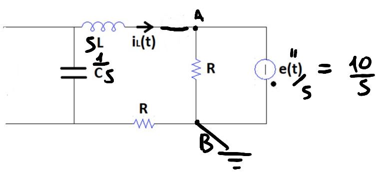
e', J e V



$$i_L = i_L' + i_L''$$

$$i_L' = J$$

e''



$$V_{AB} = \frac{10}{s}$$

$$i_L(s) = \frac{10}{s} \cdot \frac{1}{sL + \frac{1}{sC} + R} = \frac{10}{s^2 L + \frac{1}{C} + Rs} = \frac{10C}{s^2 LC + 1 + RCs}$$

$$i_L(s) = \frac{10^{-4}}{10^{-7}s^2 + 1 + 10^{-3}s} = \frac{10^3}{s^2 + 10^7 + 10^4 s}$$

$$s_{1,2} = \frac{-10^4 \pm \sqrt{10^8 - 4 \cdot 10^7}}{2} \cong \begin{cases} -8873 \\ -1127 \end{cases}$$

$$A_1 = \lim_{s \to -8873} \frac{10^3}{s + 1127} = -0{,}1291$$

$$A_1 = \lim_{s \to -8873} \frac{10^3}{s+1127} = -0{,}1291$$

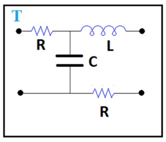
$$A_2 = \lim_{s \to -1127} \frac{10^3}{s+8873} = 0{,}1291$$

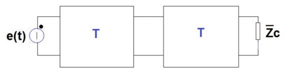
$$i_L'' = \left(-0{,}1291\, e^{-8873t} + 0{,}1291\, e^{-1127t}\right) u(t)$$

$$i_L(t) = 1 + \left(-0{,}1291\, e^{-8873t} + 0{,}1291\, e^{-1127t}\right) u(t)$$

ES 4

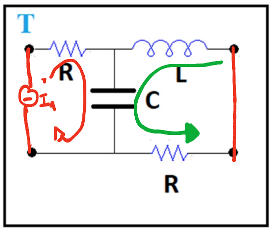
4) Determinare la rappresentazione a parametri **T** della rete a due porte indicata in figura (a sinistra), ipotizzata a regime periodico sinusoidale a pulsazione **ω**, e successivamente calcolare la potenza attiva erogata dal generatore di tensione **e(t)** in ingresso nel circuito di destra.





$R = 10\,\Omega$;
$L = 10$ mH;
$C = 100\,\mu$F;
$e(t) = 10\sqrt{2}\sin(1000t)V$;
$\overline{Z_C} = 10\,\Omega$;

$$\begin{cases} V_1 = A V_2 + B(-I_2) \\ I_1 = C V_2 + D(-I_2) \end{cases} \Rightarrow -I_2 = \frac{I_1}{D} - \frac{C}{D} V_2$$



$$j\omega L I_2 + \frac{I_2}{j\omega C} + R I_2 + \frac{I_1}{j\omega C} = 0$$

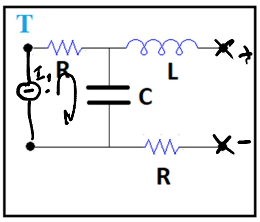
$$I_2 = -\frac{I_1}{j\omega C} \cdot \frac{1}{j\omega L + \frac{1}{j\omega C} + R}$$

$$V_1 = R I_1 + \frac{I_1}{j\omega C} + \frac{I_2}{j\omega C}$$

$$V_1 = I_1\left(R + \frac{1}{j\omega C}\right) + \frac{I_2}{j\omega C}$$

$$I_1 = -I_2\left(j\omega C\left(j\omega L + \frac{1}{j\omega C} + R\right)\right) = -j I_2 \to D = j$$

$$V_1 = -j I_2\left(R + \frac{1}{j\omega C}\right) + \frac{I_2}{j\omega C} = -I_2\left(Rj + \frac{j}{j\omega C} - \frac{1}{j\omega C}\right) = 20i + 10 = B$$



$$V_1 = R I_1 + \frac{I_1}{j\omega C} = V_2\, j\omega C\left(R + \frac{1}{j\omega C}\right) = V_1$$

$$V_2 = \frac{I_1}{j\omega C} \qquad I_1 = V_2\, j\omega C = 0{,}1j\, V_2$$

$$C = 0{,}1j$$

$$A = j\omega C\left(R + \frac{1}{j\omega C}\right) = 0{,}1j(10 - 10j) = j + 1 = A$$