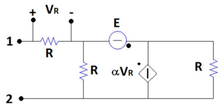
18/07/2018

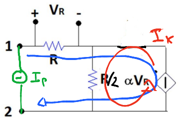
giovedì 10 dicembre 2020 15:36

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



E = 20 V;
R = 10 Ω;
α = 0.5.

R_{TH}



$$V_R = R I_p$$

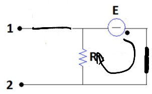
$$\alpha V_R = I_x \frac{R}{2}$$

$$\alpha R I_p =$$

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

$$R_{TH} = R + \alpha R = 15\ \Omega$$

V_{TH}

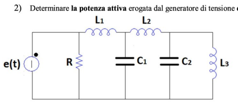


$$V_R = 0$$

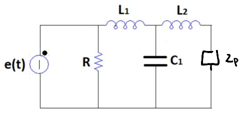
$$V_{TH} = -E = -20\ V$$

ES 2

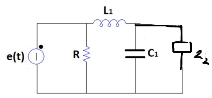
2) Determinare **la potenza attiva** erogata dal generatore di tensione **e(t)**.



$e(t) = 10\sqrt{2}\cos(1000t)\ V$;
R = 10 Ω;
L_1 = 10 mH;
L_2 = 15 mH;
L_3 = 20 mH;
C_1 = 100 μF;
C_2 = 200 μF.



$$Z_1 = \frac{\frac{j\omega L_1}{j\omega C}}{\frac{1}{j\omega C} + j\omega L} = \frac{L_3/C_2}{\frac{1-\omega^2 L C_2}{j\omega C_2}} = \frac{j L_3 \omega}{1-\omega^2 L_3 C_2} = -\frac{20j}{3}$$



$$Z_2 = Z_1 + \omega j L_2 = -\frac{20}{3}j + 15j = \frac{25}{3}j$$

$$Z_3 = \frac{Z_2 \cdot \frac{1}{j\omega C_1}}{Z_2 + \frac{1}{j\omega C_1}} = \frac{\frac{Z_2}{j\omega C_1}}{\frac{Z_2 j\omega C_1 + 1}{j\omega C_1}} = \frac{Z_2}{Z_2 j\omega C_1 + 1} = \frac{25/3\ j}{\frac{25}{30} + 1} = \frac{\cancel{25}^{5} j}{\cancel{3}_{1}} \cdot \frac{\cancel{30}^{10}}{\cancel{55}_{11}} = \frac{50}{11}j$$

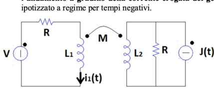
$$Z_4 = Z_3 + L_1 j\omega = \frac{50}{11}j + 10j = \frac{160}{11}j$$

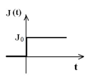
$$Z_5 = \frac{\frac{160}{11}j \cdot R}{\frac{160}{11}j + R} = \frac{1600j}{11} \cdot \frac{11}{160j + 11R} = \frac{1600j}{160j + 11R}$$

$$P = R_e\left\{ \dot{E}\ \frac{\dot{E}}{Z_5} \right\} = \frac{E^2}{Z_5} = 100 \cdot \frac{160j + 11R}{1600j} = \frac{16 \cdot 10^3 j}{\underset{16 \cdot 10^2}{1600j}} + \cancel{\frac{11R \cdot 100}{1600j}} = 10\ W$$

ES 3

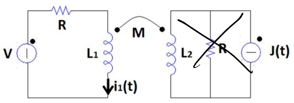
3) Determinare l'andamento temporale della corrente $\mathbf{i_1(t)}$ che scorre sull'induttore $\mathbf{L_1}$ per $-\infty < t < +\infty$, considerando l'**andamento a gradino della corrente erogata del generatore di corrente J(t)**, come in figura. Il circuito è ipotizzato a regime per tempi negativi.





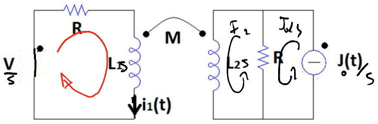
V = 10 V (costante)
J0 = 1 A;
R = 20 Ω;
L_1 = 10 mH;
L_2 = 20 mH;
M = 12 mH.

$$t < 0$$



$$i_1(0^-) = \frac{V}{R} = 0{,}5\ A$$

$t \geq 0$



$$\begin{cases} I_2(s)(L_2 s + R) - \frac{J_0}{s} R + M s\, I_1(s) = 0 \\ 0 = R\, I_1(s) + I_1(s)\, L_1 s + M s\, I_2(s) \end{cases}$$

$$I_2(s) = \frac{(R + L_1 s) - I_1(s)}{M s}$$

$$-\frac{I_1(s)(R + L_1 s)}{M s}(L_2 s + R) - \frac{J_0}{s} R + M s\, I_1(s) = 0$$

$-5{,}6 \cdot 10^{-5}$

$$I_1\left(M s - \frac{(R + L_1 s)(L_2 s + R)}{M s} \right) = \frac{J}{s} \cdot R$$

$$I_1 = \frac{R}{M s^2 - \frac{(R + L_1 s)(L_2 s + R)}{M}} = \frac{R M}{M^2 s^2 - L_2 R s - R^2 - L_1 L_2 s^2 - L_1 R s} = \frac{R M}{s^2(M^2 - L_1 L_2) + s(-L_2 R - L_1 R) - R^2} = -\frac{R M}{s^2(L_1 L_2 - M^2) + s(L_2 R}$$

$$\Delta = 92855{,}713$$

$$s_1 = -714$$

$$s_2 = -10000$$

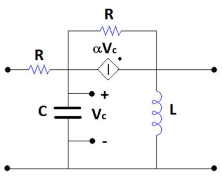
$$A_1 = \lim_{s \to s_1} \frac{-4285{,}714}{s + 10000} = -0{,}4615$$

$$A_2 = \lim_{s \to s_2} \frac{-4285{,}714}{-10000 + 714} = +0{,}4615$$

$$i_1 = 0{,}5 + \left(-0{,}4615\, e^{-714 t} + 0{,}4615\, e^{-10000 t} \right) u(t)$$

ES 4

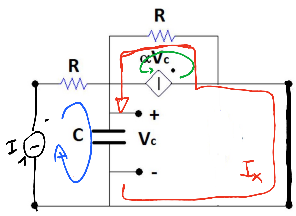
4) Determinare la rappresentazione a parametri **Y** della rete a due porte indicata in figura, ipotizzata a regime periodico sinusoidale a pulsazione ω.



R = 10 Ω;
L = 10 mH;
C = 200 μF;
α = 0.5 A/V;
ω = 1000 rad/s;

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

$V_2 = 0$



$$\frac{\quad}{+ L_1 R) + R^2} = \frac{4285,714}{5,6 \cdot 10^{-5} s^2 + 0,6 s + 400} = \frac{4285,714}{s^2 + 10714,285 + 7142857,143}$$

$$\begin{cases} V_c = \dfrac{1}{j\omega C}\left(I_1 + I_x\right) = I_1 \\[2ex] \left(R + \dfrac{1}{j\omega C}\right) I_x + R\alpha V_c + \dfrac{1}{j\omega C} I_1 = 0 \\[2ex] \left(R + \dfrac{1}{j\omega C}\right) I_2 + \dfrac{R\alpha}{j\omega C} I_2 + \dfrac{R\alpha}{j\omega C} I_1 + \dfrac{1}{j\omega C} I_1 = 0 \end{cases}$$

$$I_2 = \frac{-I_1\left(\dfrac{R\alpha+1}{j\omega C}\right)}{R + \dfrac{1}{j\omega C} + \dfrac{R\alpha}{j\omega C}} = \frac{-I_1(R\alpha+1)}{Rj\omega C + 1 + R\alpha} = (0{,}9 - 0{,}3\,i)\, I_1$$

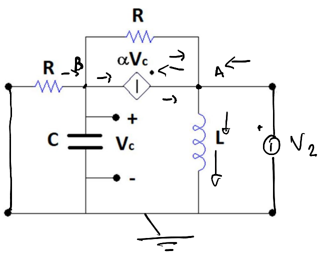
$$V_1 = R I_1 + \frac{1}{j\omega C}\left(\beta I_1 + I_1\right) = \left(R + \frac{\beta+1}{j\omega C}\right)^{-1} I_1$$

$\downarrow$ Y_{11}

$$I_1 = Y_{11} V_1$$

$$Y_{21} = \beta Y_{11} = \beta Y_{11} -$$

$\downarrow$



$$V_A = V_2$$

$$V_B = ?$$

$$-\alpha V_c = V_B\left(j\omega C + \frac{2}{R}\right) - V_2\left(\frac{1}{R}\right)$$

$$V_B\left(j\omega C + \frac{2}{R} + \alpha\right) = V_2 \frac{1}{R}$$

$$V_c = \frac{V_2}{Rj\omega C + 2 + R\alpha}$$

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

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

$$I_2 =$$