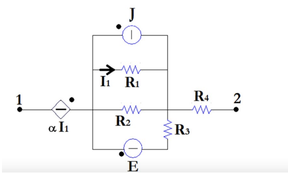
01/07/2020

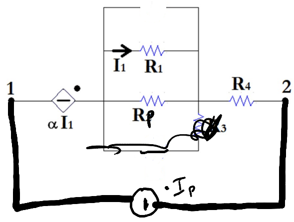
sabato 2 gennaio 2021 10:32

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



J = 2 A;
E = 50 V;
$R_1 = 10\ \Omega$;
$R_2 = 20\ \Omega$;
$R_3 = 30\ \Omega$;
$R_4 = 40\ \Omega$;
$\alpha = 15$ V/A.

CALCOLO R_{TH}

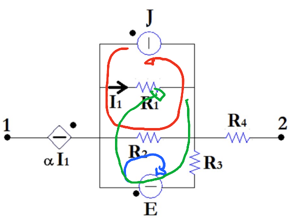


$$R_p = \frac{60}{5}$$

$$I_1(R_1 + R_p) + I_p R_p = 0$$

$$I_1 = \frac{-I_p R_p}{R_1 + R_p} = \gamma I_p = -\frac{6}{11} I_p$$

$$V_p = I_p(R_4 + \gamma R_1 + \alpha\gamma) = 37{,}27\ I_p$$



$$\begin{cases} I_2(R_2 + R_3) + J R_2 + I_1 R_3 = E \\ I_1(R_3 + R_1) + R_3 I_2 = E \end{cases}$$

$$I_1 = \frac{E - R_3 I_2}{R_3 + R_1} = 2$$

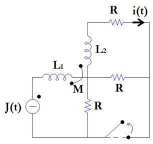
$$I_2\left(R_2 + R_3 - \frac{R_3^2}{R_3 + R_1}\right) = -J R_2 + E\left(-\frac{R_3}{R_3 + R_1} + 1\right)$$

$$I_2 = \frac{-J R_2 + E\left(-\frac{R_3}{R_3 + R_1} + 1\right)}{R_2 + R_3 - \frac{R_3^2}{R_3 + R_1}} = -1$$

$$V_{TH} = -30 + 20 = -10\ V$$

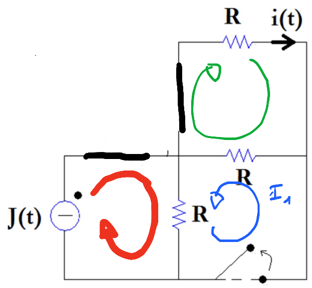
ES 2

2) Determinare l'andamento temporale della corrente **i(t)** indicata nel circuito in figura per $-\infty < t < +\infty$, considerando che l'interruttore si **APRE** per t=0. Il circuito è ipotizzato a regime per tempi negativi.



J(t) = 2 A (costante);
R = 10 Ω;
C = 100 μF;
L_1 = 10 mH;
L_2 = 15 mH;
M = 10 mH.

$t < 0$



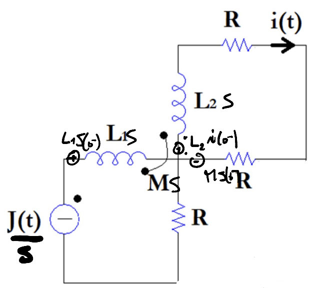
$$\begin{cases} 2R\,I + R\,I_1 = 0 \\ 2R\,I_1 + R\,I + R\,J = 0 \end{cases} \qquad I = \frac{-R I_1}{2R} = -\frac{I_1}{2}$$

$$2R\,I_1 - \frac{R\,I_1}{2} + R\,J = 0$$

$$I_1 \left(2R - \frac{R}{2} \right) = -R\,J$$

$$I_1 = \frac{-2\cancel{R}\,J}{3\cancel{R}} = -\frac{2}{3} J = -\frac{4}{3}\,A$$

$$I = +\frac{2}{3}\,A$$



$$2R\,I(s) + L_2 s\,I(s) - M s\,\cancel{J(s)} = L_2\,i(0^-) - M\,\cancel{J(0^-)}$$

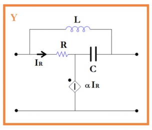
$$I(s) = \frac{+L_2\,i(0^-)}{2R + L_2 s} = \quad +\frac{2}{3} \quad =$$

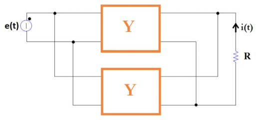
$$A_1 = \frac{2}{3}$$

$$i(t) = \begin{cases} +\frac{2}{3} & t < 0 \\ \frac{2}{3} e^{-1333{,}33} & t \geq 0 \end{cases}$$

ES 3

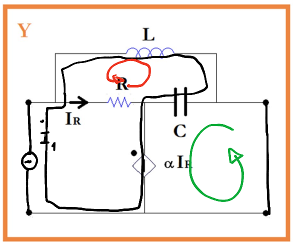
3) Determinare la rappresentazione a parametri **Y** della rete a due porte indicata in figura (a sinistra). Si ipotizzi che il circuito si trovi a regime periodico sinusoidale con pulsazione ω. Supponendo poi che due circuiti equivalenti al precedente siano collegati come nella seconda figura (a destra), calcolare la **corrente i(t)** e la **potenza complessa** erogata dal generatore di tensione.





R = 10 Ω;
L = 10 mH;
C = 100 μF;
α = 10 V/A;
ω = 1000 rad/sec;
e(t) = $50\sqrt{2}\cos(1000\,t)\,V$.

$$\begin{cases} I_1 = V_1 Y_{11} + V_2 Y_{12} \\ I_2 = V_1 Y_{21} + V_2 Y_{22} \end{cases}$$



$$\left(j\omega L + \frac{1}{j\omega C} + R\right) I_R - \left(j\omega L + \frac{1}{j\omega C}\right) I_1 - \frac{I_2}{j\omega C} = 0$$

$$\frac{I_2}{j\omega C} + \alpha I_R + \frac{I_1}{j\omega C} - \frac{I_R}{j\omega C} = 0$$

$$I_2 = -\alpha I_R j\omega C - I_1 + I_R = -\alpha\gamma Y_{11} V_1 j\omega L - Y_{11} V_1 + \gamma Y_{11} V_1 = Y_{21} V_1 = 0{,}05 j V_1$$

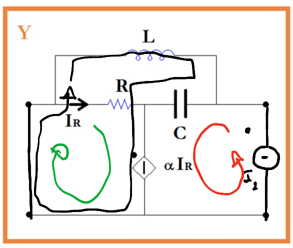
$$I_R\left(j\omega L + \cancel{\frac{1}{j\omega C}} + R\right) - \left(j\omega L + \cancel{\frac{1}{j\omega C}}\right) I_1 + \alpha I_R + \cancel{\frac{I_1}{j\omega C}} - \cancel{\frac{I_R}{j\omega C}} = 0$$

$$I_R\left(j\omega L + \alpha + R\right) = I_1\, j\omega L$$

$$I_R = \frac{I_1\, j\omega L}{j\omega L + \alpha + R} = (0{,}2 + 0{,}4j)\, I_1$$

$$V_1 = R\gamma I_1 + \alpha\gamma I_1$$

$$Y_{11} = \frac{1}{R\gamma + \alpha\gamma} = 0{,}05 - 0{,}1j \qquad I_1 = Y_{11} V_1$$



$$V_2 = \frac{1}{j\omega C}\left(I_2 + I_1\right) + \cancel{\alpha I_R}$$