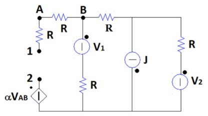
09/01/2019

domenica 13 dicembre 2020 15:39

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



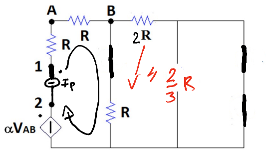
$V_1 = 10$ V;
$V_2 = 20$ V;
$J = 1$ A;
$R = 10\ \Omega$;
$\alpha = 0.8$;

Risultati:

$\mathbf{V_{TH} = 10}$ **V;**

$\mathbf{R_{TH} = 18.67\ \Omega}$**;**

R_{TN}

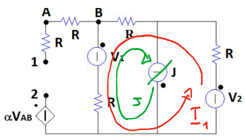


$$\begin{cases} 2R\, I_P + \frac{2}{3} R\, I_P - \alpha V_{AB} = V_P \\ V_{AB} = R\, I_P \end{cases}$$

$$V_P = \frac{8}{3} I_P - \alpha R I_P =$$

$$V_P = I_P\left(\frac{8}{3}R - \alpha R\right) \qquad R_{TH} = \frac{V_P}{I_P} = \frac{8}{3}R - \alpha R = 18{,}67\ \Omega$$

V_{TH}

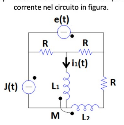


$$\begin{cases} 3R\, I_1 - 2RJ + V_1 = V_2 \quad \Rightarrow \quad I_1 = \dfrac{V_2 - V_1 + 2RJ}{3R} = 1\ A \\ V_{AB} = 0 \end{cases}$$

$$V_{TH} = V_1 + I_1 R - RJ = 10 + R\cdot 1 - R \cdot 1 = 10$$

ES 2

2) Determinare l'andamento temporale della corrente **i1(t)** e la **potenza reattiva** erogata dal generatore di corrente nel circuito in figura.

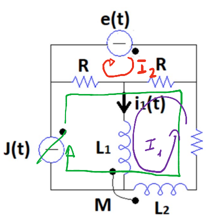


$e(t) = 20\sqrt{2}\sin(100t)$ V;
$J(t) = \sqrt{2}\sin(100t)$ A;
$R = 10\ \Omega$;
$L_1 = 10$ mH;
$L_2 = 20$ mH;
$M = 10$ mH;

Risultati:

$\mathbf{i_1(t) = 0.0665\sqrt{2}\sin(100t + 1.5042)}$ **A;**

Q = 1.3319 VAR;



$$\begin{cases} 2R\dot{I}_2 + R\dot{I}_1 - 2R\dot{J} = \dot{E} \quad \Rightarrow \quad \dot{I}_2 = \dfrac{-R\dot{I}_1 + 2R\dot{J} + \dot{E}}{2R} \\ 2R\dot{I}_1 + jωL_1\dot{I}_1 - jωM\dot{I}_1 + jωM\dot{J} + jωL_2\dot{I}_1 - jωM\dot{I}_1 - 2R\dot{J} + R\dot{I}_2 - jωL_2\dot{J} = 0 \end{cases}$$

$$2R\dot{I}_1 + jωL_1 I_1 - jωM I_1 + jωM J + jωL_2 I_1 - jωM I_1 - 2R\dot{J} - R\frac{I_1}{2} + RJ + \frac{E}{2} = 0$$

$$I_1\left(\frac{3}{2}R + jωL_1\right) + jωM\dot{J} - R\dot{J} + \frac{E}{2} = 0$$

$$I_1 = \frac{-jωM\dot{J} + R\dot{J} - \frac{E}{2}}{\frac{3}{2}R + jωL_1} = \frac{-j + \cancel{10} - \cancel{10}}{15 + j} = -0{,}00442 - 0{,}66371j$$

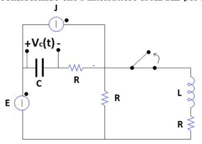
$$|I_1| = 0{,}0665\ A$$

$$V_J = R\dot{J} + jωL_1\dot{I}_1 - jωM(\dot{I}_1 - J) - RI_2 = 10 + \cancel{j}\dot{I}_1 - j\cancel{\dot{I}_1} + j\dot{J} + \frac{RI_1}{2} - R\dot{J} - \cancel{\frac{E}{2}} = J + \frac{RI_1}{2} - R = -9{,}66$$

75 + 8

ES 3

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

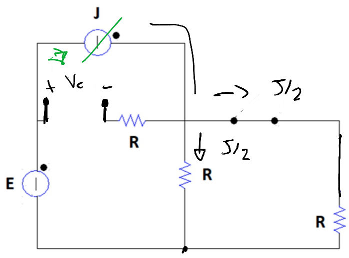


E = 10 V (costante);
J = 2 A (costante);
R = 10 Ω;
L = 10 mH;
C = 10 μF.

Risultati:

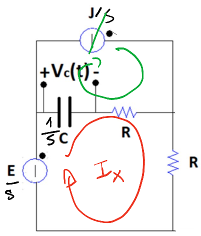
$$V_C(t) = \begin{cases} 0, & t < 0 \\ -10 + 10e^{-5000t}, & t \geq 0 \end{cases}$$

$t < 0$



$$V_C(t) = E - RJ/2 = 10 - 10 \cdot 1 = 0$$

$t \geq 0$



$$2R\,I_x(s) - R\,J(s) + \frac{I_x}{sC} - \frac{J(s)}{sC} = \frac{E}{s}$$

$$I_x(s)\left(2R + \frac{1}{sC}\right) = J(s)\left(R + \frac{1}{sC}\right) + \frac{E}{s}$$

$$I_x(s) = \frac{\frac{2}{s}\left(R + \frac{1}{sC}\right) + \frac{10}{s}}{2R + \frac{1}{sC}}$$

$$V_C(s) = \frac{I_x}{sC} - \frac{J(s)}{sC} = \frac{1}{sC}\left(\frac{\frac{2}{s}\left(R + \cancel{\frac{1}{sC}}\right) + \frac{10}{s} - \frac{2}{s}\left(2R + \cancel{\frac{1}{sC}}\right)}{2R + \frac{1}{sC}}\right)$$

$$V_C(s) = \frac{-\frac{2R}{s} + \frac{10}{s}}{2RsC + 1} = \frac{-2R + 10}{2s^2RC + s}$$

$$V_C(s) = \frac{-\frac{1}{C} + \frac{10}{2RC}}{s^2 + \frac{s}{2RC}} = \frac{-10^5 + 5 \cdot 10^4}{s^2 + 5000s}$$

$$s_1 = 0 \qquad s_2 = -5000$$

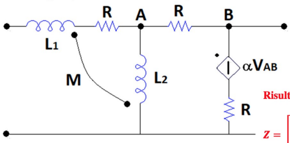
$$A_1 = \lim_{s \to 0} \frac{-100000 + 50000}{s + 5000} = -10$$

$$A_2 = \lim_{s \to -5000} \frac{-100000 + 50000}{-5000} = 10$$

$$V_C(t) = \begin{cases} 0 & t < 0 \\ -10 + 10e^{-5000t} & t \geq 0 \end{cases}$$

Es 4

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

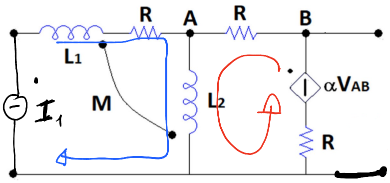


$R = 10\ \Omega$;
$L_1 = 10$ mH;
$L_2 = 20$ mH;
$M = 14$ mH;
$\alpha = 0.5$;
$\omega = 1000$ rad/sec.

Risultati:

$$Z = \begin{bmatrix} 38.1954 + 35.4414j & 6.6334 + 8.29 \\ 9.9512 + 12.439j & 6.3415 + 2.92 \end{bmatrix}$$

$$\begin{cases} \dot{V}_1 = Z_{11}\dot{I}_1 + Z_{12}\dot{I}_2 \\ \dot{V}_2 = Z_{21}\dot{I}_1 + Z_{22}\dot{I}_2 \end{cases}$$



$$\begin{cases} V_{AB} = -R I_x \\ 2R I_x + JWL_2 I_x + JWL_2 I_1 + JWMI_1 = \alpha V_{AB} \\ \Downarrow \\ I_x\left(2R + JWL_2 + R\alpha\right) = -JWL_2 I_1 - JWMI_1 \end{cases}$$

$$I_x = \frac{-JWL_2 - JWM}{2R + JWL_2 + R\alpha} I_1 = \gamma I_1 = (-0{,}6634 - 0{,}8292\,J)\, I_1$$

$$V_1 = JWL_1 I_1 + JWM(I_1 + \gamma I_1) + JWL_2(I_1 + \gamma I_1) + JWMI_1 + RI_1$$

$$V_1 = I_1(JWL_1 + 2JWM + JWM\gamma + JWL_2 + JWL_2\gamma + R)$$

$$I_1\left(JWL_1 + 2JWM + JWL_2 + \gamma(JWM + JWL_2) + R\right)$$

$$Z_{11} \cong 38{,}1954 + 35{,}4414\,J$$

$$V_2 = \alpha V_{AB} + R I_x = \alpha R\gamma I_1 + R\gamma I_1 = R\gamma I_1(\alpha + 1) =$$

$$Z_{21} = R\gamma(\alpha + 1) = -9{,}951 - 12{,}438\,J$$