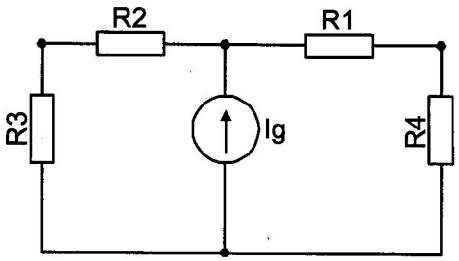
DIGITALNA TEHNIKA I

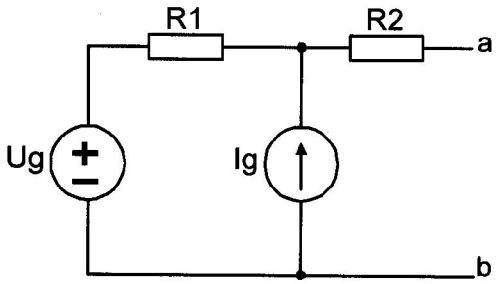
VSŠ

1.kolokvij 7. 12. 2007

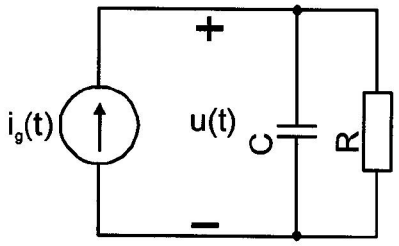
1. Izračunajte napetosti v vozliščih vezja.
   Upoštevajte: $I_g=1A$ $R_1=1\Omega$ $R_2=2\Omega$ $R_3=3\Omega$ $R_4=4\Omega$



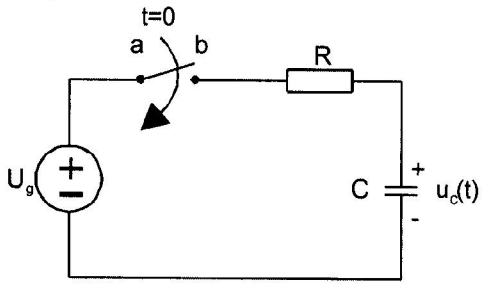
2. Izračunajte parametre Theveninovega nadomestnega vezja za spodnji neidealni generator.
   Upoštevajte: $I_g=5A$ $U_g=5V$ $R_1=1\Omega$ $R_2=2\Omega$



3. Izračunajte napetost $u(t)$ v vezju na sliki.
   Upoštevajte: $C=1\mu F$ $R=10\Omega$ $i_g(t)=1A\cos(\omega t)$ $\omega=10^5 rd/s$

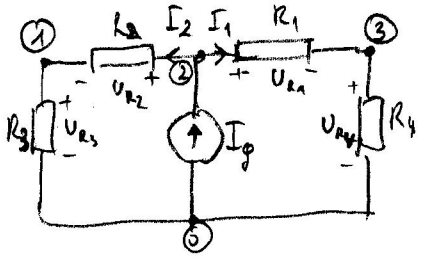


4. V trenutku $t=0$ sklenemo stikalo. Izračunajte napetost $u_C(t)$ na kondenzatorju C z uporabo Laplaceove transformacije. Začetna napetost $u_C(t)$ na kondenzatorju je $u_C(0^+)=0V$!
   $C=1F$ $R=1\Omega$ $U_g=1V$



Čas pisanja je 60min. Vsaka naloga je vredna 10 točk. Na list z rešitvami se podpišite in napišite še vpisno številko ter kateri predmet pišete. Rezultati bodo objavljeni na https://estudent.fri.uni-lj.si

①



$U_{R3} = I_2 R_3$; $U_{R2} = I_2 R_2$

$U_{R1} = I_1 R_1$; $U_{R4} = I_1 R_4$

$U_{R3} = \frac{1}{2} \cdot 3 = \frac{3}{2} V$ $U_{R2} = \frac{1}{2} \cdot 2 = 1V$

$U_{R1} = \frac{1}{2} \cdot 1 = \frac{1}{2} V$ $U_{R4} = \frac{1}{2} \cdot 4 = 2V$

$U_1 = U_{R3} = \underline{1,5V}$; $U_3 = U_{R4} = \underline{2V}$

$U_2 = U_{R3} + U_{R2} = \underline{2,5V}$;

KTZ ②:

$$I_2 + I_1 = I_g \rightarrow I_g = \left(1 + \frac{I_2}{I_1}\right) I_1$$

KNZ:

$$U_{R3} + U_{R2} = U_{R4} + U_{R1}$$

$$(R_3 + R_2) I_2 = I_1 (R_1 + R_4)$$

$$\frac{I_2}{I_1} = \frac{R_1 + R_4}{R_2 + R_3} = \frac{1+4}{2+3} = \frac{5}{5} = \underline{1} \rightarrow I_2 = I_1$$

$$I_g = \left(1 + \frac{I_2}{I_1}\right) I_1 = (1+1) I_1 \Rightarrow I_1 = \frac{I_g}{2} = \frac{1}{2} A = I_2$$

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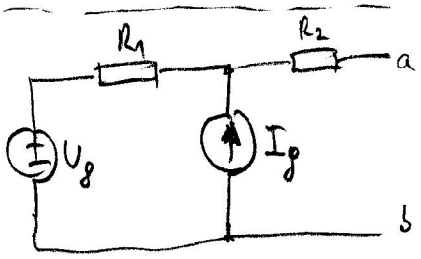
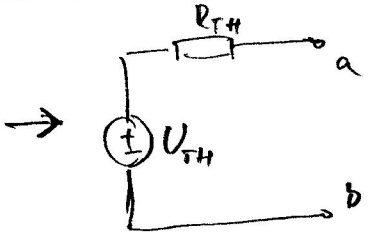
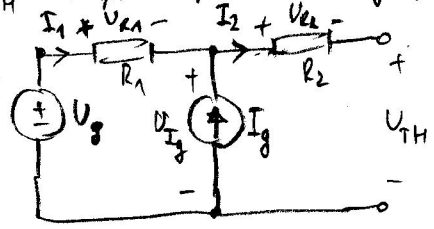
②





U_{TH} = odprte sponke torej pomeni da je $I_2 = 0$. Ker je $I_2 = 0$ je tudi $U_{R2} = I_2 R_2 = 0V$

Torej je U_{TH} enaka napetosti U_{Ig} (KNZ)

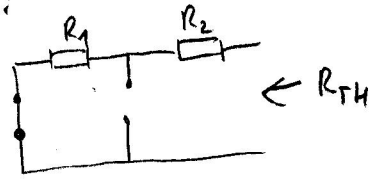


KTZ: $I_1 = -I_g$

KNZ: $U_{I_g} + U_{R1} = U_g = U_{I_g} + I_1 \cdot R_1 = U_{I_g} - I_g R_1$

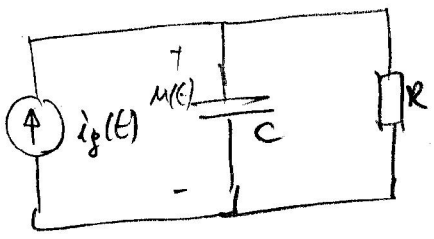
$$U_{I_g} = U_g + I_g R_1 = 5V + 5A \cdot 1\Omega = \underline{10V} = \underline{U_{TH}}$$

R_{TH}:



$R_{TH} = R_1 + R_2 = \underline{3\Omega}$

3)

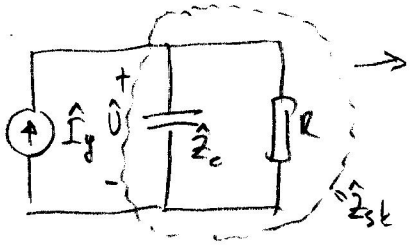


Transformiramo napajalni vir

$i_g(t) = 1A \cos(\omega t) \Rightarrow \hat{I}_g = 1A$

Izračunamo $\hat{Z}_c$

$$\hat{Z}_c = \frac{1}{j\omega C} = \frac{1}{j \cdot 10^5 \frac{1}{s} 10^{-6} \frac{As}{V}} = -j10\,\Omega$$



→ Izračunamo skupno impedanco

$$\hat{Z}_{sk} = \frac{\hat{Z}_c \cdot R}{\hat{Z}_c + R} = \frac{10 \cdot (-j10)}{10 - j10}\,\Omega = \frac{-10j}{1-j} = \frac{e^{-j90°}}{\sqrt{2}\,e^{-j45°}} \cdot 10$$

$$\hat{Z}_{sk} = \frac{10}{\sqrt{2}} e^{-j45°}\,\Omega = 7{,}07\, e^{-j45°}\,\Omega$$

$$\hat{U} = \hat{I}_g \cdot \hat{Z}_{sk} = 1A \cdot 7{,}07\, e^{-j45°}\,\Omega = \frac{10}{\sqrt{2}} e^{-j45°} V \rightarrow u(t) = \underline{7{,}07 \cos(10^5 t - 45°)\,V}$$

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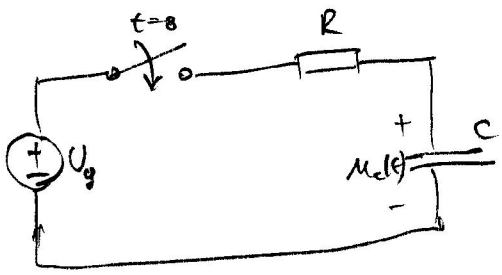
4)



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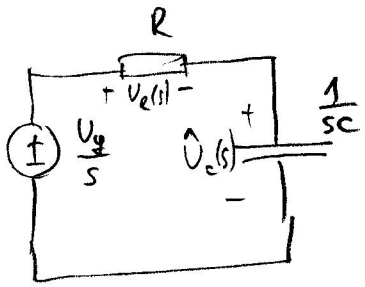
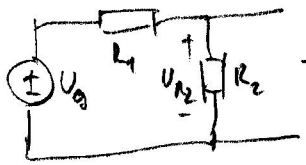


Napetostni delilnik:



$$\rightarrow U_{R_2} = U_g \frac{R_2}{R_1 + R_2} \dashrightarrow \hat{U}_c(s) = \frac{U_g}{s} \cdot \frac{\frac{1}{sC}}{\left(R + \frac{1}{sC}\right)}$$

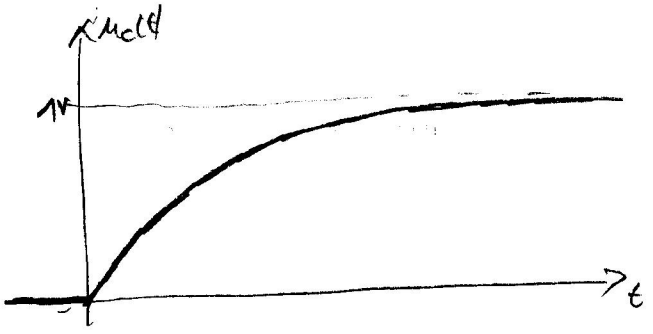
$$\hat{U}_c(s) = \frac{1}{s} \frac{\frac{1}{s}}{\left(1 + \frac{1}{s}\right)} = \frac{\frac{1}{s}}{s \cdot \frac{1}{s}(s+1)} = \frac{1}{s(1+s)}$$

$$U_c(s) = \frac{1}{s(1+s)} = \frac{A}{s} + \frac{B}{1+s} = \frac{1}{s} - \frac{1}{s+1}$$

↓ INV. LAPLACEOVA TRANSFORMACIJA

$$A = \lim_{s \to 0} \frac{1}{1+s} = 1$$

$$B = \lim_{s \to -1} \frac{1}{s} = -1$$



$$u_c(t) = 1(t) - e^{-t} \cdot 1(t) = \underline{(1 - e^{-t}) \cdot 1(t)\,V}$$