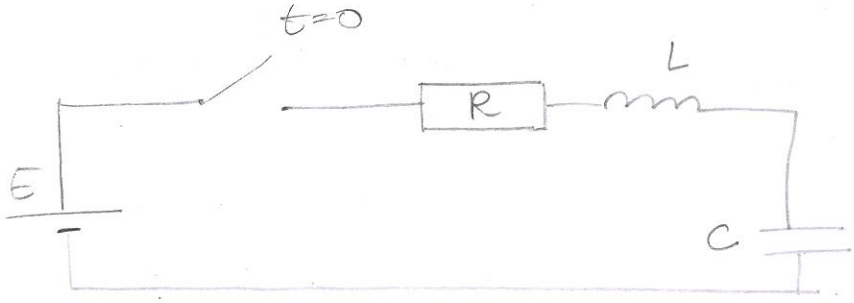
24.10.2011. god.

3- kompletna frekvencija

by queen ♛

MASS 12 EK



$$U_k(t) = R \cdot I_k(t)$$

$$U_L(t) = L \cdot \frac{dI}{dt}$$

$$U_C(t) = \frac{1}{C} \int_0^t i(t) \cdot dt$$

$$E = U_k + U_L + U_C = R \cdot i(t) + L \cdot \frac{di}{dt} + \frac{1}{C} \int_0^t i(t)\,dt$$

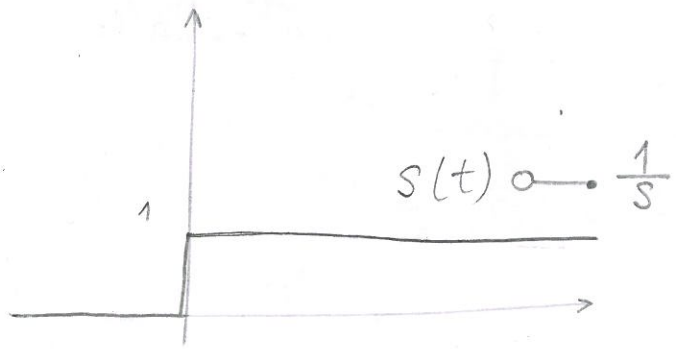
$$U_k(t) \circ\!\!-\!\!\bullet\; U(s) = R\,I(s)$$

$$U_L(t) \circ\!\!-\!\!\bullet\; U(s) = sL \cdot I(s)$$

$$U_C(t) \circ\!\!-\!\!\bullet\; U(s) = \frac{1}{sC}\, I(s)$$

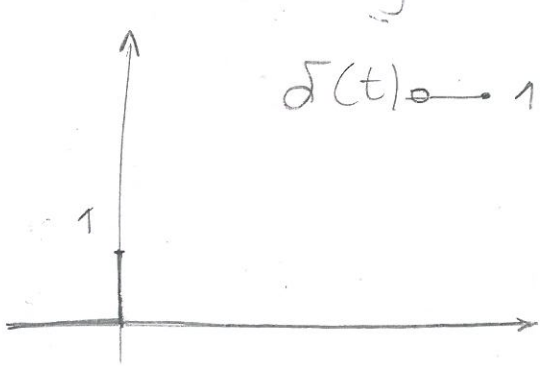
$$E(s) = R\,I(s) + sL \cdot I(s) + \frac{1}{sC} \cdot I(s)$$

STEP F-JA



$$s(t) \circ\!\!-\!\!\bullet\; \frac{1}{s}$$

DIRACHIOVA F-JA



$$\delta(t) \circ\!\!-\!\!\bullet\; 1$$

$$e^{-at} \cdot s(t) \circ\!\!-\!\!\bullet\; \frac{1}{s+a}$$

$$\sin \omega t \cdot s(t) \circ\!\!-\!\!\bullet\; \frac{\omega}{s^2+\omega^2}$$

$$\cos \omega t \cdot s(t) \circ\!\!-\!\!\bullet\; \frac{s}{s^2+\omega^2}$$

$$U_c(s) = \frac{s}{s^2+7s+12}$$ (po tablici transformacije)

$s^2+7s+12=0$

$$s_{1,2} = \frac{-7 \pm \sqrt{49-48}}{2}$$

$s_1 = -3$

$s_2 = -4$

$-3s-12+4s+12 = s$

$$\frac{s}{s^2+7s+12} = \frac{A}{s+3} + \frac{B}{s+4} = \frac{As+4A+Bs+3B}{(s+3)(s+4)}$$

$A+B=1 \quad A=1-B$

$4A+3B=0$

$4-4B+3B=0$

$B=4 \Rightarrow A=-3$

$$U_s(s) \multimap u_c(t) = [Ae^{-3t} + Be^{-4t}]s(t)$$

* ne realna rj:

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

$s^2+2s+2=0$

$$s_{1,2} = \frac{-2 \pm \sqrt{4-8}}{2} = -1 \pm j1$$

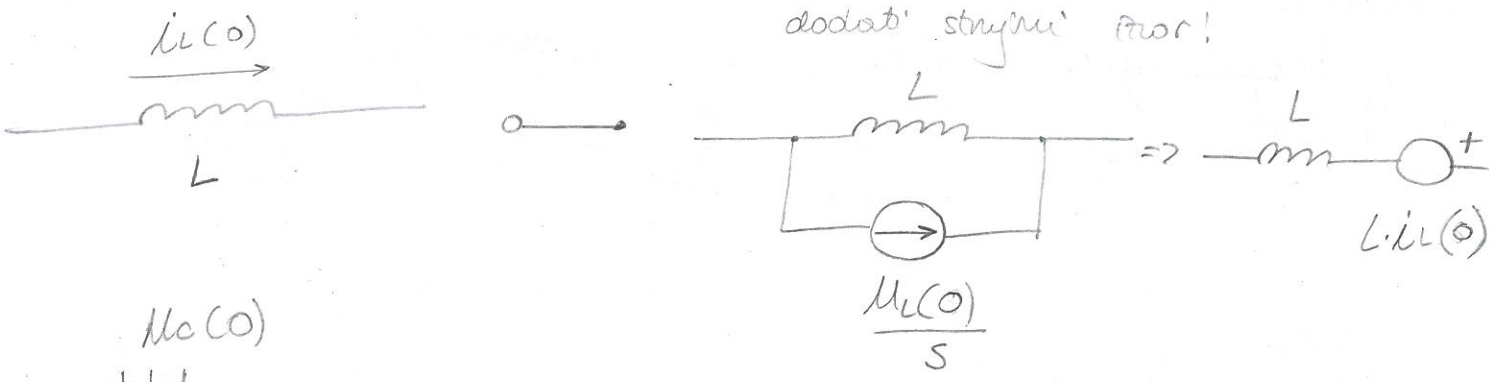
$$= \frac{2(s+1)}{(s+1)^2+1^2} - \frac{2}{(s+1)^2+1^2}$$

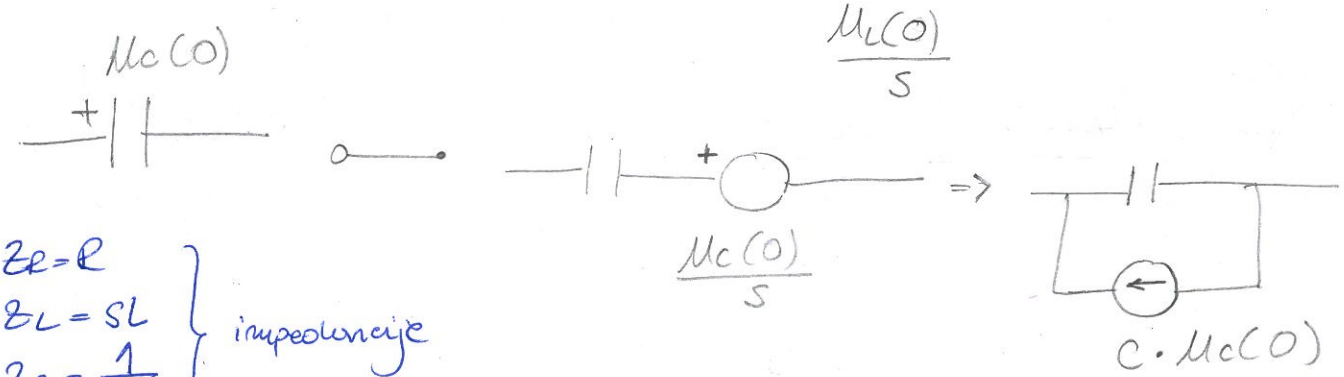
$\multimap [2\cos 1 \cdot t \cdot e^{-t} - 2\sin(1 \cdot t) \cdot e^{-t}] \cdot s(t)$

RJ. MREŽA SA VIŠE IZVORA

* naponi izvora
* struje u petlji

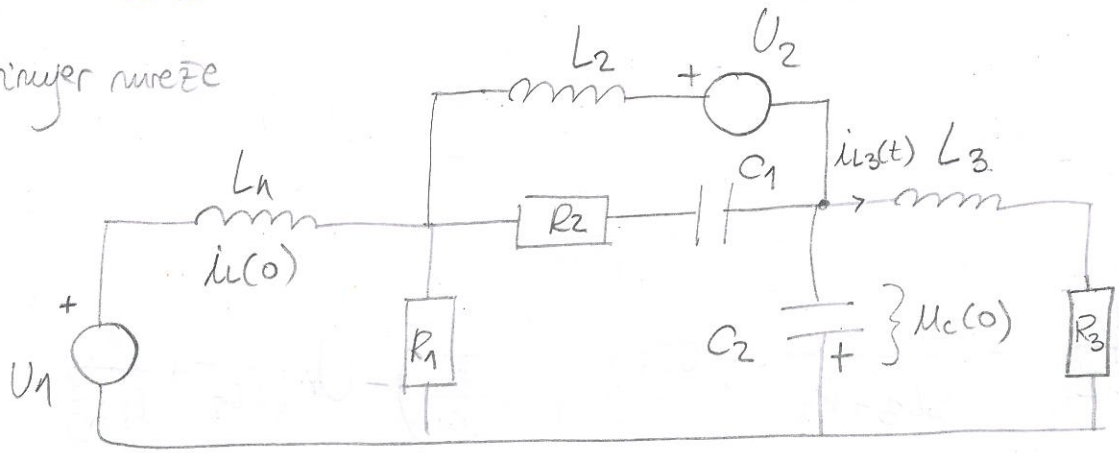
POČETNI UVJET (bilo energija!)





$Z_R = R$
$Z_L = sL$
$Z_C = \frac{1}{sC}$
} impedancije

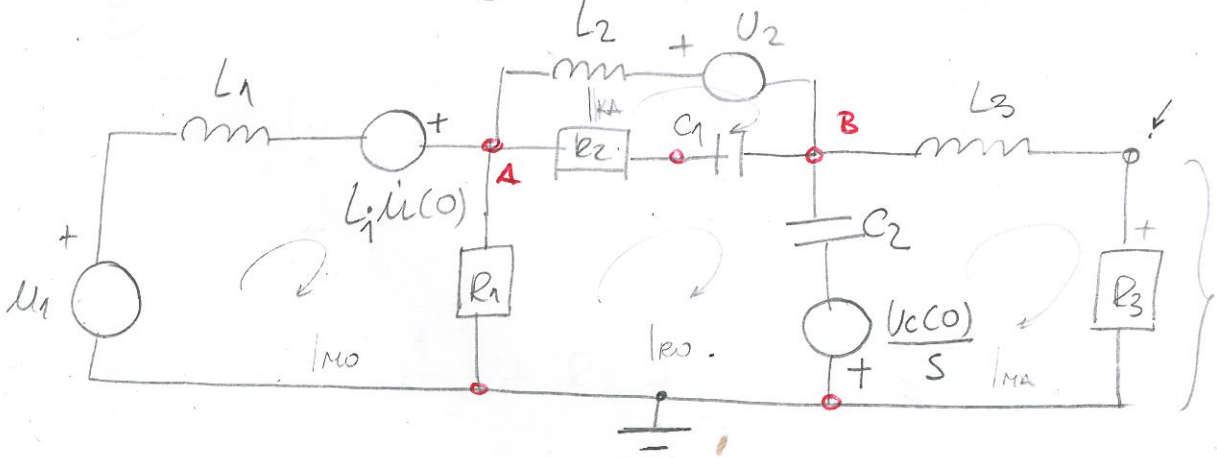
Primjer mreže



$i_{L3}(t) = ?$

- bezdimenzionirani iznosi
- normirane elemente

prebaciti u frekvencijsku domenu => POČETNI UVJETI



1. K. zak.
Superp.
nap. izv. POTENCIJALI ČVOROVA
struja zak.
struja petlji
U_{R3}

8 GRANA - 8 elemenata

4 TEMELJNE PETLJE - 4 STEZE

$I_{R1} = I_{N0} - I_{R0}$

$I_{R3} =$ [illegible]

[illegible] $I_{R2} = I_{R0} - I_{KA}$

NAPONSKI IZVOR — za naponske izvore

OTPOR U GRANI — za strujne izvore

(A) U_A - potencijal TOČKE A

U_L - NAPON NA INDUKTIVITETU

- GRANE OKO ČVORA

1. suma vodljivosti dotičnih grana — 2. oduzmi susjedni!

$$U_A\cdot\left(\frac{1}{sL_1}+\frac{1}{R_1}+\frac{1}{R_2+\frac{1}{sC_1}}+\frac{1}{sL_2}\right)-U_B\left(\frac{1}{sL_2}+\frac{1}{R_2+\frac{1}{sC_1}}\right)=$$

vodljivost

susjedni čvorovi negativni!

= izvorima!

$$=\frac{u_1+L_1\cdot i_{L1}(0)}{sL_1}+\frac{U_2}{sL_2}$$

+ jer ⊕ gledamo prema čvoru!

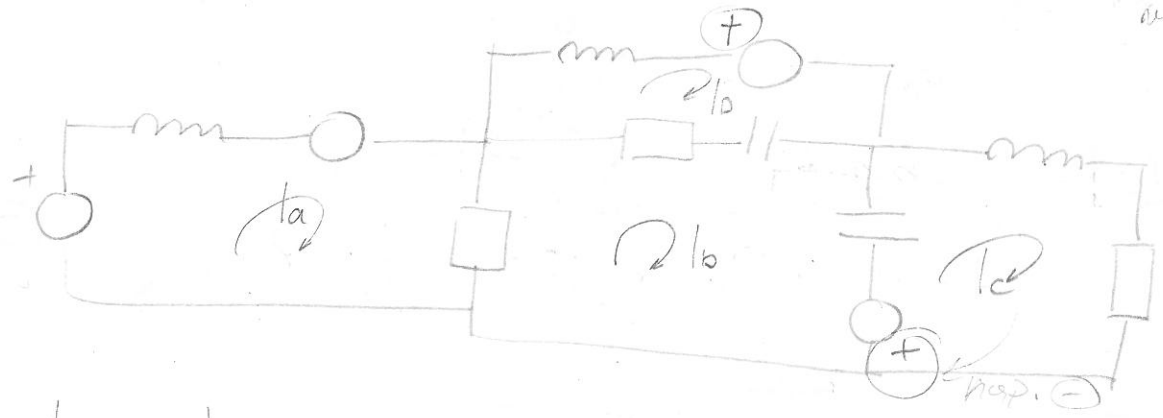
(B)

$$U_B\left(\frac{1}{sL_2}+\frac{1}{sL_3+R_3}+sC_2+\frac{1}{R_2+\frac{1}{sC_1}}\right)-U_A\left(\frac{1}{sL_2}+\frac{1}{R_2+\frac{1}{sC_1}}\right)$$

$$=-\frac{U_2}{sL_2}-\frac{\frac{U_C(0)}{s}}{\frac{1}{sC_2}}\cdot \quad \leftarrow C_2U_C(0)$$

Rj. pomoću STRUJA PETLJI

I_D ulazi u čvor = − minus s dr. str.



$I_{R1} = I_A - I_B$

$I_{R3} = I_C$

I_a, I_b, I_c, I_d – imaginarne struje!

(A) PETLJE s kojima se str. dvodiruje i na kojim elem.

$$I_A(sL_1 + R_1) - I_b R_1 = U_1 + L_1 i_1(0)$$

Prorium

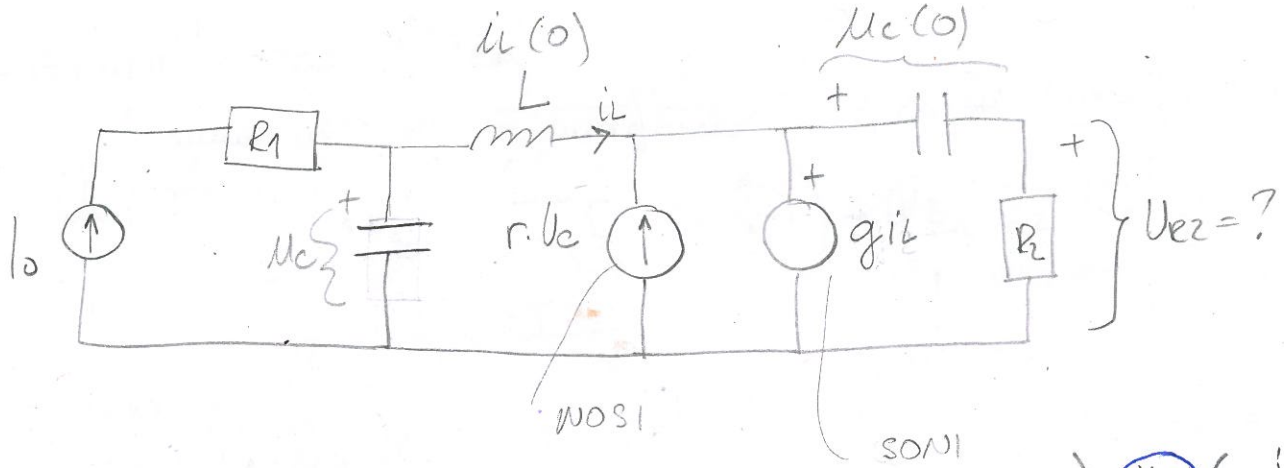
(B)
$$I_b\left(R_1 + R_2 + \frac{1}{sC_1} + \frac{1}{sC_2}\right) - I_A R_1 - I_D\left(R_2 + \frac{1}{sC_1}\right)$$

$$- I_c \frac{1}{sC_2} = + \frac{U_c(0)}{s}$$

(C)
$$I_c\left(\frac{1}{sC_2} + sL_3 + R_3\right) - I_b \frac{1}{sC_2} = - \frac{U_c(0)}{s}$$

(D)
$$I_D\left(\frac{1}{sC_2} + R_2 + \frac{1}{sC_1}\right) - I_B\left(R_2 + \frac{1}{sC_1}\right) = - U_2$$

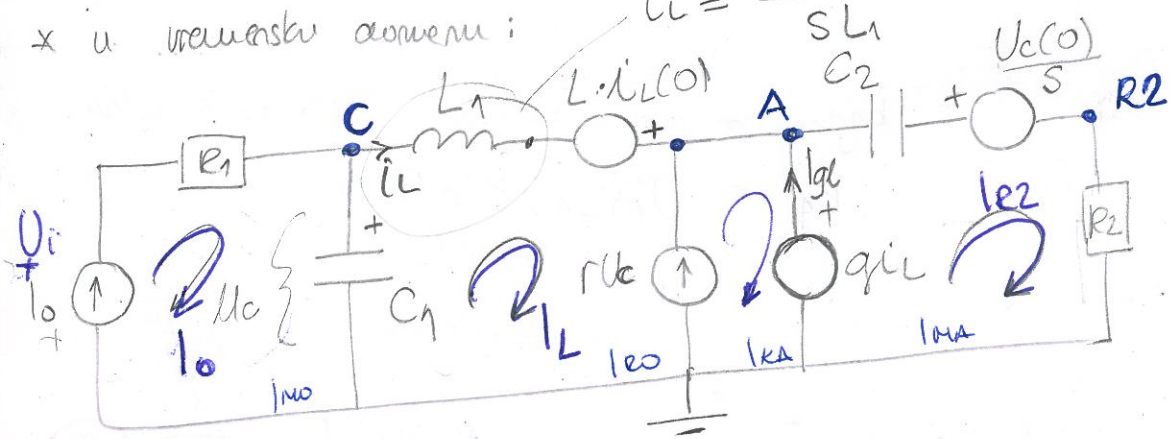
UVOĐENJE ZANJENSKIH IZVORA - mijenja se mreža

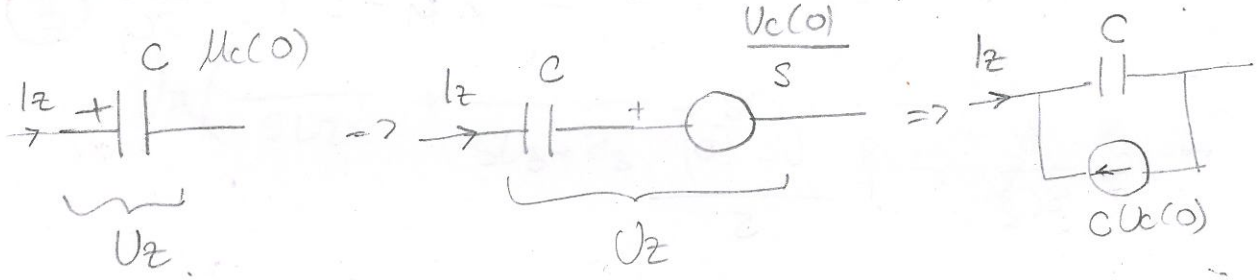


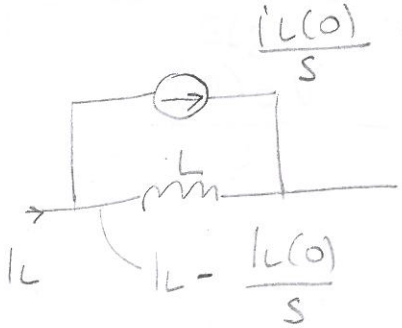
x u vremenskoj domeni:

$$i_L = \frac{U_c - (U_A - L \cdot i_L(0))}{SL_1} = \frac{U_c + (g \cdot i_L - L \cdot i_L(0))}{SL_1}$$

(izraziti!)







(A) $U_A = g \cdot I_L$

ono što je u seriji sa ⊖ izvorom NE PIŠEMO U JEDNADŽBI!!!

(C) $U_c\left(\frac{1}{R_1} + sC_1 + \frac{1}{sL_1}\right) - U_A \frac{1}{sL_1} = -\frac{i_L(0)}{s} + I_0$

izvorima!

(R2) $U_{R2}\left(\frac{1}{R_2} + sC_2\right) - U_A \cdot sC_2 = -C_2 U_c(0)$

(A) $U_A\left(\frac{1}{sL_1} + sC_2\right) - U_c \cdot \frac{1}{sL_1} - U_{R2} \cdot sC_2 = \frac{i_L(0)}{s} + C_2 U_c(0) + r \cdot U_c + I_{gl}$

NAPON ⊖ izvora ovdje 0 umjesto!

Imaginarne struje! I_0, I_L, I_{R2}

(L) $I_L\left(\frac{1}{sC_1} + sL_1\right) - I_0 \frac{1}{sC_1} = L_1 i_L(0) - g \cdot I_L$

izvorima!

kroz koje otpore teče?!

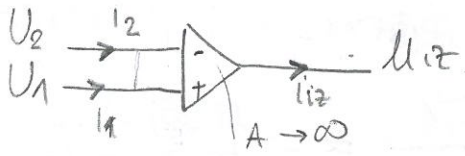
napon na strujnom izvoru!

(0) $I_0\left(R_1 + \frac{1}{sC_1}\right) - I_L \cdot \frac{1}{sC_1} = -U_t$

(R2) $I_{R2}\left(\frac{1}{sC_2} + R_2\right) = -\frac{U_c(0)}{s} + g \cdot I_L$

$$U_{R2} = I_{R2} \cdot R_2$$

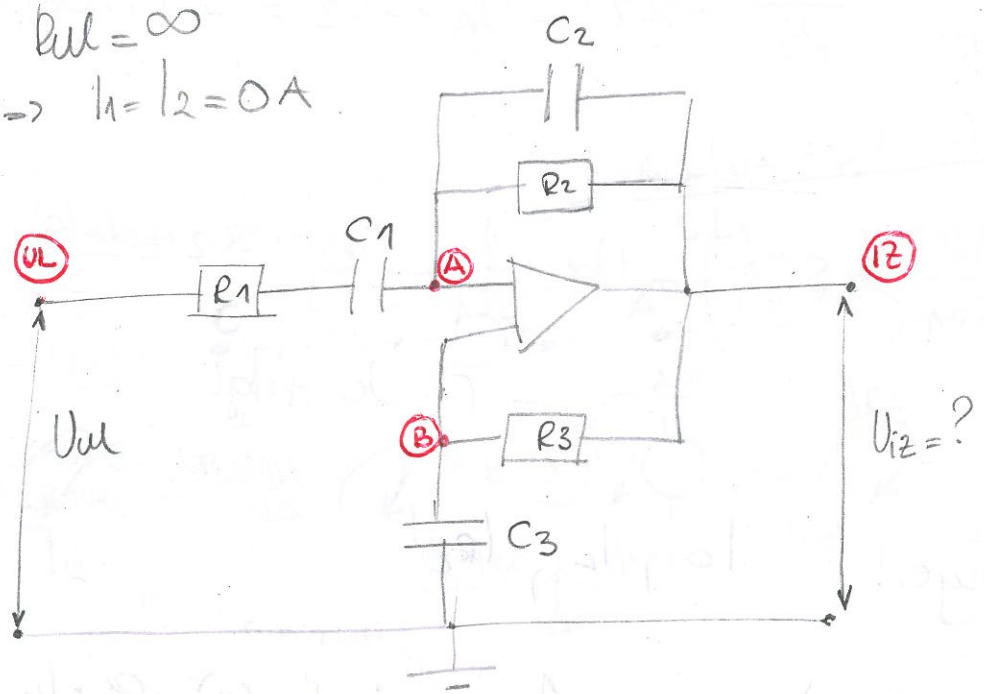
POJAČALO



$U_{iz} = A \cdot (U_1 - U_2) \Rightarrow U_1 = U_2$ IDEALNO POJAČALO

$R_{ul} = \infty$

$\rightarrow I_1 = I_2 = 0A$



(A) $U_A\left(\frac{1}{R_1 + \frac{1}{sC_1}} + \frac{1}{R_2} + sC_2\right) - U_{ul} \cdot \frac{1}{R_1 + \frac{1}{sC_1}} - U_{iz}\left(\frac{1}{R_2} + sC_2\right) = 0$

(B) $U_B\left(\frac{1}{R_3} + sC_3\right) - U_{iz}\left(\frac{1}{R_3}\right) = 0$

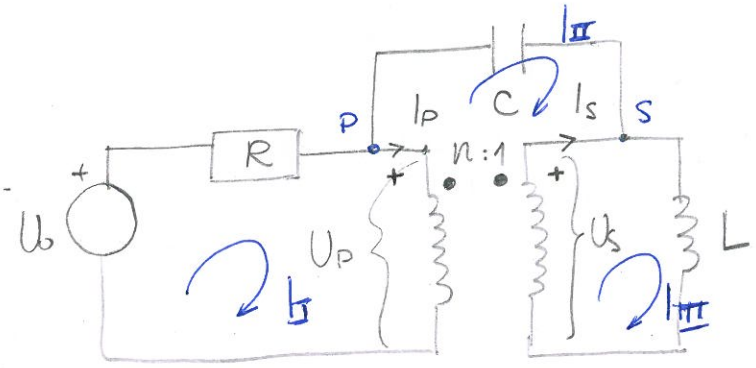
(P) : $\boxed{U_A = U_B}$

TRANSFORMATOR

$t_1: U_p = n \cdot U_s$

$t_2: I_p = \frac{1}{n} I_s$

n – prijenosni omjer (omjer br. zavoja)



4 jedn. s 4 nepozn.

Ⓟ $U_p\left(\frac{1}{R} + sC\right) - U_s \cdot sC = \frac{U_0}{R_1} - I_p$

Ⓢ $U_s\left(\frac{1}{sL} + sC\right) - U_p \cdot sC = I_s$

ALGORITAM (za transformator) GLEDATI STRUJE PRIMARA I SEKUNDARA !!!

POMOĆU PETLJI I_I, I_{II}, I_{III}

I $I_I R = U_0 - U_p$

II $I_{II} \cdot \frac{1}{sC} = U_p - U_s$

III $I_{III} \cdot sL = U_s$

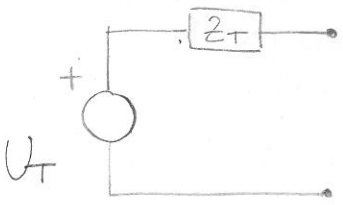
$I_p = I_I - I_{II}$

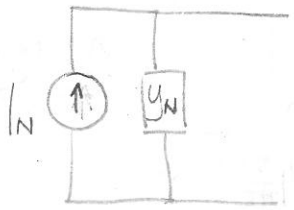
$I_s = I_{III} - I_{II}$

$I_I - I_{II} = \frac{1}{n}\left(I_{III} - I_{II}\right)$

TEOREM NADOMJESNOG IZVORA

THEVENIN I NORTON



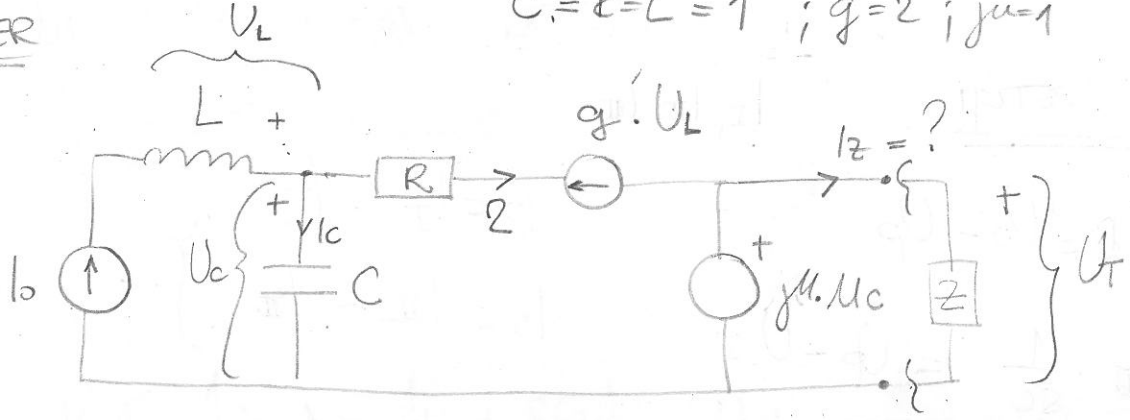


$$Z_T = Z_N = \frac{1}{Y_N}$$

$$E_T = Z_T \cdot I_N = \frac{I_N}{Y_N}$$

PRIMJER

$C = \ell = L = 1 \; ; g = 2 \; ; \mu = 1$



2.

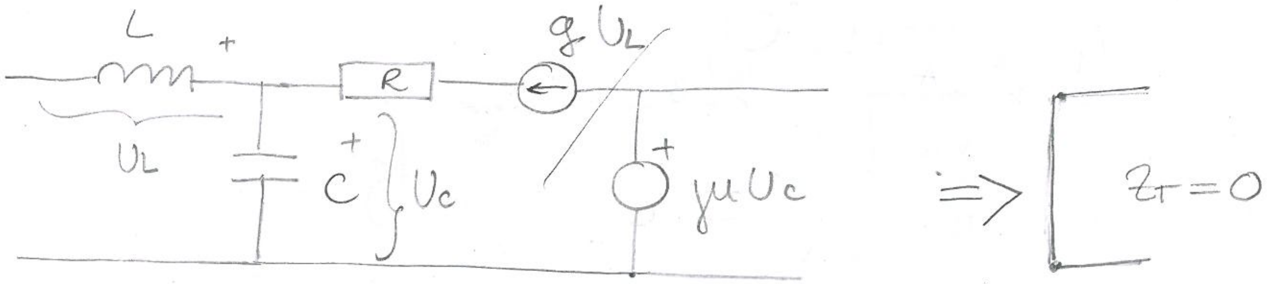
$$U_L = -I_0 \cdot sL = \frac{-1}{s} \cdot s = -1$$

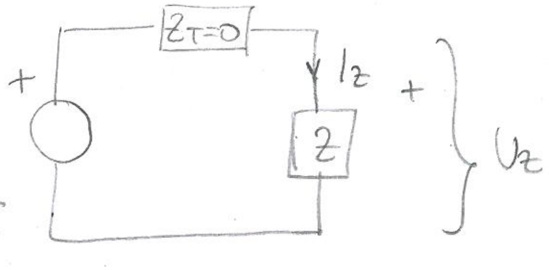
$$I_0 = I_C + 2 = \frac{1}{s} - 2$$

$$U_C = I_C \cdot \frac{1}{sC} = \frac{1}{s}\left[\frac{1}{s} - 2\right] = \frac{1}{s^2} - \frac{2}{s}$$

$$U_T = \mu U_C = 1 \cdot \left[\frac{1}{s^2} - \frac{2}{s}\right] = \frac{1}{s^2} - \frac{2}{s}$$

* nadomjesna mreža



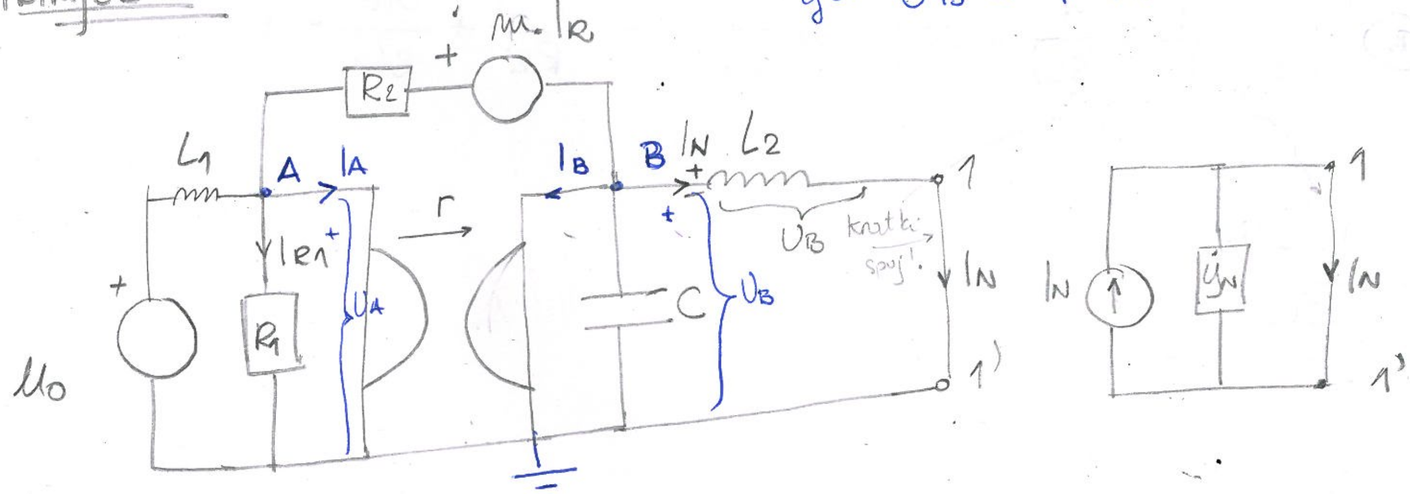


$U_T = \frac{1}{s^2} - \frac{2}{s}$

GIRATOR: g1: $U_A = r \cdot I_B$

g2: $U_B = -r \cdot I_A$

PRIMJER 2



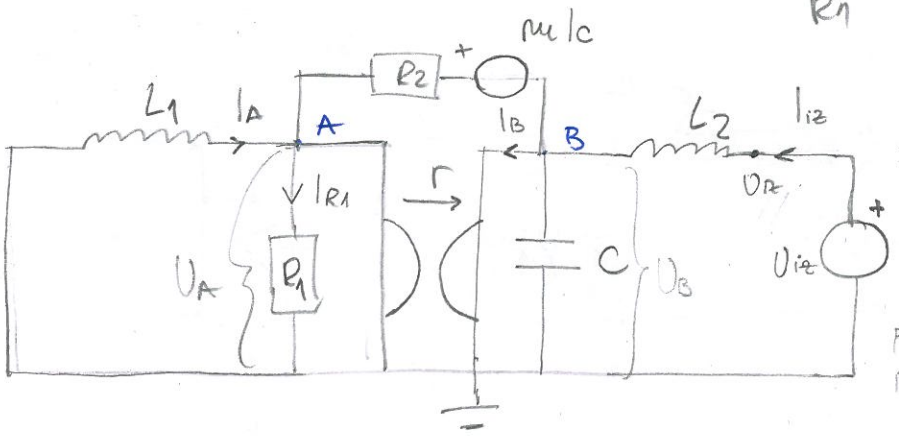
(A) $U_A\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{sL_1}\right) - U_B\frac{1}{R_2} = \frac{U_0}{sL_1} + \frac{m I_R}{R_2} - I_A$

(B) $U_B\left(\frac{1}{sL_2} + sC + \frac{1}{R_2}\right) - U_A\frac{1}{R_2} = -\frac{m I_R}{R_2} - I_B$

$I_N = \frac{U_B}{sL_2}$

* nadomjesna mreža

$$I_{R1} = \frac{U_A}{R_1}$$



$$Y_N = \frac{I_{iz}}{U_{iz}} = \frac{U \cdot [?]}{U_{iz}}$$

(A) $$U_A\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{sL_1}\right) - U_B\left(\frac{1}{R_2}\right) = \frac{mI_c}{R_2} - I_A$$

(B) $$U_B\left(\frac{1}{R_2} + \frac{1}{sL_2} + sC\right) - U_A\frac{1}{R_2} = -\frac{mI_c}{R_2} + \frac{U_{iz}}{sL_2} - I_B$$

$$I_{iz} = \frac{U_{iz} - U_B}{sL_2}$$