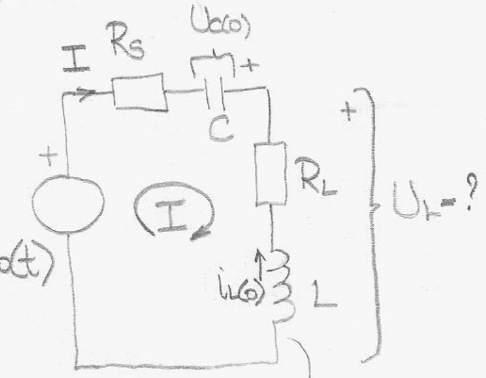
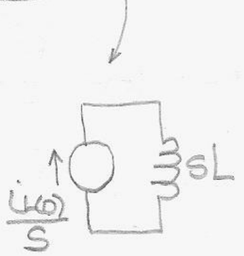
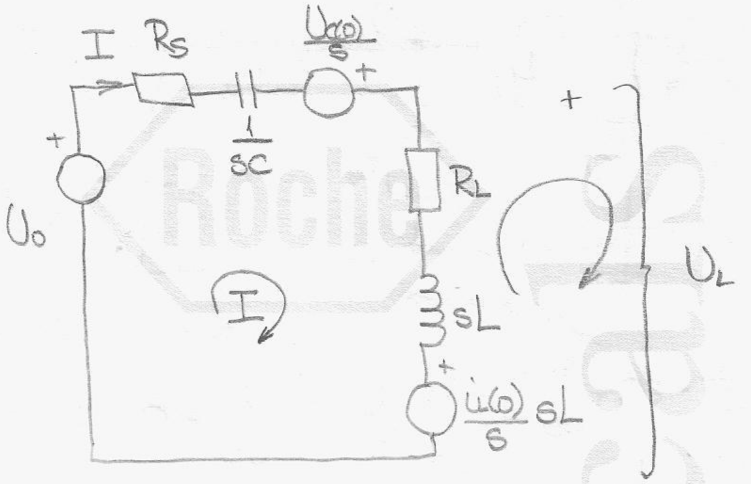
iz zad. za vježbu

16.



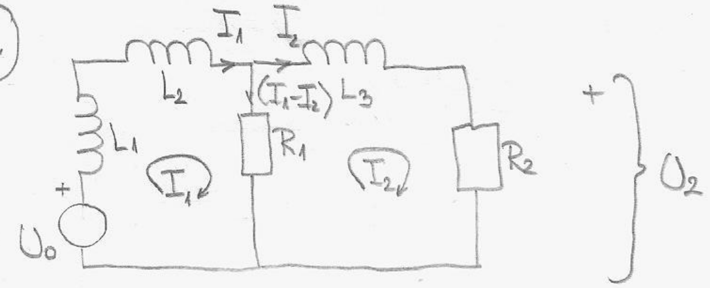




$$-U_0 + IR_S + I\frac{1}{sC} - \frac{U_C(0)}{s} + IR_L + IsL + \frac{i_L(0)}{\cancel{s}}\cancel{s}L = 0$$

$$-i_L(0)\cdot L - IsL - IR_L + U_L = 0$$

1.

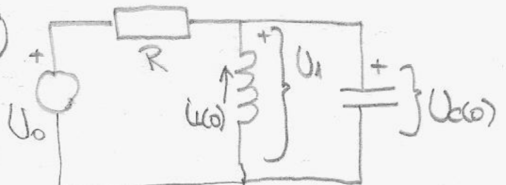


$$U_0 - I_1sL_1 - I_1sL_2 - (I_1 - I_2)R_1 = 0 \quad (1)$$

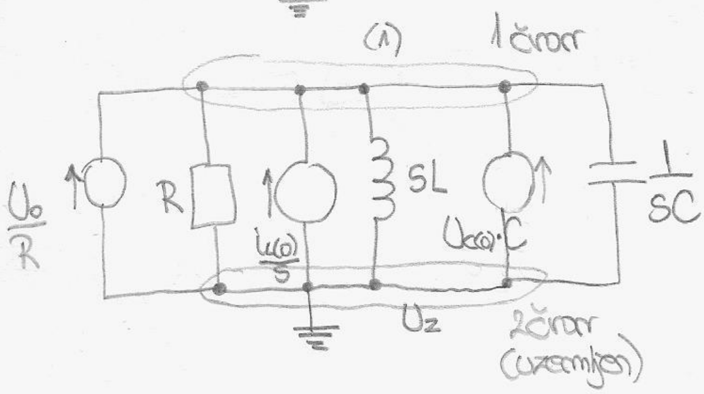
$$(I_1 - I_2)R_1 - I_2sL_3 - I_2R_2 = 0$$

$$U_2 = I_2R_2$$

20.

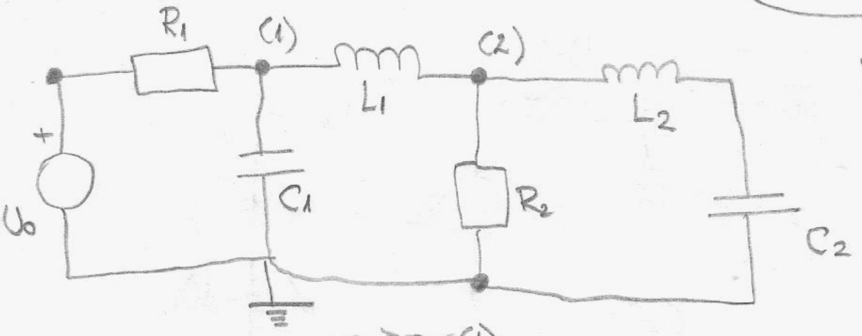


Kod jedn. čvorova uvijek je 1 čvor uzemljen.

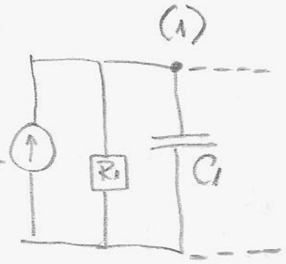


$$U_1\left[\frac{1}{R}+\frac{1}{sL}+sC\right] - U_2\,\overset{0}{\cancel{[\ldots]}} = \frac{U_0}{R} + \frac{i_L(0)}{s} + U_C(0)C$$

jedn. čv.



ili



za čvor (1)

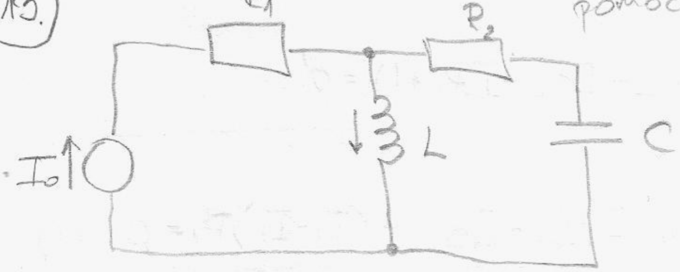
susjedni čvorovi

(1) $U_1\left[\frac{1}{R_1}+sC_1+\frac{1}{sL_1}\right]-U_0\frac{1}{R_1}-U_2\cdot\frac{1}{sL_1}=0 \rightarrow$ struja cama (koje ulaze u čvor)

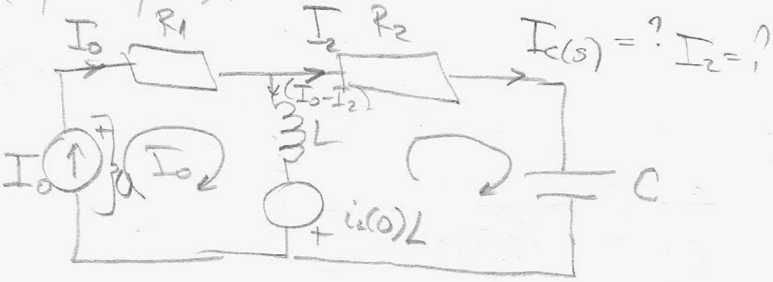
(2) $U_2\left[\frac{1}{sL_1}+\frac{1}{R_2}+\frac{1}{sL_2+\frac{1}{sC_2}}\right]-U_1\cdot\frac{1}{sL_1}=0$

$\rightarrow$ vodljivosti

(13.)



pomoću jedn. petlji



(1) $U-I_0R_1-(I_0-I_2)sL+i_L(0)L=0$

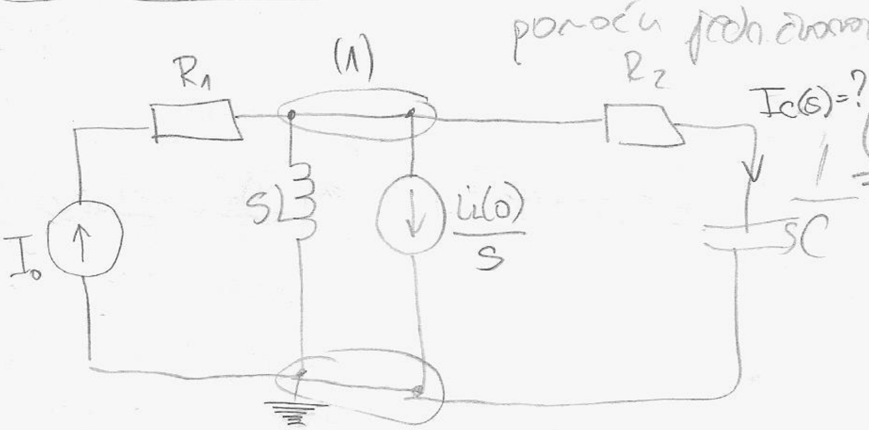
(2) $-i_L(0)L+(I_0-I_2)sL-I_2R_2-I_2\frac{1}{sC}=0$

$i_0(t)=\delta(t)$

$I_0(s)=1$

---

pomoću jedn. čvorova ? ✓



$\frac{1}{sC}$

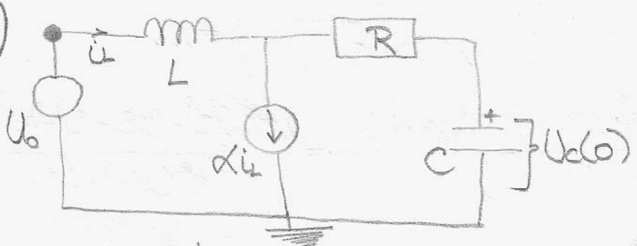
$I_C(s)=?$

$U_1\left[\frac{1}{sL}+\frac{1}{R_2+\frac{1}{sC}}\right]=I_0-\frac{i_L(0)}{s}$

$I_C=\frac{U_1}{R_2+\frac{1}{sC}}$

12. & 13. zad. $I_C(t)=\delta(t)-2e^{-t/2}\cos\left(\frac{\sqrt{3}}{2}t\right)S(t)$

10.



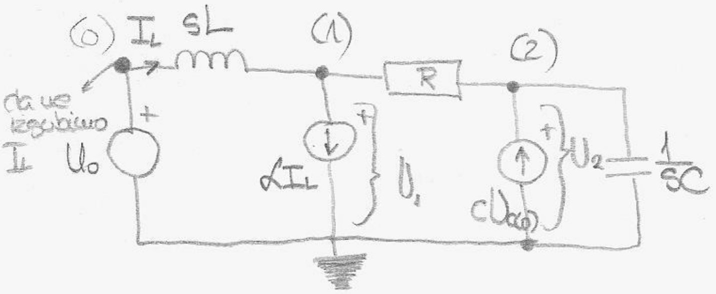
pomoću čvorišta

$I_L = ?$

$U_0 = S(t) = \frac{1}{s}$ $\quad R=2$

$\alpha = \frac{1}{2}$ $\quad L=1$

$U_C(0) = \frac{1}{2}$ $\quad C=1$



(1) $U_1\left[\frac{1}{sL}+\frac{1}{R}\right] - U_2\cdot\frac{1}{R} - U_0\cdot\frac{1}{sL} = -\alpha I_L$

(2) $U_2\left[\frac{1}{R}+sC\right] - U_1\cdot\frac{1}{R} = cU_c(0)$

(0) $U_0\left[\frac{1}{sL}\right] - U_1\cdot\frac{1}{sL} = I_L$

$$U_1\left[\frac{1}{s}+\frac{1}{2}\right] - U_2\cdot\frac{1}{2} - \frac{1}{s}\cdot\frac{1}{s} = -\frac{1}{2}I_L$$

$$U_2\left[\frac{1}{2}+s\right] - U_1\cdot\frac{1}{2} = \frac{1}{2} \quad /\cdot 2 \qquad 2U_2\left[\frac{1}{2}+s\right] - U_1 = 1, \quad U_2 = \frac{U_1+1}{2s+1}$$

$$\frac{1}{s}\cdot\frac{1}{s} - U_1\cdot\frac{1}{s} = I_L$$

$$\frac{U_1}{s}+\frac{U_1}{2} - \left(\frac{U_1+1}{2s+1}\cdot\frac{1}{2}\right) - \frac{1}{s^2} = -\frac{1}{2}\left(\frac{1}{s^2}-\frac{U_1}{s}\right)$$

$$\frac{U_1}{s}+\frac{U_1}{2} - \frac{U_1+1}{2(2s+1)} - \frac{1}{s^2} = \frac{-1}{2s^2} + \frac{U_1}{2s} \quad /\cdot 2$$

$$\frac{2U_1}{s}+U_1 - \frac{U_1+1}{2s+1} - \frac{2}{s^2} = \frac{-1}{s^2} + \frac{U_1}{s}$$

$$\frac{2U_1}{s}+U_1 - \frac{U_1}{2s+1} - \frac{U_1}{s} = \frac{-1}{s^2} + \frac{2}{s^2} + \frac{1}{2s+1}$$

$$U_1\left(\frac{2}{s}+1-\frac{1}{2s+1}-\frac{1}{s}\right) = \frac{1}{s^2}+\frac{1}{2s+1}$$

$$U_1 = \frac{\frac{1}{s^2}+\frac{1}{2s+1}}{\frac{2}{s}+1-\frac{1}{2s+1}-\frac{1}{s}}$$

$$I_L = \frac{1}{s^2} - \frac{1}{s}\left(\frac{\frac{2s+1+s^2}{s^{\cancel{2}}\cancel{(2s+1)}}}{\frac{2(2s+1)+s(2s+1)-s-(2s+1)}{\cancel{s(2s+1)}}}\right)$$

$$= \frac{1}{s^2} - \frac{1}{s}\left(\frac{2s+1+s^2}{\cancel{4s}+4+2s^2\cancel{+s}\cancel{-s}\cancel{-2s}-1}\right)$$

$$= \frac{1}{s^2} - \frac{1}{s}\left(\frac{(s+1)^2}{2s^2+2s+3}\right)$$

$$=\frac{1}{s^2}-\frac{1}{s}\left(\frac{(s+1)^2}{2s^2+2s+3}\right)=\frac{1}{s^2}-\frac{1}{s}\left(\frac{(s+1)^2}{2s^2+2s+1+2}\right)=\frac{1}{s^2}-\frac{1}{s}\left(\frac{(s+1)^2}{2(s^2+s+1)+1}\right)=\ldots \qquad (4)$$

$$=\frac{1}{s^2}-\frac{1}{s}\left(\frac{s^2+2s+1}{2s^2+2s+3}\right)=\frac{1}{s^2}-\frac{s^2+2s+1}{2s^3+2s^2+3s}=\frac{2s^3+2s^2+3s-s^2(s^2+2s+1)}{s^2(2s^3+2s^2+3s)}=\frac{\cancel{2s^3}+2s^2+3s-s^4-\cancel{2s^3}-s^2}{s^2(2s^3+2s^2+3s)}$$

$$=\frac{-s^4+s^2+3s}{s^2(2s^3+2s^2+3s)}=\frac{-s^3+s+3}{s(2s^3+2s^2+3s)}=\frac{-s^3+s+3}{2s^4+2s^3+3s^2}=\ldots$$

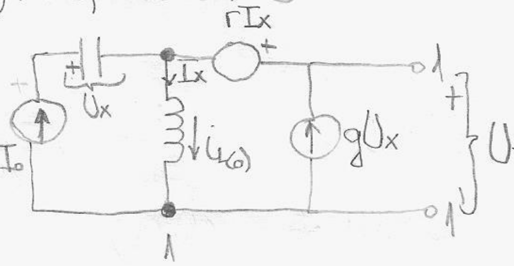
---

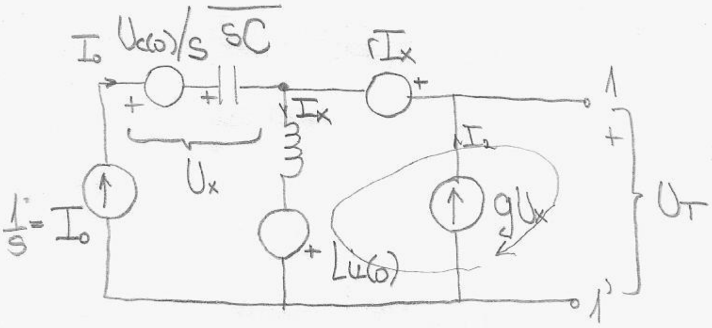
3. iz ispita 07/08

$R=L=C=1$ $\qquad U_c(0)=1$

$i_0(t)=S(t)$ $\qquad i_L(0)=1$

$r=g=0.5$





$$I_2=gU_x=\frac{1}{2}\left(\frac{1}{s}+\frac{1}{s^2}\right)$$

$$I_x-I_0-I_2=0$$

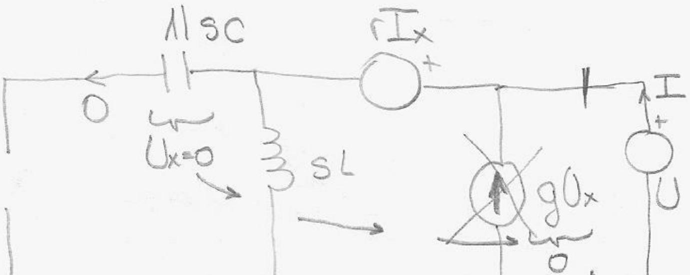
$$I_x=I_0+I_2=\frac{1}{s}+\left(\frac{1}{2s}+\frac{1}{2s^2}\right)=\frac{3}{2s}+\frac{1}{2s^2}$$

$$U_x=\frac{U_c(0)}{s}+I_0\frac{1}{sC}=\frac{1}{s}+\frac{1}{s^2}$$

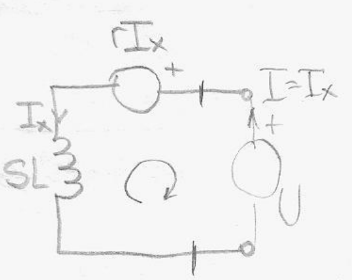
$$L i_L(0)-I_x sL-rI_x+U_T=0$$

$$\boxed{U_T=I_x(sL+r)-L i_L(0)}$$

$Z_T=?$ (strujne odspojimo, naponske kratko spojimo) početni uvjeti kao nez. izvori, zavisni izvori ostaju u mreži



$$Z_T=\frac{U}{I}$$



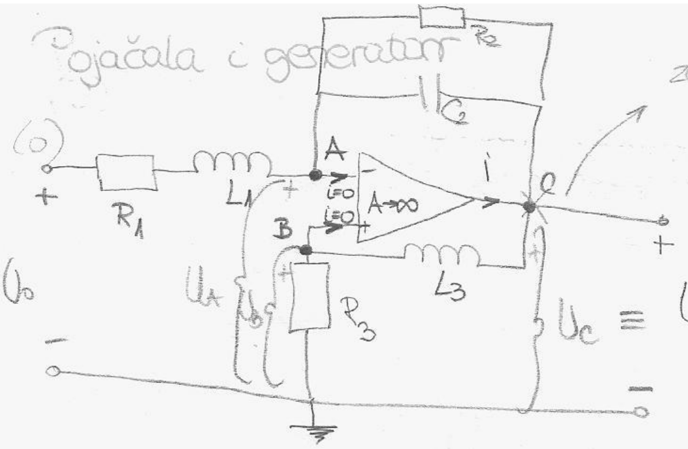
$$Z_T=\frac{U}{I_x}=\frac{I_x(sL+r)}{I_x}=\boxed{sL+r}$$

$$-I_x sL-rI_x+U=0$$

Pojačala i generatori

(5)

(6)



$U_C = U_{iz}$

za taj čvor se ne piše jednadžba (NIKADA)

$U_i = A(U_B - U_A)$

$\frac{U_i}{A} = U_B - U_A$

$\boxed{U_A = U_B}$

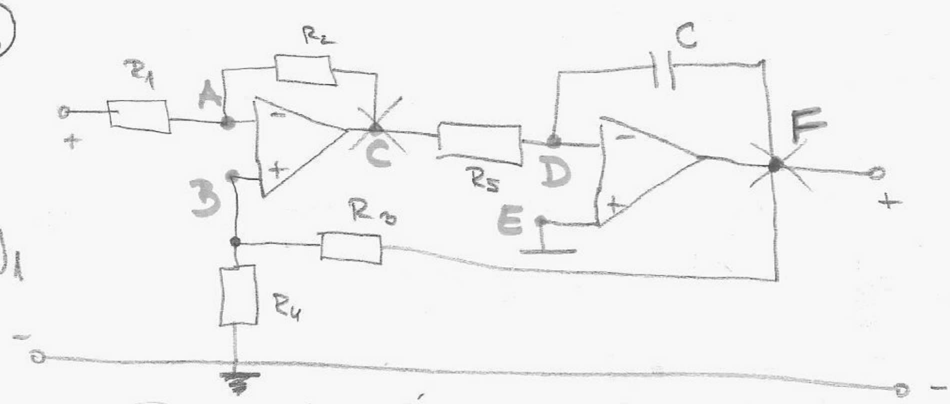
3 jedn. s 3 nepozn.

(A) $U_A\left[\frac{1}{R_1+sL_1} + \frac{1}{R_2} + sC_2\right] - U_0\frac{1}{R_1+sL_1} - U_i\left[sC_2 + \frac{1}{R_2}\right] = 0$

(B) $U_B\left[\frac{1}{R_3} + \frac{1}{sL_3}\right] - U_{iz}\cdot\frac{1}{sL_3} = 0$

$U_{iz} = ?$ uvijek ovom metodom ⇓

(5.)



$U_2 = ?$

(A) $U_A\left(\frac{1}{R_1} + \frac{1}{R_2}\right) - U_1\cdot\frac{1}{R_1} - U_C\cdot\frac{1}{R_2} = 0$

(B) $U_B\left(\frac{1}{R_3} + \frac{1}{R_4}\right) - U_2\frac{1}{R_3} = 0$

$U_A = U_B$

$U_D = U_E = 0$

(C) ne pišemo

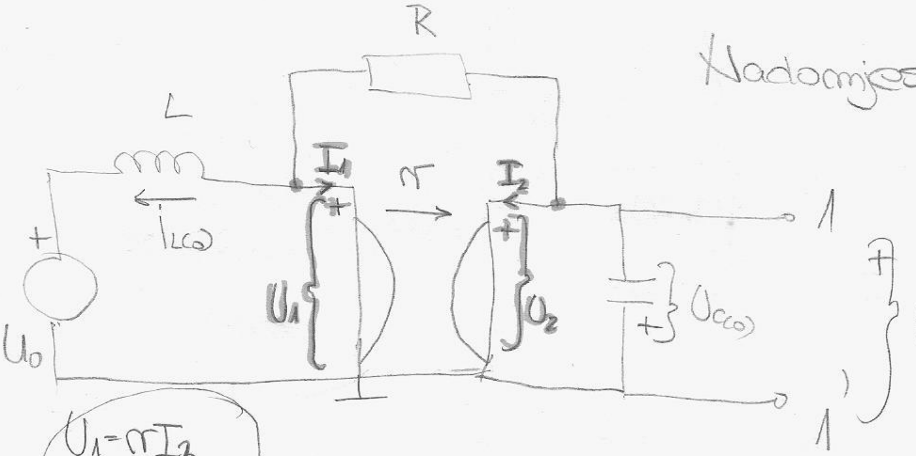
(D) $U_D\left(\frac{1}{R_5} + sC\right) - U_C\cdot\frac{1}{R_5} - U_2 sC = 0$

(E) $U_E = 0$

(F) ne pišemo

GIRATOR

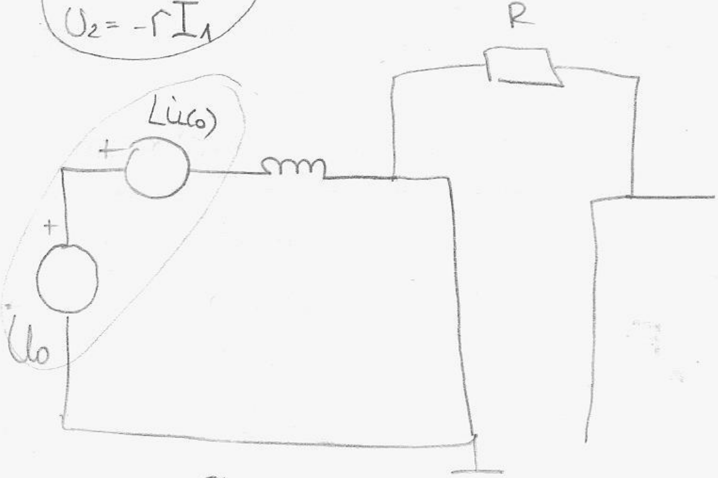
Nadomjestiti po Nortonu!

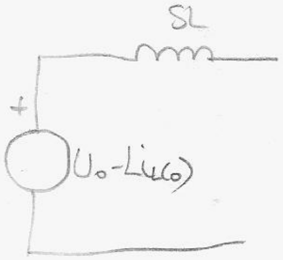


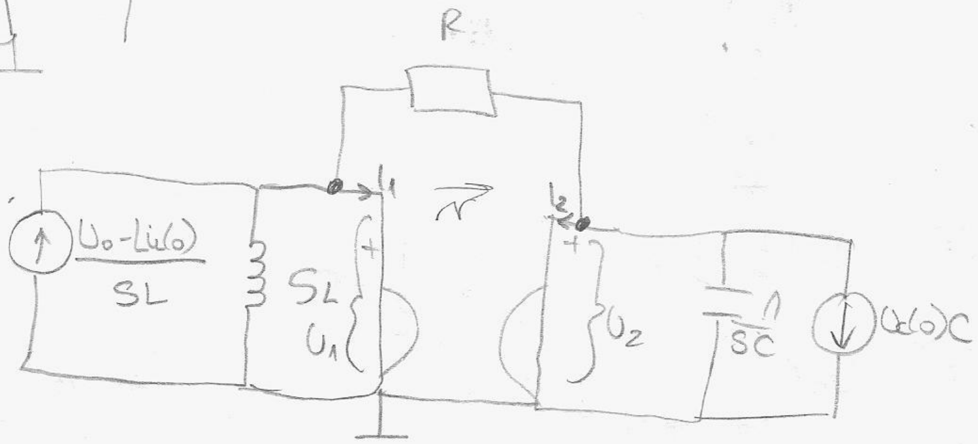
$U_T = U_2$

$U_1 = r I_2$

$U_2 = -r I_1$

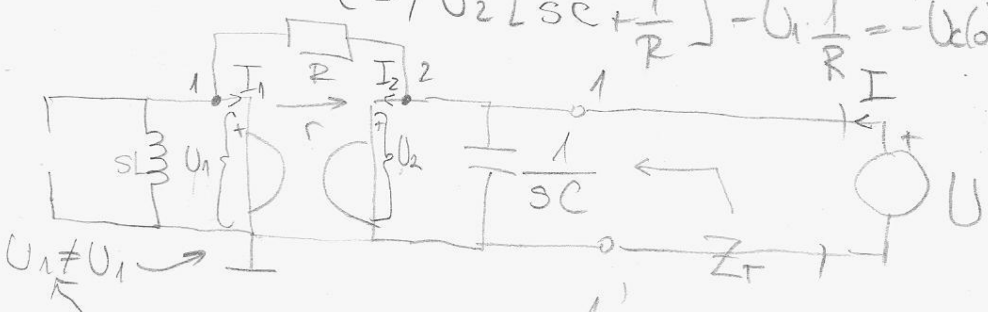






(1) $U_1\left[\frac{1}{SL} + \frac{1}{R}\right] - U_2 \frac{1}{R} = \frac{U_0}{SL} - \frac{i_L(0)}{S} - I_1$

(2) $U_2\left[SC + \frac{1}{R}\right] - U_1 \frac{1}{R} = -U_C(0)C - I_2$



$Z_T = \frac{U}{I} = \frac{U_2}{I}$

$U_1 \neq U_1$

(1) $U_1\left[\frac{1}{SL} + \frac{1}{R}\right] - U_2 \cdot \frac{1}{R} = -I_1 = \frac{U_2}{r}$

(2) $U\left[\frac{1}{R} + SC\right] - U_1 \frac{1}{R} = \cancel{-I_2 + I} = I - \frac{U_1}{r}$

GIRATOR-nastavak

$$U_1\left[\frac{1}{sL}+\frac{1}{R}\right] = U_2\left[\frac{1}{R}+\frac{1}{r}\right]$$

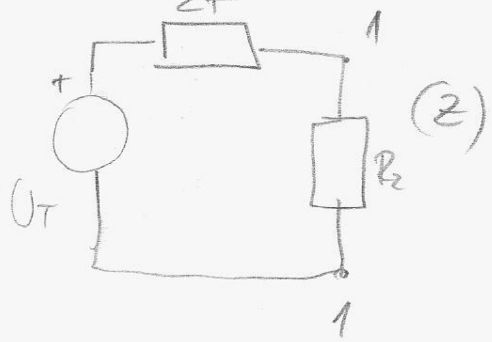
$$U_1 = U_2\,\frac{\frac{1}{R}+\frac{1}{r}}{\frac{1}{sL}+\frac{1}{R}}$$

$$U\left[\frac{1}{R}+sC\right] + U_1\left[\frac{1}{r}-\frac{1}{R}\right] = \underline{I}$$

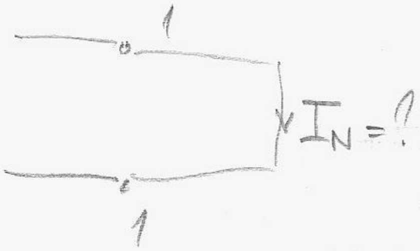
$$U\underbrace{\left[\frac{1}{R}+sC+\left(\frac{1}{r}-\frac{1}{R}\right)\frac{\frac{1}{r}+\frac{1}{R}}{\frac{1}{sL}+\frac{1}{R}}\right]}_{Z_T} = I$$

Thevenin

$$Z_T = \frac{U}{I} = Z_N$$



shema (cista)

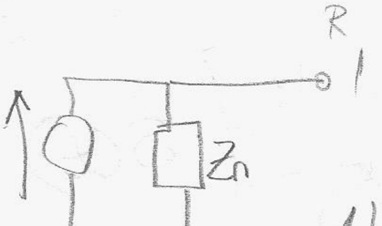


$U_2 = 0$

$I_1 = 0$

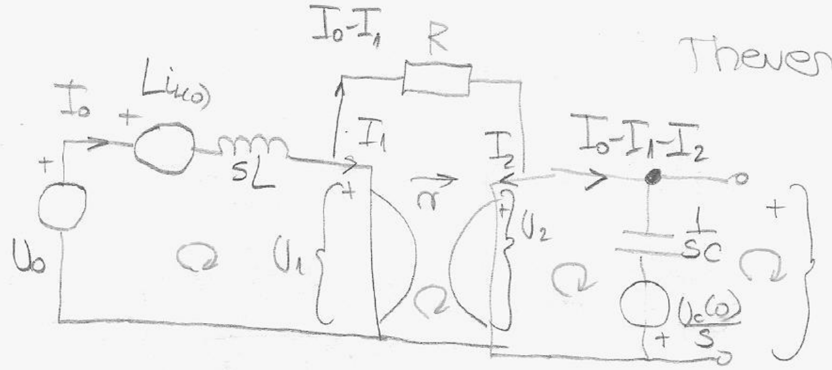
$$(1)\quad U_1\left(\frac{1}{sL}+\frac{1}{R}\right] - \cancel{U_2}^{\,0}\cdot\frac{1}{R} = \frac{U_0}{sL} - \frac{i_L(0)}{s} - \cancel{I_1}^{\,0}$$

$$(2)\quad \cancel{U_2}^{\,0}\left[\frac{1}{R}+sC\right] - U_1\cdot\frac{1}{R} = -I_N - I_2 - CU_c(0)$$



Thevenin pomoću jednadžbi petlji

(8)



♡ =)

$U_1 = r I_2$
$U_2 = -r I_1$

I) $U_0 - Li_L(0) - I_0 sL - U_1 = 0$

II) $U_1 - (I_0 - I_1)R - U_2 = 0$

III) $U_2 - (I_0 - I_1 - I_2)\frac{1}{sC} + \frac{U_C(0)}{s} = 0$

IV) $-\frac{U_C(0)}{s} + (I_0 - I_1 - I_2)\frac{1}{sC} - U_T = 0$

Laplace: $U_0(t) = \delta(t) \circ\!\!-\!\!\bullet\ U(s) = 1$

$U_0(t) = S(t) \circ\!\!-\!\!\bullet\ U(s) = \frac{1}{s}$

$= e^{-\alpha t} \cdot S(t) \circ\!\!-\!\!\bullet\ \frac{1}{s+\alpha}$

$= t^n e^{-\alpha t} S(t) \circ\!\!-\!\!\bullet\ \frac{n!}{(s+\alpha)^{n+1}}$

pr. $\frac{1}{s^2+3s+2} = \frac{1}{(s+2)(s+1)} = \frac{A}{s+2} + \frac{B}{s+1} = \frac{As+A+Bs+2B}{(s+2)(s+1)} = 1$

..., $A = ?$ $B = ?$ ...

$$\frac{s+1}{s^2+s+1} = \frac{s+1}{(s+\frac{1}{2})^2 + \frac{3}{4}} = \frac{s+\frac{1}{2}+\frac{1}{2}}{(s+\frac{1}{2})^2 + (\frac{\sqrt{3}}{2})^2} = \frac{s+\frac{1}{2}}{(s+\frac{1}{2})^2 + (\frac{\sqrt{3}}{2})^2} + \frac{1}{2}\frac{2}{\sqrt{3}}\frac{\frac{\sqrt{3}}{2}}{(s+\frac{1}{2})^2 + (\frac{\sqrt{3}}{2})^2}$$

$$\bullet\!\!-\!\!\circ \left[\cos\left(\frac{\sqrt{3}}{2}t\right) \cdot e^{-\frac{1}{2}t} + \frac{1}{\sqrt{3}} \cdot \sin\left(\frac{\sqrt{3}}{2}t\right) e^{-\frac{1}{2}t}\right] \cdot S(t)$$

$$\frac{s^2}{s^2+s+1} = \frac{s^2+s+1-s-1}{s^2+s+1} = 1 - \frac{s+1}{s^2+s+1} \bullet\!\!-\!\!\circ\ \delta(t) - [\ldots]$$