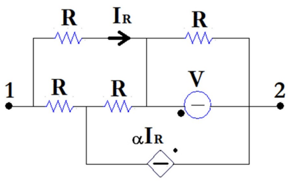
09/01/2020

domenica 27 dicembre 2020 10:16

Es 1

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



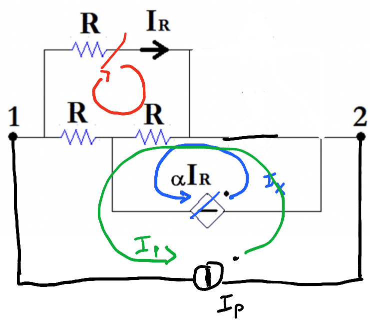
V = 50 V;
R = 15 Ω;
α = 6 V/A;

Risultati:

V_{TH} = 29.167 V;

R_{TH} = 6.25 Ω;

R_{TH}



$$\begin{cases} 3RI_R + RI_x + 2RI_p = 0 \\ R(I_x + I_p + I_R) = \alpha I_R \end{cases} \Longrightarrow 3R\left(\frac{-I_x - I_p}{1-\frac{\alpha}{R}}\right) + RI_x + 2RI_p = 0$$

$$-\frac{3I_x + 3I_p}{1-\frac{\alpha}{R}} + I_x + 2I_p = 0$$

$$I_x + I_1 + I_R = \frac{\alpha I_R}{R}$$

$$I_R\left(1-\frac{\alpha}{R}\right) = -I_x - I_p$$

$$I_x\left(1 - \frac{3}{1-\frac{\alpha}{R}}\right) = \left(-2 + \frac{3}{1-\frac{\alpha}{R}}\right) I_1$$

$$I_R = \frac{-I_x - I_p}{1-\frac{\alpha}{R}} = \frac{+\frac{3}{4}I_p - I_p}{1-\frac{\alpha}{R}}$$

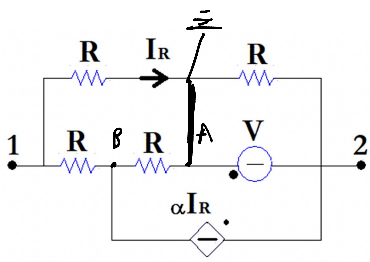
$$I_x = \frac{\left(-2 + \frac{3}{1-\alpha/R}\right)}{1 - \frac{3}{1-\alpha/R}} I_p = \gamma I_p = -\frac{3}{4} I_p$$

$$= \frac{-\frac{1}{4}I_1}{1-\frac{\alpha}{R}} = -\frac{5}{12} I_p$$

$$V_p = -RI_R = +\frac{5R}{12} I_p$$

$$R_{TH} = +\frac{5}{12}R =$$

V_{TH}



$$V_A = 0 \qquad I_R = \frac{V_1 - V_A}{R} = \frac{V_1}{R} = -1{,}39\ A$$

$$V_2 = -V$$

$$V_B = -\alpha I_R - V = -\alpha \frac{V_1}{R} - V$$

$$0 = V_1 \left(\frac{2}{R}\right) - \frac{V_B}{R}$$

$$0 = V_1 \frac{2}{R} - \frac{1}{R}\left(-\alpha \frac{V_1}{R} - V\right)$$

$$V_1 \frac{2}{R} + \alpha \frac{V_1}{R^2} + \frac{V}{R} = 0$$

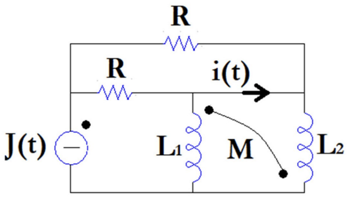
$$V_1 \left(\frac{2}{R} + \frac{\alpha}{R^2}\right) = -\frac{V}{R}$$

$$V_1 = \frac{-V}{2 + \frac{\alpha}{R}} = -20{,}83\ V$$

$$V_{TH} = R I_R + V = 29{,}1667\ V$$

Es 2

2) Determinare l'andamento temporale della corrente **i(t)** e la **potenza complessa complessivamente impegnata nei due induttori mutuamente accoppiati** nel circuito in figura.

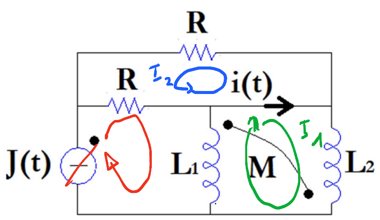


$J(t) = \sqrt{2}\sin(1000t)$ A;
R = 10 Ω;
L_1 = 10 mH;
L_2 = 20 mH;
M = 12 mH;

Risultati:

i(t) = $0.0926\sqrt{2}\sin(1000t + \pi)$ A;

$\bar{S}$= 1.037j VA;



$$\begin{cases} 2R I_2 + R\dot{J} = 0 \Rightarrow I_2 = -\frac{\dot{J}}{2} \\ (j\omega L_1 + j\omega L_2) I_1 + j\omega M I_1 + j\omega M (I_1 - \dot{J}) - j\omega L_1 \dot{J} = 0 \end{cases}$$

$$54 j I_1 = 22\, j\, \dot{J}$$

$$I_1 = \frac{11}{27} = 0{,}407$$

$$I = I_1 + I_2 = -0{,}5 + 0{,}407 = -0{,}0926\ A$$

$$i(t) = 0{,}0926\sqrt{2}\sin(1000t + \pi)$$

$$P_1 = [j\omega L_1 (I_1 - \dot{J}) + j\omega M I_1](I_1 - J)^* = 0{,}620\, j$$

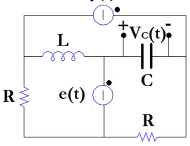
$$P_1 = [j\omega L_1 (I_1 - J) + j\omega M I_1] (I_1 - J)^* = 0,620\,J$$

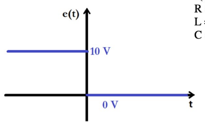
$$P_2 = [j\omega L_2 I_1 + j\omega M (I_1 - J)] (I_1) = 0,416\,J$$

$$P_{TOT} = P_1 + P_2 = 1,037\,J\ VA$$

Es 3

3) Determinare l'andamento temporale della tensione **Vc(t)** per $-\infty < t < +\infty$ ai capi del condensatore, data la tensione erogata dal generatore come da figura a destra. Il circuito è ipotizzato a regime per tempi negativi.





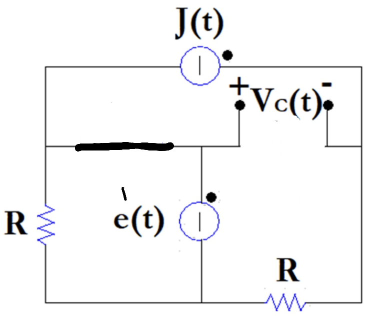
J(t) = 3 A (costante);
R = 10 Ω;
L = 15 mH;
C = 15 μF;

Risultati:

$V_C(t) = -20 + (10e^{-6666.67t} - 10)u(t)$ V

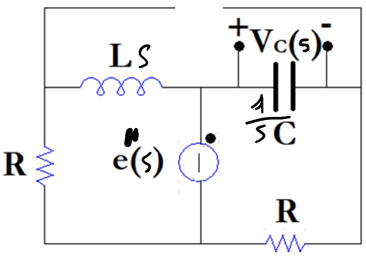
$$e(t) = e' + e'' = 10 - 10\,u(t)$$

ATTIVO e' E J



$$V_c' = 10 - RJ = -30 + 10 = -20$$

ATTIVO e''



$$V_c''(s) = \frac{e''(s)}{\frac{1}{sC} + R} \cdot \frac{1}{sC} = \frac{e''/s}{1 + RsC} = \frac{e''}{s + Rs^2C} = \frac{-10}{s(1 + RsC)} = \frac{-6666,67}{s\left(\frac{1}{RC} + s\right)}$$

$$s_1 = 0 \qquad s_2 = -\frac{1}{RC}$$

$$A_1 = -10$$

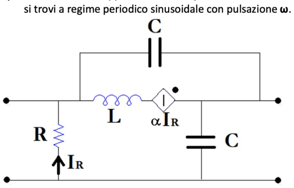
$$A_2 = \lim_{s \to -\frac{1}{RC}} -6666,67 \cdot (-RC) = 10$$

$$V_c(t) = -20 + \left(-10 + 10\,e^{-6666,67t}\right) u(t)$$

$$V_c(t) = -20 + \left(-10 + 10\, e^{-6666,67t}\right) u(t)$$

Es 4

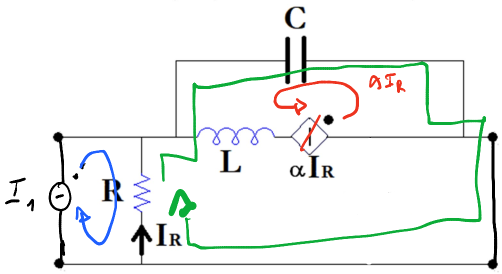
4) Determinare la rappresentazione a parametri **h** della rete a due porte indicata in figura. Si ipotizzi che il circuito si trovi a regime periodico sinusoidale con pulsazione **ω**.



R = 10 Ω;
L = 10 mH;
C = 20 μF
α = 0.5;
ω = 1000 rad/sec.

Risultati:

$$h = \begin{bmatrix} 17.2414 - 6.8966j & 0.1379 + 0.3448j \\ 0.7241 - 0.6897j & 0.0138 + 0.0545j \end{bmatrix}$$



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

$$\begin{cases} I_x\left(\dfrac{1}{j\omega C} + R\right) - R I_1 - \dfrac{\alpha I_R}{j\omega C} = 0 \\ I_R = I_x - I_1 \end{cases}$$

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

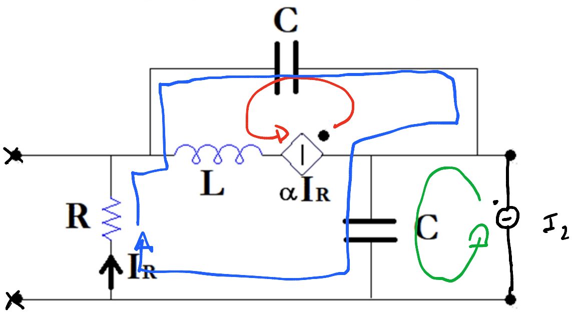
$$I_x = \gamma I_1 = (-0,72 + 0,69j)\, I_1$$

$$I_R = (\gamma - 1)\, I_1 = (-0,72 - 1 + 0,69j)\, I_1 = (-1,72 + 0,69j)\, I_1$$

$$V_1 = -R I_R = (+17,2 - 6,9j)\, I_1 = h_{11} I_1$$

$$I_2 = -I_x = -\gamma I_1 = h_{21} I_1$$

$$h_{21} = 0,72 - 0,69j$$



$$I_R\left(R+\frac{2}{j\omega C}\right)-\frac{\alpha I_R}{j\omega C}+\frac{I_2}{j\omega C}=0$$

$$I_R\left(R+\frac{2-\alpha}{j\omega C}\right)=-\frac{I_2}{j\omega C}$$

$$I_R=\frac{-I_2}{\left(R+\frac{2-\alpha}{j\omega C}\right)j\omega C}=(-0{,}655+0{,}087j)\,I_2$$

$$V_2=\frac{1}{j\omega C}(I_2+I_R)=\frac{1}{j\omega C}(1+\gamma)\,I_2=$$

$$V_2\,h_{22}=I_2 \qquad h_{22}=0{,}0138+0{,}0545j$$

$$V_1=-R\,I_R=-R\,\gamma I_2=-R\,\gamma\,h_{22}\,V_2=$$

$$h_{12}=0{,}1378+0{,}34436j$$