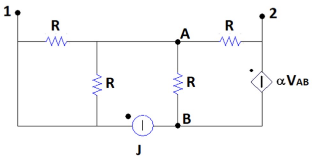
26/06/2019

sabato 19 dicembre 2020   15:43

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

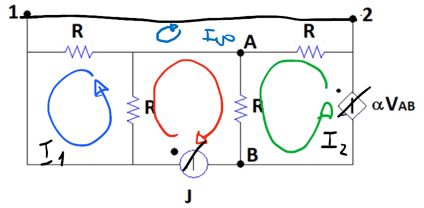


J = 2.5 A;
R = 10 Ω;
α = 0.5;

Risultati:

$J_{NO} = 2.5$ A;

$R_{NO} = 8.33\ \Omega$;



$$\begin{cases} V_{AB} = R(I_2 + J) \\ 2R I_2 + RJ + R I_{NO} = \alpha V_{AB} \\ 2R I_1 + RJ + R I_{NO} = 0 \\ 2R I_{NO} + R I_2 + R I_1 = 0 \end{cases}$$

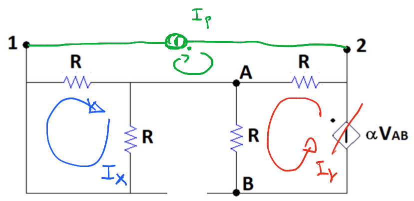
$$\Rightarrow (2R - R\alpha) I_2 = -RJ + R\alpha J - R I_{NO}$$

$$I_1 = -\frac{\cancel{R}(J + I_{NO})}{2\cancel{R}} \qquad I_2 = \frac{-RJ + R\alpha J - R I_{NO}}{2R - R\alpha} = \frac{-J + \alpha J - I_{NO}}{2 - \alpha}$$

$$2R I_{NO} + \frac{-RJ + \alpha JR - R I_{NO}}{2 - \alpha} - \frac{R(J + I_{NO})}{2} = 0$$

$$I_{NO}\left(2R - \frac{R}{2-\alpha} - \frac{R}{2}\right) = \frac{RJ(1-\alpha)}{2-\alpha} + \frac{RJ}{2}$$

$$I_{NO} = \frac{\frac{RJ}{3} + \frac{RJ}{2}}{20 - 6{,}67 - 5} = 2{,}501 \ \text{A}$$



$$\begin{cases} V_{AB} = R I_Y \\ 2R I_Y + R I_P = \alpha R I_Y \\ 2R I_X - R I_P = 0 \end{cases}$$

$$I_Y = \frac{-R I_P}{2R - \alpha R} = \frac{-I_P}{2 - \alpha}$$

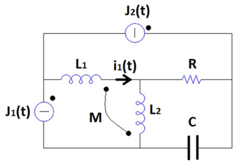
$$I_X = \frac{R I_P}{2R} = \frac{I_P}{2}$$

$$V_P = 2R I_P - \frac{R I_P}{2 - \alpha} - \frac{R I_P}{2}$$

$$R_{NO} = \frac{V_P}{I_P} = 2R - \frac{R}{2-\alpha} - \frac{R}{2} = 20 - 6{,}67 - 5 = 8{,}33\ \Omega$$

Es 2

2) Determinare l'andamento temporale della corrente **$i_1(t)$** nel primo induttore e la **potenza attiva** dissipata sul resistore del circuito in figura.

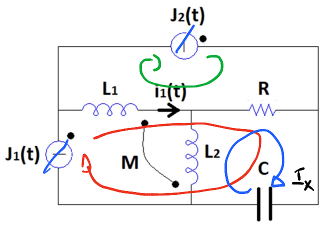


$J_1(t) = \sqrt{2}\cos(1000t)$ A;
$J_2(t) = 2\sqrt{2}\cos(1000t + \pi/3)$ A $2(\cos \pi/3 + i \sin(\pi/3))$
$R = 10\ \Omega$;
$C = 100\ \mu F$;
$L1 = 10$ mH;
$L2 = 20$ mH;
$M = 14$ mH

Risultati:

$i_1(t) = \sqrt{6}\cos(1000t - \pi/2)$ **A;** $1 + \sqrt{3}\, i$

P = 91.4 W;



$$I_1 = J_1 - J_2 = -\sqrt{3}\, j$$

$$\sqrt{3}\sqrt{2}\cos(1000t - \pi/2)$$

$$R I_x \quad j\omega L_2 I_x - j\omega M I_1 + R J_1 - R J_2 + \frac{I_x}{j\omega C} + \frac{J_1}{j\omega C} = 0$$

$$I_x \left(j\omega L_2 + \frac{1}{j\omega C} + R \right) = j\omega M I_1 - R I_1 - \frac{J_1}{j\omega C}$$

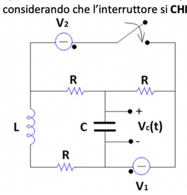
$$I_x = \frac{j\omega M I_1 - R I_1 - \frac{J_1}{j\omega C}}{j\omega L_2 + \frac{1}{j\omega C} + R} = 2{,}578 + 0{,}1535\, j$$

$$I_R = I_x + J_1 - J_2 = 2{,}578 + 0{,}1535\, j + 1 - 1 - \sqrt{3}\, j = 0$$

$$I_R = 2{,}578 - 1{,}578\, j$$

Es 3

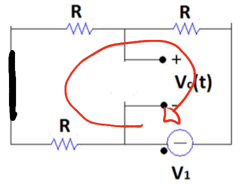
3) Determinare l'andamento temporale della tensione **Vc(t)** ai capi del condensatore per $-\infty < t < +\infty$, considerando che l'interruttore si **CHIUDE** per t=0. Il circuito è ipotizzato a regime per tempi negativi



$V_1 = 10$ V;
$V_2 = 20$ V;
$R = 10\ \Omega$;
$L = 10$ mH;
$C = 100\ \mu F$.

Risultati:

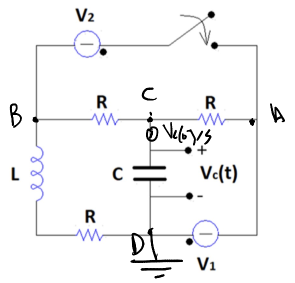
$$v(t) = \begin{cases} -20/3\ V, & t < 0 \\ (\frac{40}{3} e^{-2000t} - 20)\ V, & t \geq 0 \end{cases}$$



$$i_1(0^-) = \frac{V_1}{\ } = \frac{1}{2}\ A$$

$$\overline{3R} \quad - \quad 3$$

$$V_c(0^-)\ 2R\, I_1 = -\frac{20}{3}\ V$$



$$V_B = V_1 - V_2 = -\frac{10}{s} V$$

$$V_D = -V_1$$

$$V_c(s) = V_C - V_D = V_C$$

$$0 = V_C\left(\frac{1}{R} + \frac{1}{R} + \frac{1}{sC}\right) - \frac{V_B}{sR} - \frac{V_D}{sR}$$

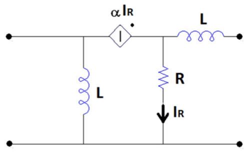
$$\frac{V_B + V_D}{sR} = V_C\left(\frac{2}{R} + \frac{1}{sC}\right)$$

$$\frac{V_B + V_D}{sR\left(\frac{2}{R} + \frac{1}{sC}\right)} = V_C \Rightarrow \frac{V_B + V_D}{2s + \frac{R}{C}} + \frac{V_C(0^-)}{s} = \frac{(V_B + V_D)s + V_C(0^-)\left(2s + \frac{R}{C}\right)}{s\left(2s + \frac{R}{C}\right)}$$

$$s_1 = 0 \qquad s_2 = -\frac{R}{2C} =$$

ES 4

4) Determinare la rappresentazione a parametri **h (ibridi)** della rete a due porte indicata in figura. Si ipotizzi che il circuito si trovi a regime periodico sinusoidale con pulsazione ω.

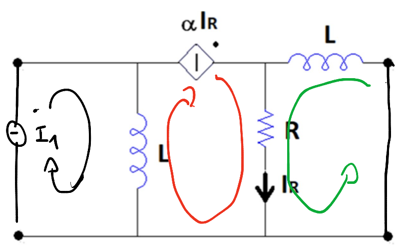


$R = 10\ \Omega$;
$L = 10$ mH;
$\alpha = 0.5$;
$\omega = 1000$ rad/sec.

Risultati:

$$h = \begin{bmatrix} 10j & -0.2 - 0.4j \\ 0 & 0.04 - 0.02j \end{bmatrix}$$

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



$$I_R = I_2 + \alpha I_R$$

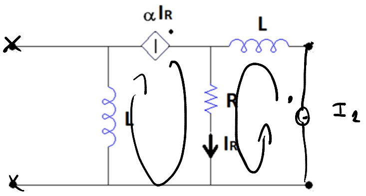
$$\left(I_R = \frac{I_2}{\ \ } \right.$$

$$\begin{cases} I_R = \dfrac{I_2}{1-\alpha} \\ (j\omega L + R)\,\alpha I_R + R I_2 - j\omega L I_1 = 0 \\ (j\omega L + R)\, I_2 + R\alpha I_R = 0 \end{cases}$$

$I_2(j\omega L + R) + R\alpha \dfrac{I_2}{1-\alpha} = 0 \Rightarrow I_2 = 0 \quad \Rightarrow h_{21} = 0$

$$j\omega L\left(I_1 - \frac{\alpha I_2}{1-\alpha}\right)$$

$I_2 = 0 \qquad h_{11} = j\omega L = 10j$



$$I_R = I_2 + \alpha I_R$$

$$I_R = \frac{I_2}{1-\alpha}$$

$$V_2 = (j\omega L + R) I_2 + R\,\frac{\alpha I_2}{1-\alpha}$$

$$V_2 = \left(j\omega L + R + \frac{R\alpha}{1-\alpha}\right) I_2$$

$$\frac{V_2}{j\omega L + R + \frac{R\alpha}{1-\alpha}} = I_2$$

$h_{22} = 0{,}04 - 0{,}02j$

$$V_1 = -R\alpha I_R = -R\alpha \frac{I_2}{1-\alpha} = -R\alpha \frac{V_2 h_{22}}{1-\alpha} =$$