POZ

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GIR
ID. TRANSF.
OP. POJ.
VEZANI IZVOR
} NORTON THEVENIN

(1)

- METODA ČVOROVA
- METODA PETLJI
- KZN + KZS

8-ČH1 Č-1

- NORMALIZACIJA
- POSMAK
- FAZORI

(2) MREŽE/GRAFOVI - IZ MATRICA I GRAFA => MREŽU

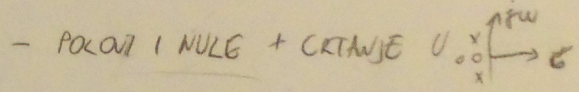
OBRNUTO

(3) PRIJENOSNE KARAKTERISTIKE - NAČI $T(s) = \frac{U_{IZ}}{U_{UL}}$

- $|T(j\omega)|$ i $\varphi \in \arg|T(j\omega)|$

$\alpha(\omega)$ - LOGARITAMSKI

- POLOVI I NULE + CRTANJE U



- STABILNOST/NESTABILNOST

- CRTANJE KARAKTERISTIKE

(4) ČETVEROPOLI - ODREĐIVANJE PARAMETARA - PRERAČUNAVANJE IZ JEDNE U DRUGE

- T I Π SPOJ

(- SPAJANJE ČETVEROPOLA)

- RECIPROČNOST
- SIMETRIČNOST

(3) PRIJENOSNE KARAKTERISTIKE – NAĆI $T(s) = \frac{U_{IZ}}{U_{UL}}$

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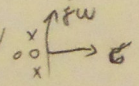
– POLOVI I NULE + CRTANJE U 

– STABILNOST/NESTABILNOST

– CRTANJE KARAKTERISTIKE

(4) ČETVEROPOLI – ODREĐIVANJE PARAMETARA – PRERAČUNAVANJE IZ JEDNE U DRUGE

– T i Π SPOJ

(– SPAJANJE ČETVEROPOLA)

– RECIPROČNOST
– SIMETRIČNOST

(5) FILTRI – PREPOZNAVANJE FILTRA

– ODREĐIVANJE ω φ i k

– CRTANJE KARAKTERISTIKE

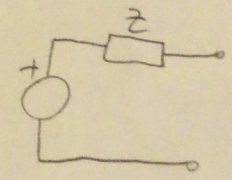
(6) LINIJE → $U(t) \rightarrow U(x,t)$

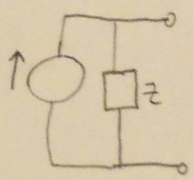
$I(t) \rightarrow I(x,t)$

OPĆI POJMOVI

OHMOV ZAKON

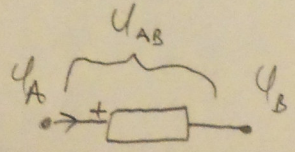
$$I = \frac{U}{Z}$$





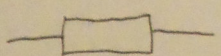
$U \longrightarrow I = \frac{U}{Z}$

$U = I \cdot Z \longleftarrow I$



$$I = \frac{\varphi_A - \varphi_B}{R}$$

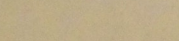
ELEMENTI



$R \circ\!\!-\!\!\circ R$

$$u_c(t) = \frac{1}{C}\int_{-\infty}^{t} i(\tau)\,d\tau = u_c(0) + \frac{1}{C}\int_{0}^{t} i(\tau)\,d\tau \circ\!\!-\!\!\bullet\; U(s) = \frac{u_c(0)}{s} + \frac{1}{sC}\cdot I(s)$$

$$Z_C \circ\!\!-\!\!\bullet \boxed{\frac{1}{sC}} \qquad \left(i = C\cdot\frac{du}{dt}\right)$$



$$u_L(t) = L\cdot\frac{di}{dt} \qquad Z_L \circ\!\!-\!\!\bullet \boxed{s\cdot L}$$

$$i(t) = \frac{1}{L}\int_{-\infty}^{t} u(\tau)\,d\tau = i_L(0) + \frac{1}{L}\int_{0}^{t} i(\tau)\,d\tau \circ\!\!-\!\!\bullet\; I(s) = \frac{i_L(0)}{s} + \frac{1}{sL}\cdot U(s)$$

NORMALIZACIJA

a) IMPEDANCIJE

$$R_N = \frac{R}{R_0} = \qquad R = R_N \cdot R_0$$

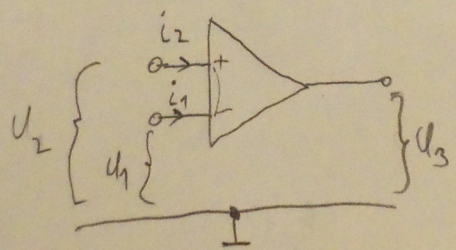
$$sL_N = \frac{sL}{R_0} \qquad sL = sL_N \cdot R_0$$

$$\frac{1}{sC_N} = \frac{1}{sCR_0} \qquad sC = \frac{sC_N}{R_0}$$

b) FREKVENCIJE

$$s_N = \frac{s}{\omega_0}$$

OP. AMP



$$(U_2 - U_1) = \frac{U_3}{A} \Big|_{A \to \infty} = 0$$

$$U_2 = U_1$$

$$i_2 = i_1 = 0$$

KIRCHHOFFOVI ZAKONI

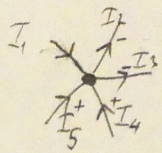
KZ - ZA STRUJE

KZ - ZA NAPONE

$\bar{c}-1$

$g-(\bar{c}-1)$ $g-\bar{c}+1$

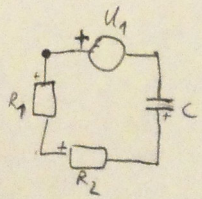
KZS



$I_1 - I_2 - I_3 + I_4 + I_5 = 0$

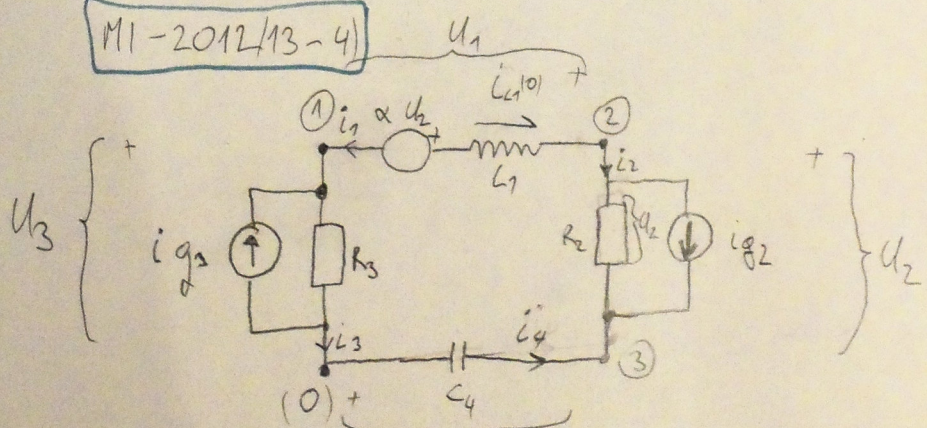
$\bar{c}-1$

KZN



$u_{R_1} + u_{R_2} + u_c - u_1 = 0$

M1-2012/13-4)



a) KZS i KZN

b) NAPONSKO-STRUJNE JEDNADŽBE ZA GRANJE

c) $u_{R_2}(s)$ i $u_{R_2}(t)$

d) $I_{R_3}(s)$ $i_{R_3}(t)$

a)

$\bar{c} = 4$

$g = 4$

$KZS \rightarrow \bar{c} - 1 = 3$

$KZN \rightarrow g - \bar{c} + 1 = 1$ } 4

1) $I_1 - I_3 = 0$

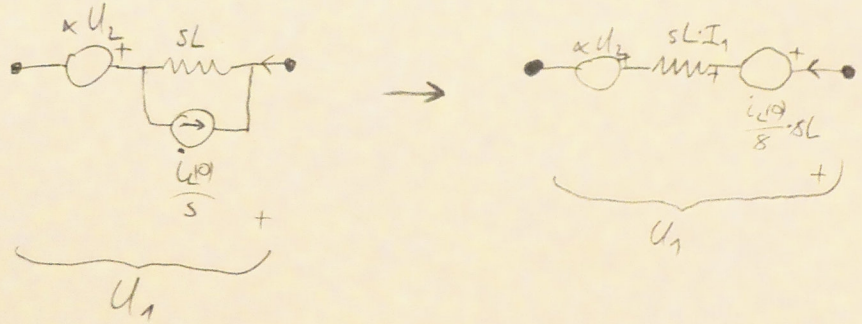
2) $I_1 + I_2 = 0$ } KZS

3) $I_2 + I_4 = 0$

4) $U_1 + U_3 + U_4 - U_2 = 0$ KZN

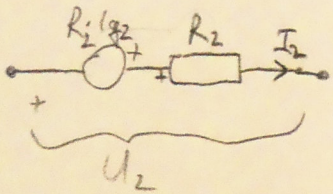
b)

1)



$U_1 = i_L(0) \cdot L + I_1 \cdot sL + \alpha U_2 = i_L(0) \cdot L + I_1 \, sL + \alpha \cdot (I_2 - I_{g2}) \cdot R_2$

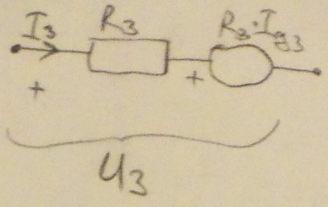
2)



$U_2 = I_2 \cdot R_2 - R_2 \cdot I_{g2}$

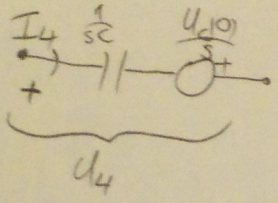
MI 2012/13 - 4)

3)



$$U_3 = I_3 \cdot R_3 + R_3 \cdot I_{g3}$$

4)



$$U_4 = I_4 \frac{1}{sC} - \frac{U_{C0}}{s}$$

c)

$$I_1 = -I_2 = I_3 = I_4$$

$$U_1 - U_2 + U_3 + U_4 = 0$$

$$U_1 = s \cdot 1 \cdot I_1 + 1 + 2 \cdot \left(-I_1 - \frac{1}{s}\right) \cdot 1$$

$$U_2 = \left(-I_1 - \frac{1}{s}\right) \cdot 1$$

$$U_3 = \left(I_1 + \frac{1}{s}\right) \cdot 2$$

$$U_4 = \frac{1}{s \cdot \frac{1}{2}} \cdot I_1 - \frac{2}{s}$$

$$sI_1 + 1 - 2I_1 - \frac{2}{s} + I_1 + \frac{1}{s} + 2I_1 + \frac{1}{s} + \frac{2}{s} I_1 - \frac{2}{s} = 0$$

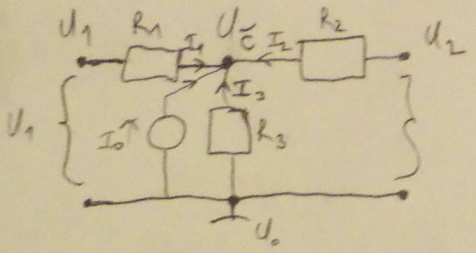
$$\left(s - 2 + 1 + 2 + \frac{2}{s}\right) I_1 = \frac{1}{s} - 1 \quad | \cdot s$$

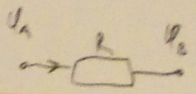
$$(s^2 + s + 2) I_1 = 1 - s$$

$$I_1 = \frac{1 - s}{s^2 + s + 2}$$

⋮

METODA NAPONA ČVOROVA





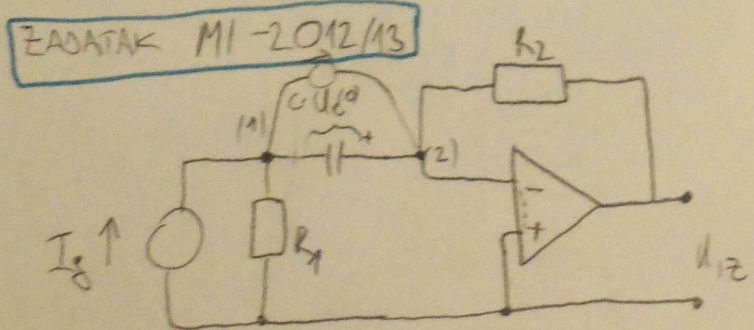
$$I = \frac{U_A - U_B}{R}$$

$$I_0 + I_1 + I_2 + I_3 = 0$$

$$I_0 + \frac{U_1 - U_{\check{C}}}{R_1} + \frac{U_2 - U_{\check{C}}}{R_2} + \frac{U_0 - U_{\check{C}}}{R_3} = 0$$

$$U_{\check{C}}\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) - U_1\left(\frac{1}{R_1}\right) - U_2\left(\frac{1}{R_2}\right) - U_0\left(\frac{1}{R_3}\right) = I_0$$

ZADATAK MI -2012/13

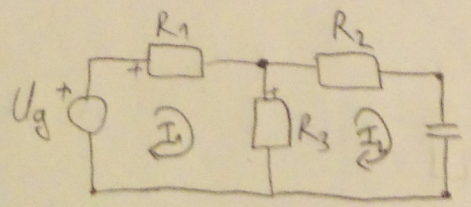


(1) $U_1\left(\frac{1}{R_1} + sC\right) - U_2(sC) = I_g - C \cdot u_C(0)$

(2) $U_2\left(sC + \frac{1}{R_2}\right) - U_1(sC) - U_{12}\left(\frac{1}{R_2}\right) = C\,u_C(0)$

$(U_2 = 0)$

METODA KONTURNIH PETLJI



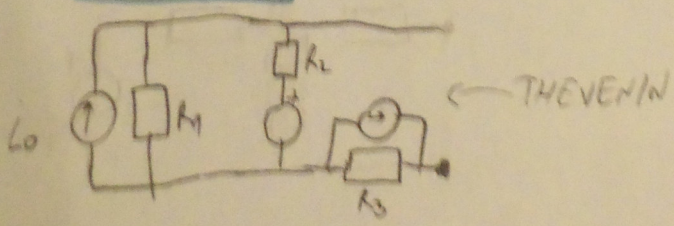
(1) $-U_g + I_1 \cdot R_1 + (I_1 - I_2) \cdot R_3 = 0$

(2) $I_2 \cdot R_2 + I_2 \frac{1}{sC} - (I_1 - I_2) \cdot R_3 = 0$

THEVENIN

a)

MI-2003-1)

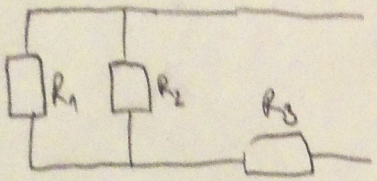


THEVENINOV UPOR – UGASIŠ NEZAVISNE IZVORE

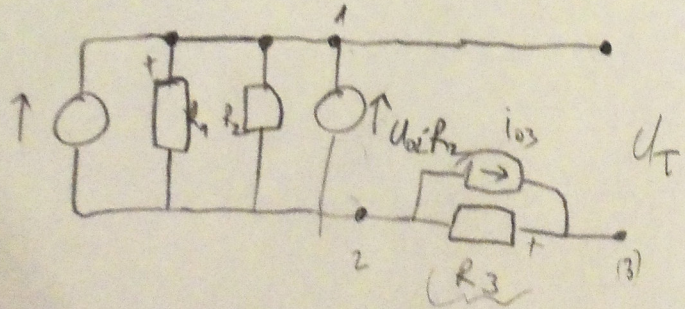
I IZRAČUNAŠ EKVIVALENTNI UPOR

THEVENINOV NAPON – NA STEZALKAH ... IZRAČUNAŠ NAPON. OSTALO PRAKTIČNO

(MI 2005-1)

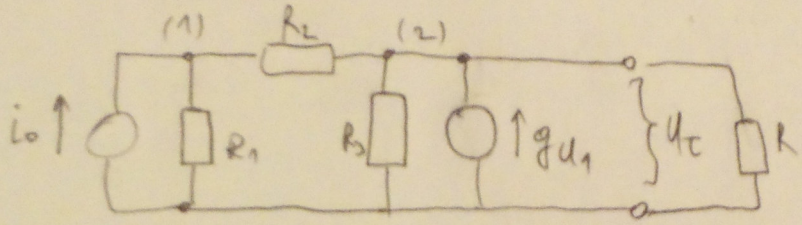


$$R_T = R_3 + R_1 // R_2$$



$$U_T = (i_o + R_2 U_{oz}) \cdot \left(\frac{R_1 \cdot R_2}{R_1 + R_2} \right) - I_{o3} \cdot R_3$$

M1 2012/2013 -2)



$i_0 = 2A$

$R_1 = 1\,\Omega$

$R_2 = \frac{1}{2}\,\Omega$

$R_3 = \frac{1}{3}\,\Omega$

a) u_T

(1) $u_1\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - u_2\left(\frac{1}{R_2}\right) = i_0$

(2) $u_2\left(\frac{1}{R_2}+\frac{1}{R_3}\right) - u_1\left(\frac{1}{R_2}\right) = g \cdot u_1$

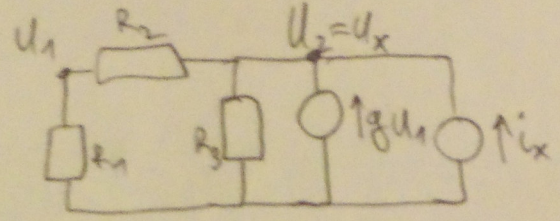
$u_2(2+3) = (g+2)\,u_1 \qquad u_2 = \frac{g+2}{5}u_1 \qquad u_1 = \frac{5}{g-2}\cdot u_2$

$u_1(1+2) - u_2(2) = 2$

$\frac{15}{g+2}u_2 - 2u_2 = 2 \qquad u_2\left(\frac{15-2g-4}{g+2}\right) = 2$

$u_2 = \frac{2g+4}{11-2g} = u_T$

b)



(1) $U_1\left(\frac{1}{R_1}+\frac{1}{R_2}\right) - U_2\left(\frac{1}{R_2}\right) = 0$

(2) $U_2\left(\frac{1}{R_2}+\frac{1}{R_3}\right) - U_1\left(\frac{1}{R_2}\right) = gU_1 + i_x$

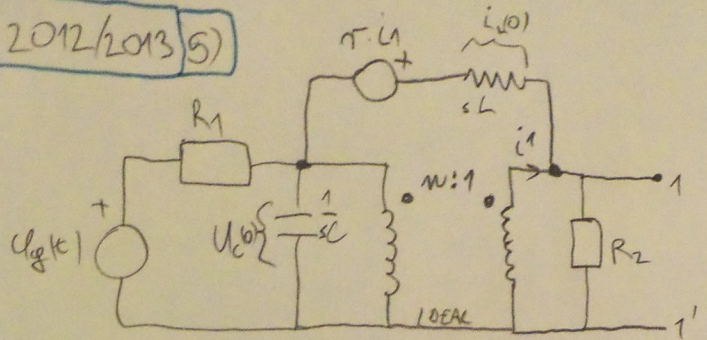
$3 \cdot U_1 = 2U_2 \qquad U_1 = \frac{2}{3}U_2$

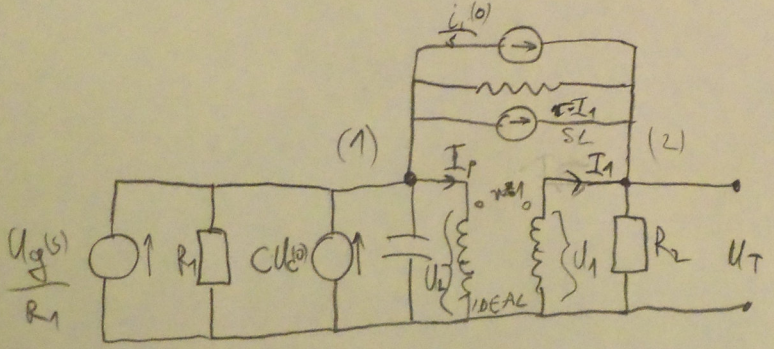
$U_2 \cdot 5 - U_1(2+g) = i_x$

$U_2 5 - \frac{2}{3}(2+g)U_2 = i_x$

$U_2\left(\frac{11-2g}{3}\right) = i_x \qquad \frac{U_2}{i_x} = R_T = \frac{3}{11-2g}$

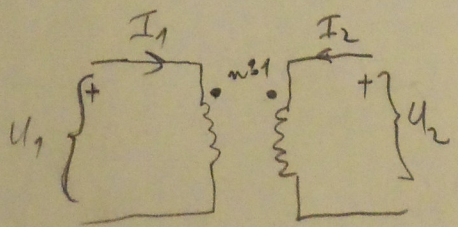
M1 2012/2013 5)





(1) $$U_1\left(sC+\frac{1}{R_1}+\frac{1}{sL}\right)-U_2\left(\frac{1}{sL}\right)=\frac{U_g(0)}{R_1}+CU_c(0)+\frac{r\cdot I_s}{sL}-I_p$$

(2) $$U_2\left(\frac{1}{sL}+\frac{1}{R_2}\right)-U_1\left(\frac{1}{sL}\right)=\frac{-rI_s}{sL}+\frac{i_1(0)}{s}+I_s$$



$$U_1=+wU_2$$

$$I_1=-\frac{1}{w}I_2$$

(3) $U_1=w\cdot U_2$

(4) $I_p=\frac{1}{w}I_s$