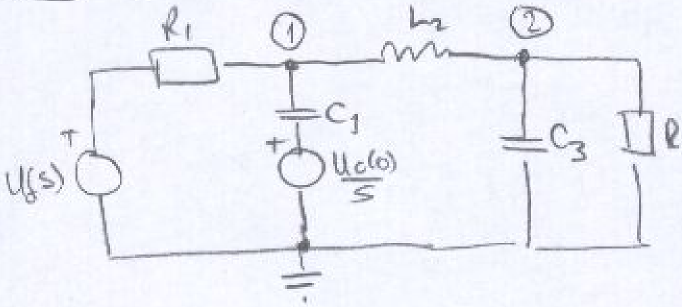
27.6. ①



$\Big\}\ U_{R_2} = U_2 = ?$ $\qquad U(s) = 1$

Čvori:

① $(U_1 - U_0)\cdot\frac{1}{R_1} + (U_1 - U_2)\cdot\frac{1}{sL_2} + \left(U_1 - \frac{U_C(0)}{s}\right)\cdot sC_1 = 0$

② $(U_2 - U_1)\cdot\frac{1}{sL_2} + U_2\cdot sC_3 + U_2\cdot\frac{1}{R_2} = 0$

iz ②

$$\frac{U_1}{sL_2} = U_2\left(\frac{1}{sL_2} + sC_3 + \frac{1}{R_2}\right)$$

$$U_1 = U_2\left(1 + s^2C_3L_2 + \frac{sL_2}{R_2}\right) = U_2\cdot(1 + 2s^2 + 2s)$$

u ①

$$\frac{U_2}{R_1}(1 + 2s + 2s^2) - \frac{U_0}{R_1} + U_2(1 + 2s^2 + 2s - 1)\cdot\frac{1}{sL_2} + \left(U_2(1 + 2s^2 + 2s) - \frac{U_C(0)}{s}\right)\cdot sC_1 = 0$$

$$U_2(1 + 2s^2 + 2s) - U_0 + U_2(2s^2 + 2s)\cdot\frac{1}{2s} + U_2(1 + 2s^2 + 2s)\cdot s - 1 = 0$$

$$U_2(2s^2 + 2s + 1 + s + 1 + s + 2s^3 + 2s^2) - U_0 - 1 = 0$$

$$U_2(2s^3 + 4s^2 + 4s + 2) = U_0 + 1$$

$$U_2(s) = \underbrace{\frac{U_0(s)}{(s+1)(2s^2+2s+2)}}_{\text{prisilni}} + \underbrace{\frac{1}{2(s+1)(s^2+s+1)}}_{\text{slobodni}} \qquad U_0(s) = 1$$

$$\frac{1}{2(s+1)(s^2+s+1)} = \frac{1}{2}\left[\frac{A}{s+1} + \frac{Bs+C}{s^2+s+1}\right]$$

$$1 = A(s^2+s+1) + (Bs+C)(s+1)$$

$$1 = As^2 + As + A + Bs^2 + Cs + Bs + C$$

$$\Rightarrow \begin{cases} A+B=0 \Rightarrow \underline{A=-B} \\ A+B+C=0 \\ A+C=-1 \Rightarrow \underline{C=-A+1} \end{cases}$$

$$A - A + 1 - A = 0 \Rightarrow \boxed{A=1} \quad \boxed{B=-1} \quad \boxed{C=0}$$

$U_2(s) = U_{2p} + U_{2s}$

ukupni odziv

$U_{2p} = U_{2s}$ jer su iste f-je, inače NE!

$$U_{2p} = \frac{1}{2}\left[\frac{1}{s+1} - \frac{s}{s^2+s+1}\right]$$

$\frac{1}{s+1}$ — e^{-t}

$$\frac{s}{s^2+s+1} \Rightarrow \frac{s}{\left(s+\frac{1}{2}\right)^2+\left(\frac{\sqrt{3}}{2}\right)^2} \circ\!-\!\bigcirc \cos\left(\frac{\sqrt{3}}{2}t\right)e^{-\frac{1}{2}t}$$

$$\boxed{U_{2p} = \frac{1}{2}e^{-t} + \frac{1}{2}e^{-\frac{1}{2}t}\cos\left(\frac{\sqrt{3}}{2}t\right) = U_{2s}}$$

$U_2 = U_{2p} + U_{2s}$

Mathematica kaže

$$U_{2p} = \frac{1}{2}\left(e^{-t} + \frac{1}{3}e^{-\frac{t}{2}}\left(-3\cos\left(\frac{\sqrt{3}}{2}t\right) + \sqrt{3}\sin\left(\frac{\sqrt{3}}{2}t\right)\right)\right)$$

NEGDJE SE IZGUBIO <u>sinus</u>

27.6 (2)

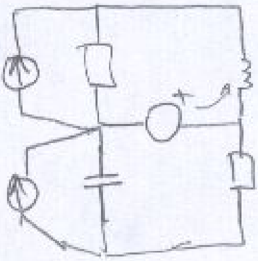
1° posmaknem izvore da Zb bude regularna

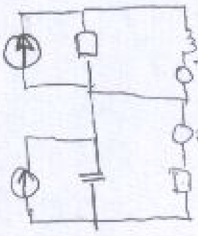
2° odredim grane i izvore te nacrtam graf

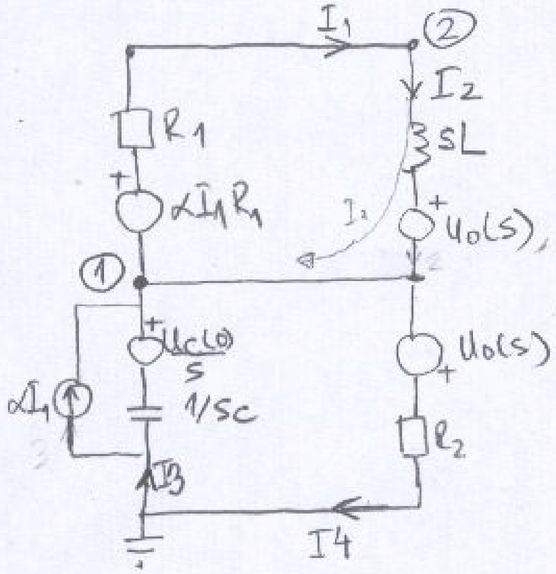
3° nađem S

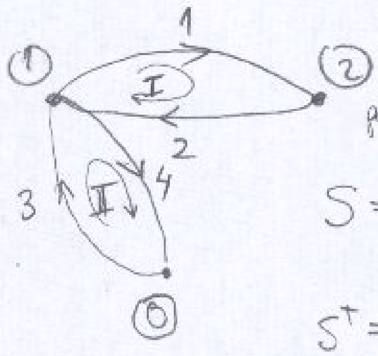
4° ispišem jednadžbe grane

5° izmnožim par matrica









petlje grane

$$S = \begin{array}{c} \\ 1 \\ 2 \end{array} \begin{array}{c} \begin{array}{cccc} 1 & 2 & 3 & 4 \end{array} \\ \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix} \end{array}$$

$$S^T = \begin{bmatrix} 1 & 0 \\ 1 & 0 \\ 0 & 1 \\ 0 & 1 \end{bmatrix}$$

$$U_1 = U_{12} = \alpha I_1 R_1 + I_1 R_1$$

$$U_2 = U_{21} = I_2 \cdot SL - U_0(s)$$

$$U_3 = U_{01} = I_3 \frac{1}{SC} - \alpha I_1 \frac{1}{SC} + \frac{U_C(0)}{s}$$

$$U_4 = U_{10} = U_0 + I_4 R_2$$

$$\boxed{U_b = Z_b I_b + E_b}$$

$$\begin{bmatrix} U_1 \\ U_2 \\ U_3 \\ U_4 \end{bmatrix} = \underbrace{\begin{bmatrix} (\alpha+1) R_1 & 0 & 0 & 0 \\ 0 & SL & 0 & 0 \\ -\alpha/SC & 0 & \frac{1}{SC} & 0 \\ 0 & 0 & 0 & R_2 \end{bmatrix}}_{Z_b} \underbrace{\begin{bmatrix} I_1 \\ I_2 \\ I_3 \\ I_4 \end{bmatrix}}_{I_b} + \underbrace{\begin{bmatrix} 0 \\ -U_0 \\ \frac{U_C(0)}{s} \\ U_0 \end{bmatrix}}_{E_b}$$

$$Z_M = S \cdot Z_b \cdot S^T$$

$$\Rightarrow Z_m = \underset{2\times 4}{\begin{bmatrix}1&1&0&0\\0&0&1&1\end{bmatrix}} \cdot \underset{4\times 4}{\begin{bmatrix}(\alpha+1)R_1&0&0&0\\0&SL&0&0\\-\frac{\alpha}{SC}&0&1/SC&0\\0&0&0&R_2\end{bmatrix}} = \overset{2\times 4}{\begin{bmatrix}(\alpha+1)R_1&SL&0&0\\0&0&1/SC&R_2\end{bmatrix}} \cdot S^T$$

$$Z_m = \underset{2\times 4}{\begin{bmatrix}(\alpha+1)R_1&SL&0&0\\0&0&1/SC&R_2\end{bmatrix}} \cdot \overset{4\times 2}{\begin{bmatrix}1&0\\1&0\\0&1\\0&1\end{bmatrix}} = \overset{2\times 2}{\begin{bmatrix}(\alpha+1)R_1+SL&0\\0&1/SC+R_2\end{bmatrix}}$$

$$E_m = -S \cdot E_b$$

$$E_m = \underset{2\times 4}{\begin{bmatrix}1&1&0&0\\0&0&1&1\end{bmatrix}} \cdot \underset{4\times 1}{\overset{-E_b}{\begin{bmatrix}0\\U_0\\-\frac{U_C(0)}{S}\\-U_0\end{bmatrix}}} = \overset{2\times 1}{\begin{bmatrix}U_0\\-\frac{U_C(0)}{S}-U_0\end{bmatrix}}$$

27.C
3

$$Z_{RC} = \frac{s^2+7s+10}{s^2+4s+3} \quad 2. \text{ CAUER}$$

$$Y_{RC}(s) = \frac{s^2+4s+3}{s^2+7s+10}$$

(realiziram također bi u protivnom dobio negativne koeficijente, odnosno R i C elemente)

$$(3+4s+s^2):(10+7s+s^2) = \boxed{\frac{3}{10}} = R_1$$

$$\ominus \; 3+\frac{21}{10}s+3/10s^2$$

$$\frac{19}{10}s+\frac{7}{10}s^2$$

$$(10+7s+s^2):\left(\frac{19}{10}s+\frac{7}{10}s^2\right) = \boxed{\frac{100}{19}\cdot\frac{1}{s}} = C_1$$

$$\ominus \; 10+\frac{70}{19}s$$

$$\frac{63}{19}s+s^2$$

$$\left(\frac{19}{10}s+\frac{7}{10}s^2\right):\left(\frac{63}{19}s+s^2\right) = \boxed{\frac{19}{63}\cdot\frac{19}{10}} = R_2$$

$$\ominus \; \frac{19}{10}s+\frac{19^2}{630}s^2$$

$$\frac{8}{63}s^2$$

$$\left(\frac{63}{19}s+s^2\right):\left(\frac{8}{63}s^2\right) = \boxed{\frac{63}{8}\cdot\frac{63}{19}\frac{1}{s}} = C_2$$

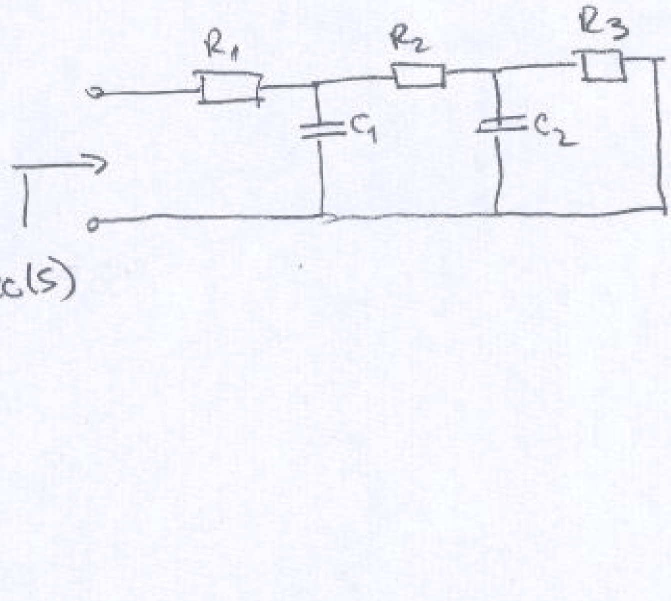
$$\ominus \; \frac{63}{19}s$$

$$s^2$$

$$\left(\frac{8}{63}s^2\right):(s^2) = \boxed{\frac{8}{63}} = R_3$$

$$\ominus \; \frac{8}{63}s^2$$

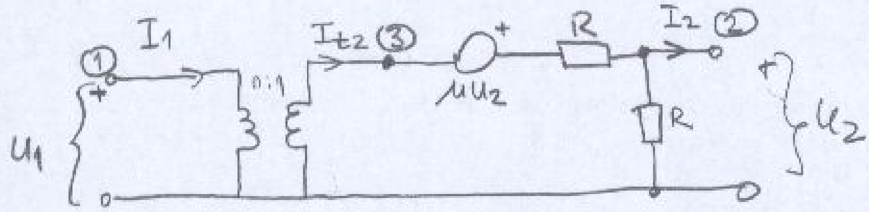
$$\emptyset$$



27.6 4

Y par. -- j-be čvorova $\quad I_1 = U_1 y_{11} - U_2 y_{22}$

$I_2 = U_1 y_{21} - U_2 y_{22}$



j-be trafoa:

$$U_1 = nU_3 \quad\quad U_3 = \frac{1}{n}\cdot U_1$$

$$I_1 = \frac{1}{n} I_{t2} \quad\quad I_{t2} = nI_1$$

čvorovi:

③ $I_{t_2} = (U_3 + \mu U_2 - U_2)\cdot \frac{1}{R}$

② $-I_2 = \frac{U_2}{R} + [U_2 - (U_3 + \mu U_2)]\cdot\frac{1}{R}$

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(2) $-I_2 = \frac{U_2}{R} + \frac{U_2}{R} - \left(\frac{1}{n}U_1 + \mu U_2\right)\cdot\frac{1}{R}$

$-I_2 = U_2\left(\frac{2}{R} - \frac{\mu}{R}\right) - \frac{1}{nR}U_1$

$\boxed{I_2 = \frac{1}{nR}U_1 - \left(\frac{2-\mu}{R}\right)U_2} \Rightarrow y_{21} = \frac{1}{nR} \quad y_{22} = \frac{2-\mu}{R}$

u (3)

$nI_1 = \left(\frac{1}{n}U_1 + (\mu-1)U_2\right)\cdot\frac{1}{R}$

$\boxed{I_1 = \frac{1}{n^2}U_1 - \frac{(1-\mu)}{nR}U_2} \Rightarrow y_{11} = \frac{1}{n^2} \quad y_{12} = \frac{1-\mu}{nR}$

Uvjet simetričnosti:

$y_{11} = y_{22}$

$\frac{1}{n^2} = \frac{2-\mu}{R}$

$\boxed{n = \sqrt{\frac{R}{2-\mu}}}$