FER2.net

Električni krugovi

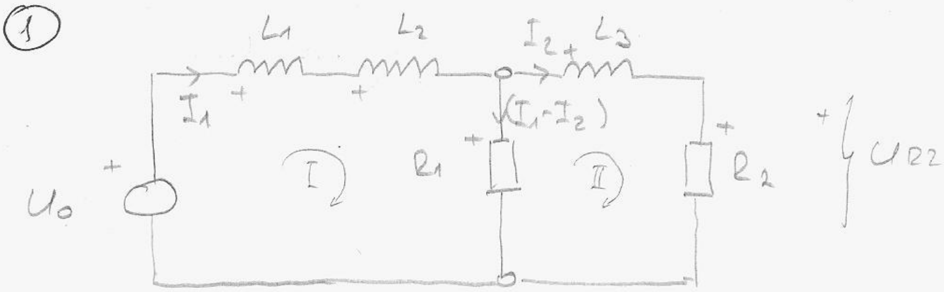
Zadaci za vježbu za prvi međuispit
ak. god. 2007./2008.

- skenirani postupci rješavanja, verzija: v0.1.

- zadaci po kojima je rješavano nalaze se u istom .rar dokumentu

by: Tywin

(1)



$$(I)\quad u_0 - I_1(sL_1+sL_2)-(I_1-I_2)R_1=0$$

$$(II)\quad (I_1-I_2)R_1 - I_2(sL_3+R_3)=0$$

$$(I)\quad \frac{1}{s}-3s\,I_1 - I_1 - I_2 = 0$$

$$(II)\quad I_1 - I_2 - I_2(4s+1)=0$$

$$(II)\quad I_1 = I_2(4s+2) \quad \text{u}\quad (I)$$

$$\frac{1}{s} - I_1(3s+1) - I_2 = 0$$

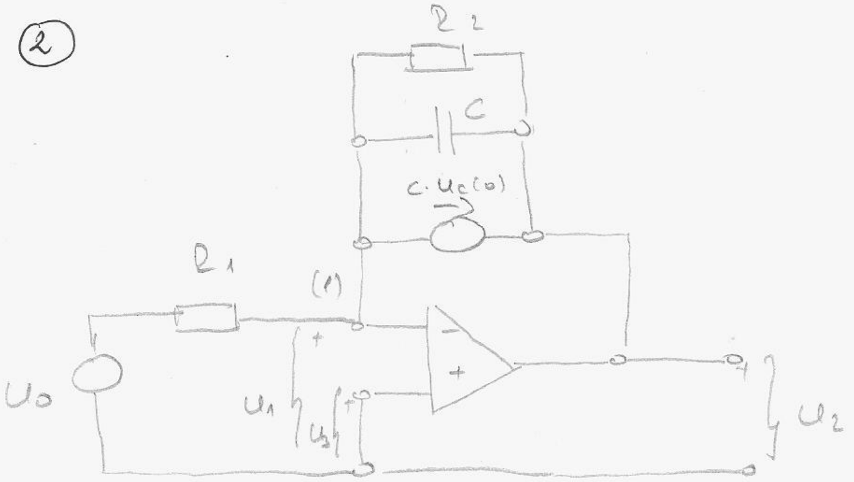
$$\frac{1}{s} - I_2(4s+2)(3s+1) - I_2 = 0$$

$$I_2\left[12s^2+10s+2-1\right] = \frac{1}{s}$$

$$I_2 = \frac{1}{s(12s^2+10s+1)}$$

$$u_{R2}(s) = I_2\cdot R_2 = \frac{1}{s(12s^2+10s+1)}$$

2



JEDNADŽBA POJAČALA:

$$\left.\begin{aligned} U_2 &= A(U_3 - U_1) \\ A &\to \infty \end{aligned}\right\} U_1 = U_3 = 0$$

(1) $$\cancelto{0}{U_1\left[\frac{1}{R_1}+\frac{1}{R_2}+sC\right]} - U_2\left[\frac{1}{R_2}+sC\right] - U_0\frac{1}{R_1} = -C\cdot U_c(0)$$

$$U_2\left[\frac{1}{R_2}+sC\right] = C\,U_c(0) - U_0\frac{1}{R_1}$$

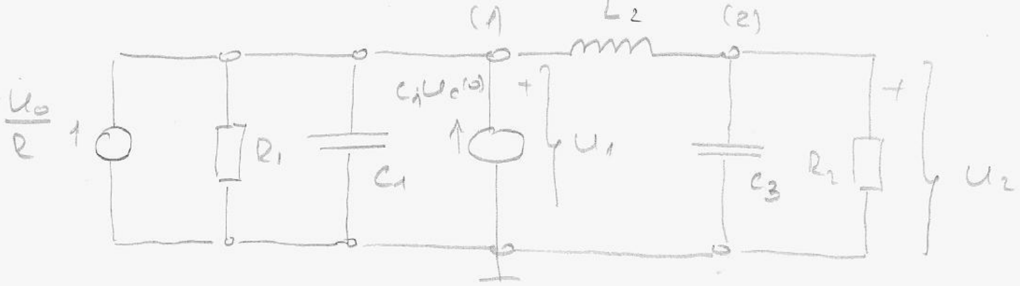
$$U_2\left[1+s\right] = 1-\frac{1}{s} = \frac{s-1}{s}$$

$$U_2 = \frac{s-1}{s(s+1)} = \frac{A}{s} + \frac{B}{s+1} = \frac{As+A+Bs}{s(s+1)}$$

$$\left\{\begin{aligned} &s-1 = As + A + Bs \\ &A+B = 1 \\ &A = -1 \Rightarrow B = 2 \end{aligned}\right\}$$

$$U_2(s) = \frac{2}{s+1} - \frac{1}{s} \quad \circ\!\!-\!\!\circ \quad u_2(t) = (2e^{-t}-1)\,S(t)$$

(3)



(1) $U_1\left[\frac{1}{R_1}+sC_1+\frac{1}{sL_2}\right]-U_2\frac{1}{sL_2}=\frac{U_0}{R}+C_1U_C(0)$

(2) $U_2\left[sC_3+\frac{1}{R_2}+\frac{1}{sL_2}\right]-U_1\frac{1}{sL_2}=0$

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

(2) $U_2\left[s+1+\frac{1}{2s}\right]-U_1\frac{1}{2s}=0$

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(2) $U_1=U_2\left[2s^2+2s+1\right]$ u (1)

(1) $U_2\left[2s^2+2s+1\right]\left[\frac{2s^2+2s+1}{2s}\right]-U_2\frac{1}{2s}=2$

$U_2\left[\frac{4s^4+4s^3+2s^2+4s^3+4s^2+2s+2s^2+2s+1}{2s}-\frac{1}{2s}\right]=2$

$U_2\left[4s^3+8s^2+8s+4\right]=4$

$U_2\left[4s^3+4s^2+4s^2+4s+4s+4\right]=4$

$U_2\left[4s^2(s+1)+4s(s+1)+4(s+1)\right]=4$

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

$U_2=\frac{1}{(s+1)(s^2+s+1)}=\frac{A}{s+1}+\frac{Bs+C}{s^2+s+1}$ → jer nema realna rješenja

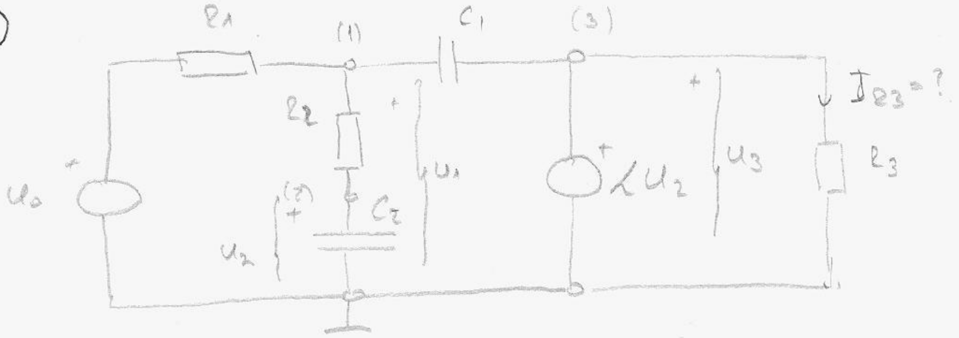
$=\frac{As^2+As+A+Bs^2+Cs+Bs+C}{(s+1)(s^2+s+1)} \Rightarrow \left.\begin{array}{l}A+B=0\\A+B+C=0\\A+C=1\end{array}\right\}\begin{array}{l}C=0\\B=-1\\A=1\end{array}$

$U_2=\frac{1}{s+1}-\frac{s}{s^2+s+1}=\frac{1}{s+1}-\frac{s+\frac{1}{2}-\frac{1}{2}}{(s+\frac{1}{2})^2+(\frac{\sqrt{3}}{2})^2}$

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

$\multimap\ u_2(t)=\left[e^{-t}-e^{-\frac{t}{2}}\cos\left(\frac{\sqrt{3}}{2}t\right)+e^{-\frac{t}{2}}\frac{\sqrt{3}}{3}\sin\left(\frac{\sqrt{3}}{2}t\right)\right]S(t)$

4



(1) $U_1\left[\frac{1}{R_1}+\frac{1}{R_2}+sC_1\right]-U_0\frac{1}{R_1}-U_2\frac{1}{R_2}-U_3\, sC=0$

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

$U_3=\alpha U_2$ u (1)

(2) $U_1=U_2\left[1+2s\right]$ u (1)

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(1) $U_2(1+s)(1+1+2s)-1-U_2-\alpha U_2 2s=0$

$U_2(2s+1)(2s+2)-U_2-4s\cdot U_2=1$

$U_2\left[4s^2+6s+2-1-4s\right]=1$

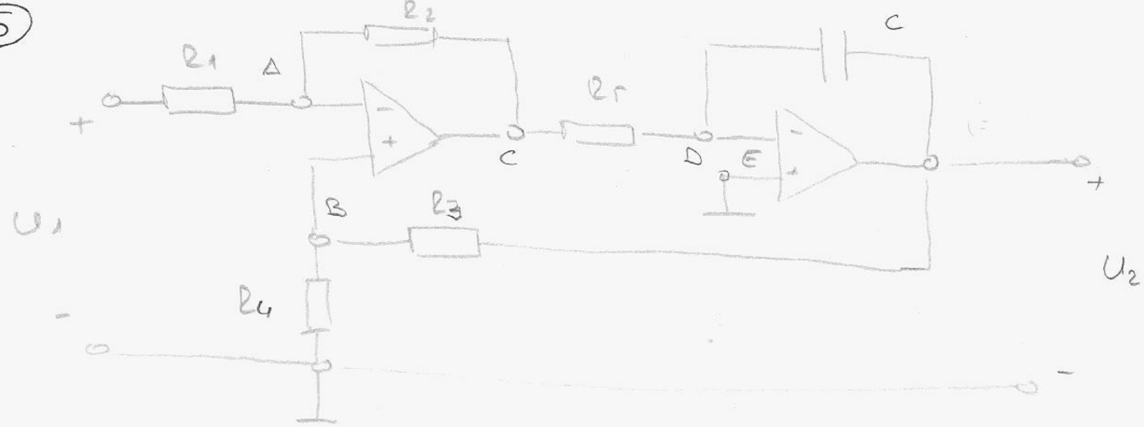
$U_2=\frac{1}{4s^2+2s+1}$

$I_{R3}=\frac{U_3}{R_3}=\frac{\alpha U_2}{R_3}=\frac{1}{4s^2+2s+1}=\frac{1}{4}\cdot\frac{1}{s^2+\frac{1}{2}s+\frac{1}{4}}$

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

o— $i_{R3}(t)=\frac{\sqrt{3}}{3}e^{-\frac{t}{4}}\sin\left(\frac{\sqrt{3}}{4}t\right)\cdot S(t)$

⑤



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

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

(D) $U_D\left[\frac{1}{R_r}+sC\right]-U_C\frac{1}{R_r}-U_2\, sC=0$

jednadžbe pojačala: $U_A=U_B$

$U_D=U_E=0$

(B) $U_A=\frac{U_2}{2}$ u (A)

(D) $U_C=-U_2\cdot s$ u (A)

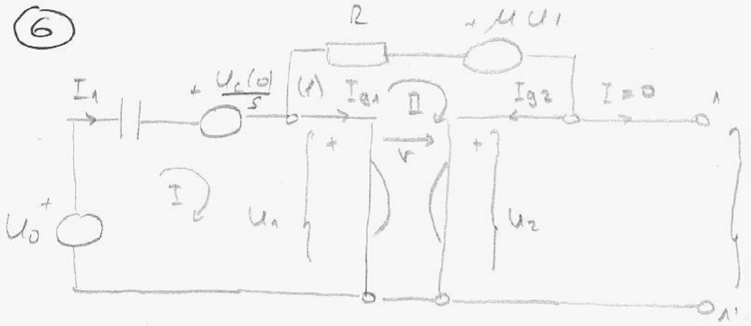
(A) $\frac{U_2}{2}\left[1+1\right]-\frac{1}{s}+U_2\cdot s=0$

$U_2\left[1+s\right]=\frac{1}{s}$

$U_2=\frac{1}{s(s+1)}=\frac{A}{s}+\frac{B}{s+1}=\frac{As+A+Bs}{s(s+1)}$ $\left\{\begin{array}{l}A+B=0\\A=1 \Rightarrow B=-1\end{array}\right\}$

$=\frac{1}{s}-\frac{1}{s+1}$

6



$U_{11'} = U_T = U_2$

a) jednadžbe giratora uz ovako postavljene struje i napone: $U_1 = r \cdot I_{g2}$ (g1)

$U_2 = -r \cdot I_{g1}$ (g1)

(I) $U_0 - I_1 \frac{1}{sC} - \frac{U_c(0)}{s} - U_1 = 0$

(II) $-I_{g2} R - \mu U_1 - U_2 + U_1 = 0$

(1) $I_1 = I_{g1} + I_{g2}$

(g1) $I_{g2} = \frac{U_1}{r}$

(g2) $I_{g1} = -\frac{U_2}{r}$

u (1) $\Rightarrow$ $I_1 = \frac{U_1 - U_2}{r}$ u (I)

(g2) u (II)

(I) $\frac{1}{s} - \frac{U_1 - U_2}{0.5 s} - \frac{2}{s} - U_1 = 0 \;/\cdot s$

(II) $-U_1 - 0.5 U_1 - U_2 + U_1 = 0$

(II) $U_1 = \frac{-U_2}{0.5} = -2U_2$ u (I)

(I) $1 - 2U_1 + 2U_2 - 2 - U_1 s = 0$

$2U_2 - U_1(s+2) = 1$

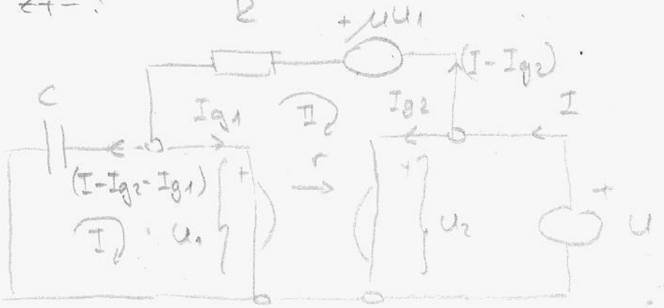
$2U_2 + 2(s+2) = 1$

$U_2 [2 + 2s + 4] = 1$

$U_2 \, 2 [s+3] = 1$

$U_2 = U_T = \frac{1}{2} \cdot \frac{1}{s+3}$

b) $Z_T = ?$



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

jdbe giratora : $U_1 = r \cdot I_{g2}$ (g1)

$U_2 = -r \cdot I_{g1}$ (g2)

(I) $\frac{1}{sC}(I - I_{g2} - I_{g1}) - U_1 = 0$

(II) $U_1 + (I - I_{g2})R - \mu U_1 - U_2 = 0$

(g1) $I_{g2} = \frac{U_1}{r}$

(g2) $I_{g1} = -\frac{U_2}{r}$ } u (I) i (II)

(I) $\frac{1}{s}(I - 2U_1 + 2U_2) - U_1 = 0 \quad / \cdot s$

(II) $U_1 + (I - 2U_1)\cdot 0.5 - 0.5\,U_1 - U_2 = 0 \quad / \cdot 2$

(I) $I - U_1(s+2) + 2U_2 = 0$

(II) $I - 2U_2 - U_1 = 0 \Rightarrow U_1 = I - 2U_2$ u (I)

(I) $I - (I - 2U_2)(s+2) + 2U_2 = 0$

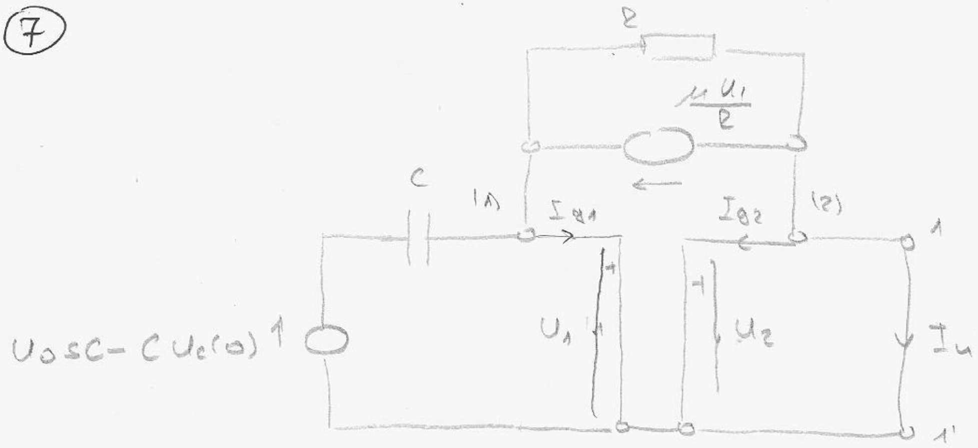
$I - I(s+2) + 2U_2(s+2) + 2U_2 = 0$

$U_2(2s + 4 + 2) = I(s + 2 - 1)$

$U_2 = I \cdot \frac{s+1}{2s+6}$

$Z_T = \frac{U_2}{I} = \frac{s+1}{2(s+3)}$

⑦



jdbe giratora: $U_1 = r \cdot I_{g2}$ (g1)

$U_2 = -r \cdot I_{g1}$ (g2)

(1) $U_1 \left[sC + \frac{1}{R} \right] - U_2 \frac{1}{R} = U_0 sC - C U_c(0) + \mu \frac{U_1}{R} - I_{g1}$

(2) $U_2 \left[\frac{1}{R} \right] - U_1 \frac{1}{R} = -\frac{\mu U_1}{R} - I_{g2} - I_n$

→ na izlazu 1-1' je kratki spoj pa $U_2 = 0$ a prema (g2) $I_{g1} = 0$

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(1) $U_1 (s+2) = 1 - 2 + U_1 \Rightarrow U_1 = \frac{-1}{s+1}$

(2) $-2U_1 = -U_1 - I_{g2} - I_n$

(g1) $I_{g2} = 2U_1 = \frac{-2}{s+1}$

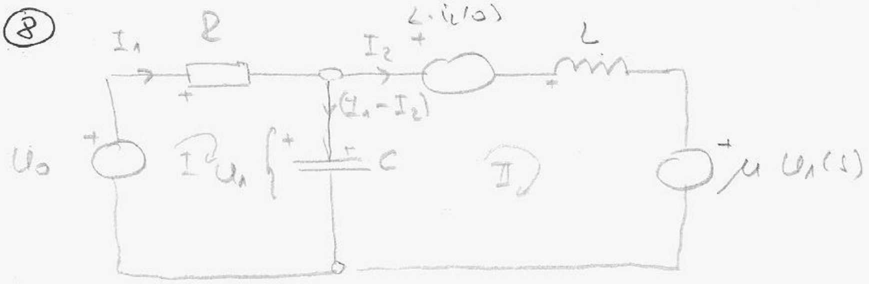
(2) $I_n = U_1 - I_{g2} = \frac{1}{s+1}$

b) Nortonova impedancija = Theveninova impendancija

$Z_N = Z_T = \frac{1}{2} \cdot \frac{s+1}{s+3}$

$Y_N = \frac{1}{Z_N} = \frac{2(s+3)}{s+1}$

8



$$U_1 = \frac{1}{sC}(I_1 - I_2) \Rightarrow I_1 = U_1 \cdot sC + I_2$$

$$(I) \quad U_0 - I_1 R_1 - (I_1 - I_2)\frac{1}{sC} = 0$$

$$(II) \quad (I_1 - I_2)\frac{1}{sC} - L\, i_L(0) - I_2 Ls - \mu U_1 = 0$$

$$(I) \quad I_1\left(1 + \frac{3}{s}\right) - I_2 \cdot \frac{3}{s} = \frac{1}{s} \quad / \cdot s$$

$$(II) \quad I_2\left(\frac{3}{s} + \frac{s}{2}\right) - I_1 \frac{3}{s} = -\frac{1}{2} - \frac{2}{3} U_1 \quad / \cdot 6s$$

$$(I) \quad I_1(s + 3) - 3 I_2 = 1$$

$$(II) \quad I_2(3s^2 + 18) - 18 I_1 = -3s + 4s \cdot U_1$$

$$I_1 = U_1 \cdot \frac{s}{3} + I_2 \quad u\ (I)\ i\ (II)$$

$$(I) \quad U_1 \frac{s}{3}(s+3) + I_2 s = 1$$

$$(II) \quad I_2(3s^2 + \cancel{18}) - 18 \cdot U_1 \frac{s}{3} - \cancel{18 I_2} = -3s - 4s \cdot U_1$$

$$3s^{\cancel{2}} I_2 - 2\cancel{s}\, U_1 = -3\cancel{s}$$

$$3s I_2 = 2U_1 - 3 \quad u \quad (I)$$

$$(I) \quad U_1(s^2 + 3s) + 2U_1 - 3 = 3$$

$$U_1(s^2 + 3s + 2) = 6$$

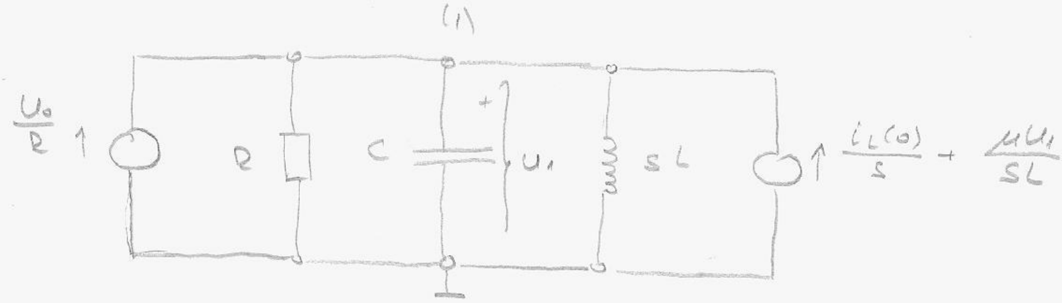
$$U_1 = \frac{6}{(s+1)(s+2)} = \frac{A}{s+1} + \frac{B}{s+2} = \frac{As + 2A + Bs + B}{(s+1)(s+2)}$$

$$\left\{\begin{array}{l} A + B = 0 \\ 2A + B = 6 \Rightarrow A = 6 \Rightarrow B = -6 \end{array}\right\}$$

$$U_1(s) = 6\left[\frac{1}{s+1} - \frac{1}{s+2}\right]$$

$$\circ\!\!-\!\!\circ \quad u_1(t) = 6\left[e^{-t} - e^{-2t}\right] S(t)$$

9



(1) $u_1\left[\frac{1}{R} + sC + \frac{1}{sL}\right] = \frac{u_0}{R} + \frac{i_L(0)}{s} + \frac{\mu u_1}{sL}$

$$u_1\left[\frac{1}{R} + sC + \frac{1-\mu}{sL}\right] = \frac{u_0}{R} + \frac{i_L(0)}{s}$$

$$u_1\left[1 + \frac{s}{3} + \frac{\frac{1}{3}}{\frac{s}{2}}\right] = \frac{1}{s} + \frac{1}{s}$$

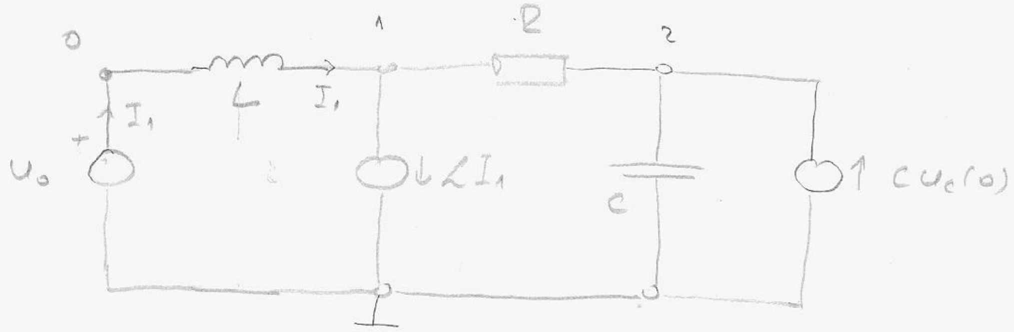
$$u_1\left[1 + \frac{s}{3} + \frac{2}{3s}\right] = \frac{2}{s} \quad / \cdot 3s$$

$$u_1\left[3s + s^2 + 2\right] = 6$$

$$u_1 = \frac{6}{s^2+3s+2} = \frac{6}{(s+1)(s+2)} = 6\left[\frac{1}{s+1} - \frac{1}{s+2}\right]$$

$$\bullet\!\!-\!\!\circ \quad u_1(t) = 6\left[e^{-t} - e^{-2t}\right] S(t)$$

10



(0) $U_0\left[\frac{1}{sL}\right] - U_1\frac{1}{sL} = I_1$

(1) $U_1\left[\frac{1}{sL}+\frac{1}{R}\right] - U_0\frac{1}{sL} - U_2\frac{1}{R} = -\lambda I_1$

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

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(0) $\frac{1}{s^2} - \frac{U_1}{s} = I_1$

(1) $U_1\left[\frac{1}{s}+\frac{1}{2}\right] - \frac{1}{s^2} - \frac{U_2}{2} = -\frac{I_1}{2}$

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

---

(0) $I_1 = \frac{1}{s^2} - \frac{U_1}{s}$ u (1)

(2) $U_2\left[\frac{2s+1}{2}\right] = \frac{U_1+1}{2} \Rightarrow U_2 = U_1\frac{1}{2s+1} + \frac{1}{2s+1}$ u (1)

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

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

$U_1\left[\frac{2s^2+\cancel{s}+4s+2-\cancel{s}-2s-1}{\cancel{2s}(\cancel{2s+1})}\right] = \frac{4s+2+s^2-2s-1}{\cancel{2}s^2(\cancel{2s+1})}$

$U_1\left[2s^2+2s+1\right] = \frac{s^2+2s+1}{s} \Rightarrow U_1 = \frac{s^2+2s+1}{s(2s^2+2s-1)}$ u (0)

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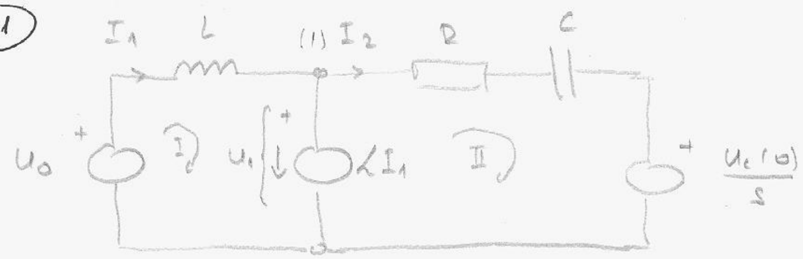
(0) $I_1 = \frac{1}{s^2} - \frac{s^2+2s+1}{s^2(2s^2+2s+1)} = \frac{2s^2+\cancel{2s}+\cancel{1}-s^2-\cancel{2s}-\cancel{1}}{s^2(2s^2+2s+1)} =$

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

$\bullet\!\!-\!\!\circ$ $i_1(t) = e^{-\frac{t}{2}}\sin\left(\frac{t}{2}\right) s(t)$

(11)



$$(\mathrm{I}) \quad U_0 - I_1 sL - U_1 = 0$$

$$(\mathrm{II}) \quad u_1 - I_2\left(R + \frac{1}{sC}\right) - \frac{u_c(0)}{s} = 0$$

$$(1) \quad I_1 = \alpha I_1 + I_2$$

$$(\mathrm{I})+(\mathrm{II}) \quad \frac{1}{s} - I_1 s - I_2\left(2 + \frac{1}{s}\right) - \frac{1}{2s} = 0$$

$$(1) \quad I_2 = \frac{I_1}{2} \quad u \quad (\mathrm{I})+(\mathrm{II})$$

$$I_1 s + \frac{I_1}{2}\left[\frac{2s+1}{s}\right] = \frac{1}{s} - \frac{1}{2s}$$

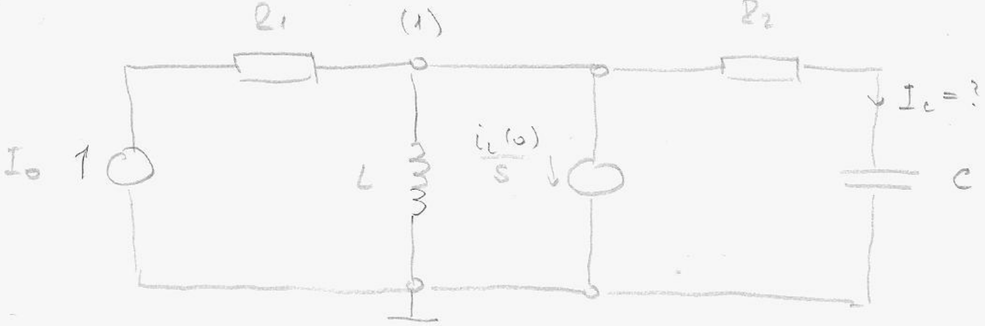
$$I_1\left[s + \frac{2s+1}{2s}\right] = \frac{1}{2s}$$

$$I_1\left[\frac{2s^2+2s+1}{2s}\right] = \frac{1}{2s}$$

$$I_1 = \frac{1}{2s^2+2s+1} = \frac{\frac{1}{2}}{\left(s+\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2}$$

$$\circ\!\!-\!\!\bullet \quad i_1(t) = e^{-\frac{t}{2}} \sin\left(\frac{t}{2}\right) S(t)$$

(12)



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

$U_1\left[\frac{1}{s}+\frac{1}{1+\frac{1}{s}}\right]=1-\frac{1}{s}$

$U_1\left[\frac{1}{s}+\frac{s}{s+1}\right]=\frac{s-1}{s}$

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

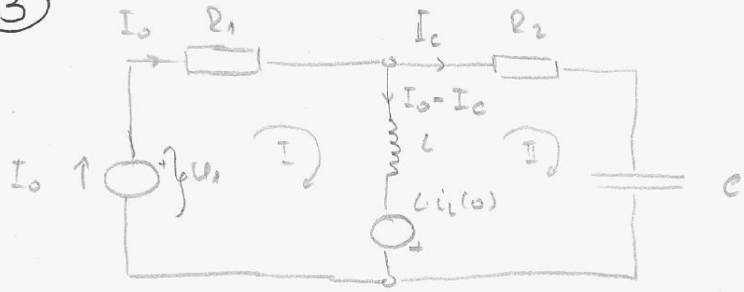
$U_1=\frac{s^2-1}{s^2+s+1}$

$I_C=\frac{U_1}{R_2+\frac{1}{sC}}=\frac{U_1}{\frac{s+1}{s}}=\frac{\frac{(s-1)\cancel{(s+1)}}{s^2+s+1}}{\frac{\cancel{(s+1)}}{s}}=\frac{s^2-s}{s^2+s+1}$

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

$\circ\!-\!\bullet\quad i_C(t)=\delta(t)-2\cdot e^{-\frac{t}{2}}\cos\left(\frac{\sqrt{3}}{2}t\right)\cdot s(t)$

(13)



$$(I)\quad U_1 - I_0 R_1 - (I_0 - I_C) sL + L \cdot i_L(0) = 0$$

$$(II)\quad -L \cdot i_L(0) + (I_0 - I_C) sL - I_C R_2 - I_C \frac{1}{sC} = 0$$

$$(II)\quad -1 + (1 - I_C) s - I_C - I \frac{1}{s} = 0$$

$$-1 + s + s I_C - I_C - I_C \frac{1}{s} = 0$$

$$I_C \left[s + 1 + \frac{1}{s} \right] = s - 1 \quad / \cdot s$$

$$I_C \left[s^2 + s + 1 \right] = s^2 - s$$

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

$$\circ\!\!-\!\!\bullet \quad i_C(t) = \delta - 2 e^{-\frac{t}{2}} \cos\left(\frac{\sqrt{3}}{2} t\right) s(t)$$

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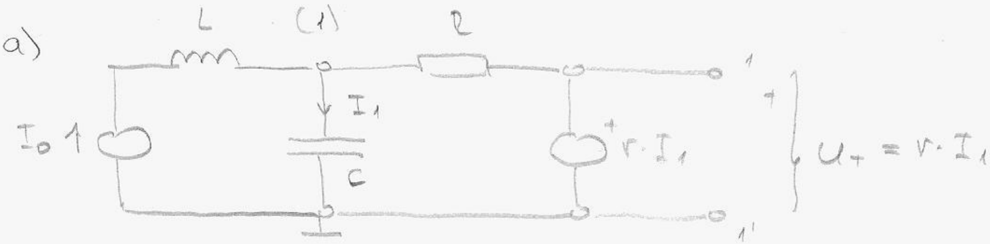
a)



(1) $U_1\left[\frac{1}{R}+sC\right] - U_T\cdot\frac{1}{R} = I_0$

$U_T = r\cdot I_1 = r\cdot\frac{U_1}{\frac{1}{sC}} = U_1\cdot rsC = s\,U_1$ u (1)

---

(1) $U_1\left[\frac{1}{2}+s\right] - \frac{sU_1}{2} = \frac{1}{s}$

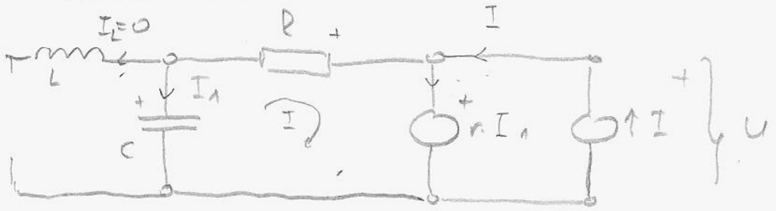
$U_1\left[\frac{1}{2}+s-\frac{s}{2}\right] = \frac{1}{s}$

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

$U_T = s\cdot U_1 = \frac{2}{s+1}$

---

b)



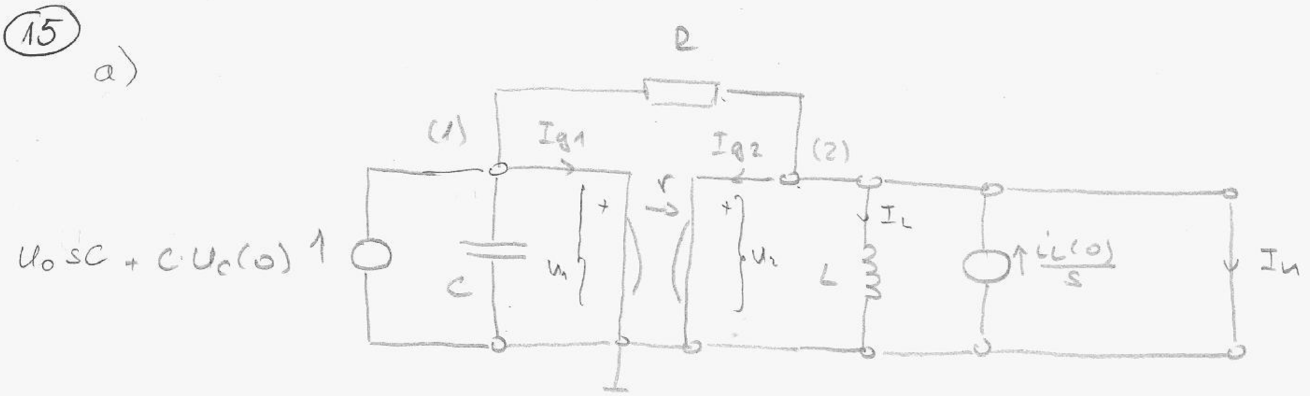
$Z_T = \frac{U}{I} = \frac{r\cdot I_1}{I}$

(I) $I_1\left(R+\frac{1}{sC}\right) - r\cdot I_1 = 0$

$I_1 = 0$

$Z_T = \frac{r\cdot I_1}{I} = \frac{r\cdot 0}{I} = 0$

(15) a)



(g1) $U_1 = r \cdot I_{g2}$

(g2) $U_2 = -r \cdot I_{g1}$

(1) $U_1\left[sC + \frac{1}{R}\right] - U_2 \frac{1}{R} = U_0 sC + C \cdot U_c(0) - I_{g1}$

(2) $U_2\left[\frac{1}{R} + \frac{1}{sL}\right] - U_1 \frac{1}{R} = \frac{i_L(0)}{s} - I_{g2} - I_n$

. zbog kratkog spoja : $U_2 = 0 \Rightarrow I_{g1} = 0$

---

(1) $U_1\left[s + 2\right] = s + \frac{1}{2}$

(2) $-U_1 \, 2 = \frac{1}{s} - I_{g2} - I_n$

---

(1) $U_1(s+2) = \frac{2s+1}{2} \Rightarrow U_1 = \frac{2s+1}{2(s+2)}$ u (2)

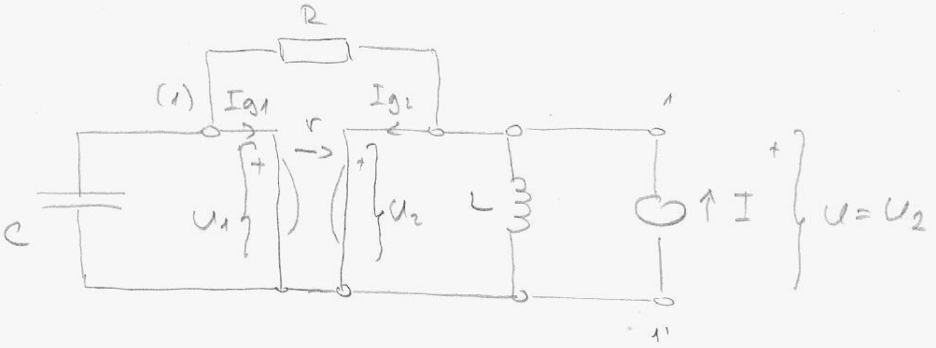
(g1) $I_{g2} = \frac{U_1}{r} = \frac{2s+1}{2(s+2)}$ u (1)

---

(2) $-\frac{2s+1}{s+2} = \frac{1}{s} - \frac{2s+1}{2(s+2)} - I_n$

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

b)



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

$$Y_N = \frac{1}{Z_N} = \frac{I}{U_2}$$

(g1) $U_1 = r \cdot I_{g2}$

(g2) $U_2 = -r \cdot I_{g1}$

(1) $U_1\left[sC + \frac{1}{R}\right] - U_2\frac{1}{R} = -I_{g1}$

(2) $U_2\left[\frac{1}{sL} + \frac{1}{R}\right] - U_1\frac{1}{R} = -I_{g2} + I$

(g1) $I_{g2} = \frac{U_1}{r} = U_1$

(g2) $I_{g1} = -\frac{U_2}{r} = -U_2$

} u (1) i (2)

---

(1) $U_1(s+2) - 2U_2 = U_2 \Rightarrow U_1 = U_2 \cdot \frac{3}{s+2}$

(2) $U_2\left(\frac{1}{s} + 2\right) - 2U_1 = -U_1 + I$

$I = U_2\left(\frac{2s+1}{s}\right) - U_1$ (1) u (2)

---

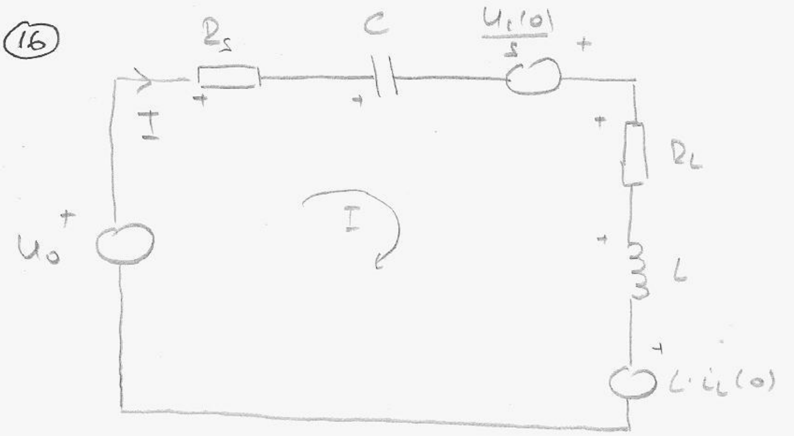
(2) $I = U_2\frac{2s+1}{s} - U_2\frac{3}{s+2}$

$$= U_2\left[\frac{2s+1}{s} - \frac{3}{s+2}\right] = U_2\left[\frac{2s^2 + s + 4s + 2 - 3s}{s(s+2)}\right]$$

$$= U_2\left[\frac{2s^2 + 2s + 2}{s(s+2)}\right]$$

$$Y_N = \frac{I}{U_2} = \frac{2s^2 + 2s + 2}{s(s+2)}$$

(16)



$u_L = ?$

$U_L = L \cdot i_L(0) + I(sL + R_L)$

$$(I) \quad u_0 - I\left(R_s + \frac{1}{sC} + R_L + sL\right) + \frac{u_c(0)}{s} - L \cdot i_L(0) = 0$$

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

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

$$I \frac{(s+1)^2}{\cancel{s}} = \frac{-s^2 + s + 1}{\cancel{s}(s+1)}$$

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

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

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

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

$$\multimap \quad u_L(t) = (3-t) \cdot e^{-t} s(t)$$

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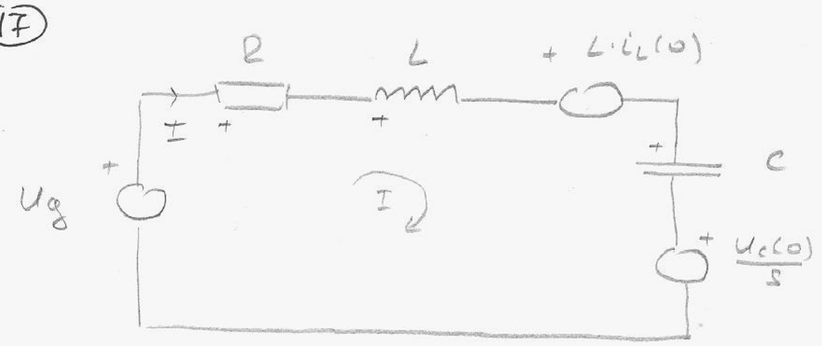


$U_c = ?$

$$U_c = \frac{U_c(0)}{s} + \frac{I}{sC}$$

$$\text{(I)} \quad U_g - I\left(R + sL + \frac{1}{sC}\right) - L\, i_L(0) - \frac{U_c(0)}{s} = 0$$

$$I\left(4 + 2s + \frac{2}{s}\right) = \frac{1}{s} - 2.4 - \frac{2.6}{s}$$

$$I\left(\frac{2s^2+4s+2}{\cancel{s}}\right) = \frac{-2.4s - 1.6}{\cancel{s}}$$

$$I = -\frac{1.2s+0.8}{s^2+2s+1} = -\frac{1.2s+0.8}{(s+1)^2}$$

$$U_c = \frac{2.6}{s} + \frac{2}{s}\cdot\left[-\frac{1.2s+0.8}{(s+1)^2}\right]$$

$$= \frac{2.6}{s} - \frac{-2.4s+1.6}{s(s+1)^2}$$

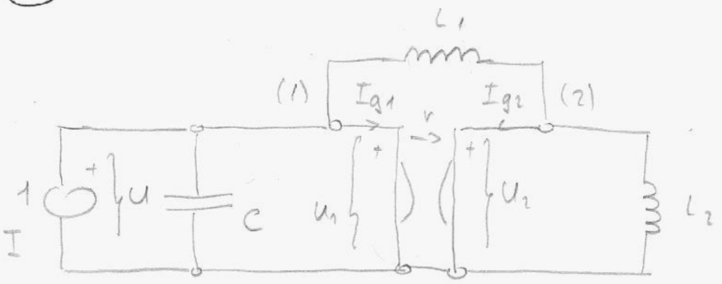
$$\left\{\begin{array}{l} \dfrac{2.4s+1.6}{s(s+1)^2} = \dfrac{A}{s} + \dfrac{Bs+C}{(s+1)^2} = \dfrac{As^2+2As+A+Bs^2+Cs}{s(s+1)^2} \\ A+B=0 \quad \Rightarrow B=-1.6 \\ 2A+C=2.4 \quad \Rightarrow C=-0.8 \\ A=1.6 \end{array}\right\}$$

$$U_c = \frac{2.6}{s} - \left[\frac{1.6}{s} + \frac{-1.6s-0.8}{(s+1)^2}\right]$$

$$= \frac{1}{s} + \frac{1.6s+0.8}{(s+1)^2} = \frac{1}{s} + \frac{1.6s+1.6-0.8}{(s+1)^2}$$

$$= \frac{1}{s} + \frac{1.6}{s+1} - \frac{0.8}{(s+1)^2}$$

$$\multimap \quad u_c(t) = \left[1 + 1.6e^{-t} - 0.8te^{-t}\right] S(t)$$



(g1) $u_1 = r \cdot I_{g2}$

(g2) $u_2 = -r \cdot I_{g1}$

$Y_{UL} = \frac{I}{u} = \frac{I}{u_1}$

(1) $u_1 \left[sC + \frac{1}{sL_1} \right] - u_2 \frac{1}{sL_1} = I - I_{g1}$

(2) $u_2 \left[\frac{1}{sL_1} + \frac{1}{sL_2} \right] - u_1 \frac{1}{sL_1} = - I_{g2}$

(g1) $I_{g2} = \frac{u_1}{r} = u_1$

(g2) $I_{g1} = -\frac{u_2}{r} = -u_2$

} u (1) i (2)

---

(1) $u_1 \left[s + \frac{1}{s} \right] - \frac{u_2}{s} = I + u_2$

(2) $u_2 \left[\frac{1}{s} + \frac{1}{s} \right] - \frac{u_1}{s} = - u_1$

---

(2) $u_2 \cdot \frac{2}{s} = u_1 \left(\frac{1}{s} - 1 \right) \Rightarrow u_2 = u_1 \frac{1-s}{2}$ u (1)

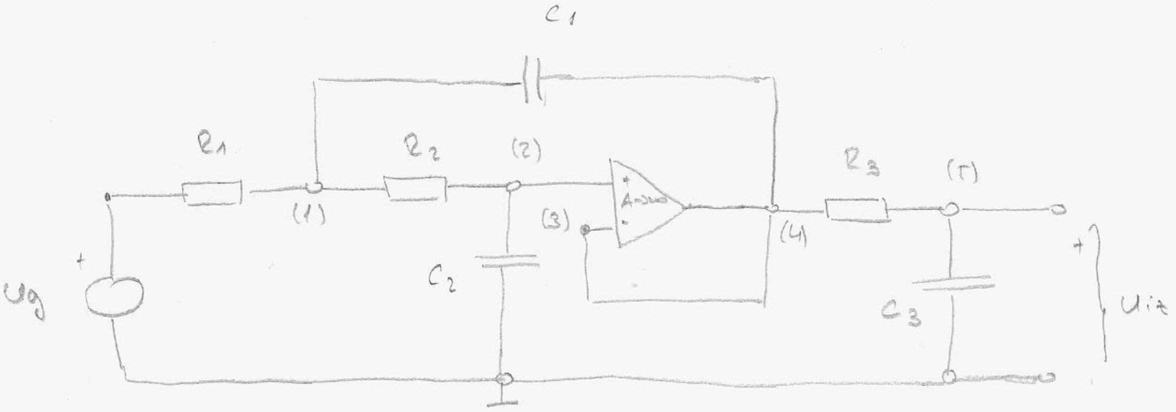
(1) $u_1 \left(\frac{s^2+1}{s} \right) - u_2 \left(\frac{1}{s} + 1 \right) = I$

$$I = u_1 \frac{s^2+1}{s} - u_1 \frac{1-s}{2} \cdot \frac{s+1}{s}$$

$$= u_1 \left[\frac{s^2+1}{s} + \frac{s^2-1}{2s} \right] = u_1 \frac{2s^2+2+s^2-1}{2s} = u_1 \frac{3s^2+1}{2s}$$

$$Y_{UL} = \frac{I}{u_1} = \frac{3s^2+1}{2s} = \frac{3}{2} s + \frac{1}{2s}$$

(19)



(1) $U_1\left[\frac{1}{R_1}+\frac{1}{R_2}+sC_1\right]-U_g\cdot\frac{1}{R_1}-U_2\frac{1}{R_2}-U_4\,sC_1=0$

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

(3) $U_3=U_4$

(4) ne pišemo

(5) $U_5\left[\frac{1}{R_3}+sC_3\right]-U_4\cdot\frac{1}{R_3}=0$

uz $U_5=U_{iz}$ i jednadžba pojačala- $U_2=U_3$ (p1)

$U_g(s)=1$

---

(1) $U_1\left[2+2s\right]-1-U_2-2s\,U_4=0$

(2) $U_2\left[1+\frac{s}{2}\right]-U_1=0 \Rightarrow U_1=U_2\,\frac{s+2}{2}$ u (1)

(3) $U_3=U_4$ + (p1) $\Rightarrow U_3=U_4=U_2$

(5) $U_5\left[1+s\right]-U_4=0 \Rightarrow U_{iz}=U_4\cdot\frac{1}{s+1}$

---

(1) $U_2\,\frac{s+2}{\cancel{2}}\cdot\cancel{2}(s+1)-U_2-2s\,U_4=1$

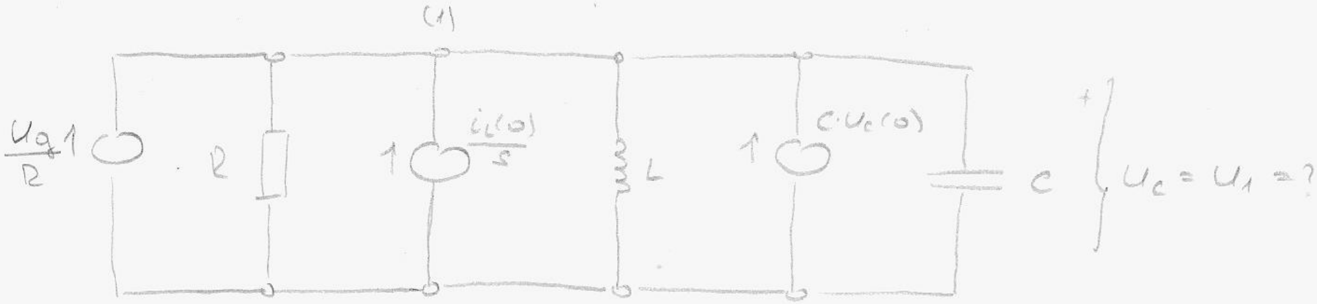
$U_2\left[s^2+3s+1\right]-2s\,U_4=1$

(3) $U_2=U_4$ u (1)

---

(1) $U_4\left[s^2+s+1\right]=1 \;;\Rightarrow U_4=\frac{1}{s^2+s+1}$ u (5)

$U_{iz}=\frac{1}{(s+1)(s^2+s+1)}$



$$(1)\quad U_1\left[\frac{1}{R}+\frac{1}{sL}+sC\right]=\frac{U_g}{R}+\frac{i_L(0)}{s}+C\cdot u_c(0)$$

$$u_g(t)=2\cdot e^{-t}s(t)\ \circ\!\!-\ U_g(s)=\frac{2}{s+1}$$

$$(1)\quad U_1\left[\frac{1}{2}+\frac{1}{s}+\frac{s}{2}\right]=\frac{1}{s+1}+\frac{4}{s}+1$$

$$U_1\left[\frac{s^2+s+2}{2\cancel{s}}\right]=\frac{s+4s+4+s^2+s}{\cancel{s}(s+1)}=\frac{s^2+6s+4}{\cancel{s}(s+1)}$$

$$U_1=2\cdot\frac{s^2+6s+4}{(s+1)(s^2+s+2)}=\frac{2s^2+12s+8}{(s+1)(s^2+s+2)}=\frac{A}{s+1}+\frac{Bs+C}{s^2+s+2}$$

$$=\frac{As^2+As+2A+Bs^2+Cs+Bs+C}{(s+1)(s^2+s+2)}$$

$$\begin{cases} A+B=2 \\ A+B+C=12 \Rightarrow C=10 \\ 2A+C=8 \Rightarrow A=-1 \quad B=3 \end{cases}$$

$$U_1=\frac{-1}{s+1}+\frac{3s+10}{s^2+s+2}=-\frac{1}{s+1}+\frac{3s+\frac{3}{2}+\frac{17}{2}}{\left(s+\frac{1}{2}\right)^2+\left(\frac{\sqrt{7}}{2}\right)^2}$$

$$=-\frac{1}{s+1}+3\frac{s+\frac{1}{2}}{\left(s+\frac{1}{2}\right)^2+\left(\frac{\sqrt{7}}{2}\right)^2}+\frac{17}{2}\cdot\frac{2}{\sqrt{7}}\cdot\frac{\frac{\sqrt{7}}{2}}{\left(s+\frac{1}{2}\right)^2+\left(\frac{\sqrt{7}}{2}\right)^2}$$

$$\circ\!\!-\ u_1(t)=\left[-e^{-t}+3e^{-\frac{t}{2}}\cos\left(\frac{\sqrt{7}}{2}t\right)+\frac{17}{\sqrt{7}}e^{-\frac{t}{2}}\sin\left(\frac{\sqrt{7}}{2}t\right)\right]s(t)$$