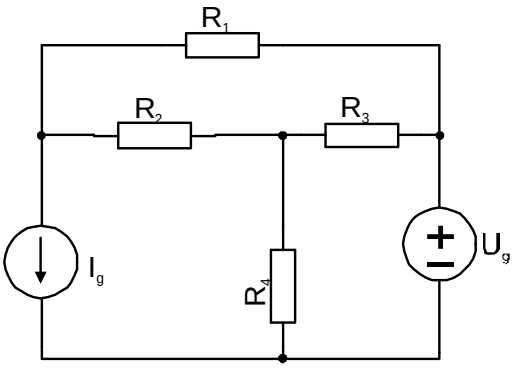
DIGITALNA TEHNIKA

1. kolokvij 22.04 2011

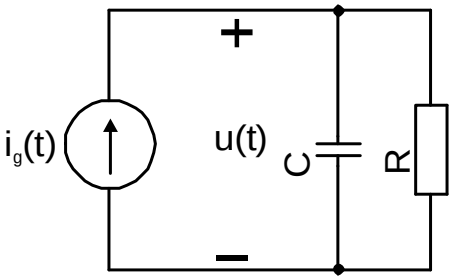
1. Z uporabo vozliščne metode izračunajte napetosti v vozliščih narisanega vezja. Upoštevajte:

$U_G=5V$
$I_g=5A$
$R_1=2\Omega$
$R_2=3\Omega$
$R_3=3\Omega$
$R_4=3\Omega$



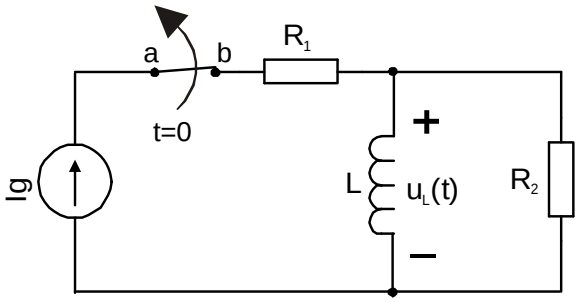
2. Vezje na sliki je vzbujano z izmeničnim generatorjem $i_g(t)=5A\ cos(10^2t+30°)$. Določite potek napetosti $u(t)$.

Upoštevajte: $C= 300\mu F$
$R= 25\Omega$

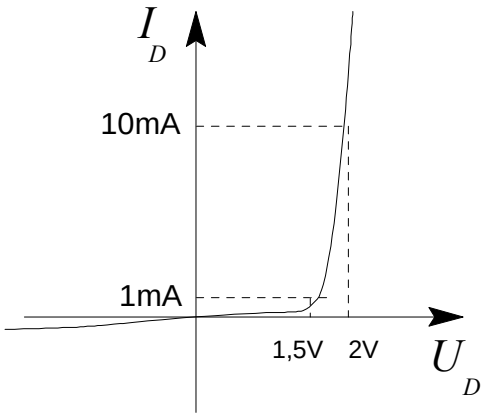


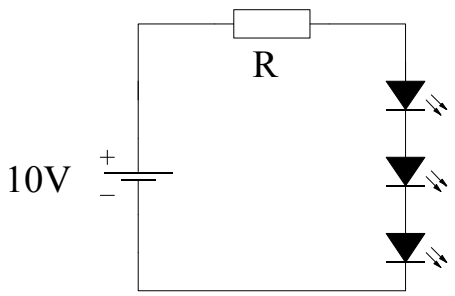
3. Stikalo je bilo dolgo časa *sklenjeno*. V trenutku *t=0 razklenemo* stikalo. Izračunajte napetost $u_L(t)$ na tuljavi L z uporabo Laplaceove transformacije.!

$L=1H$ $R_1=1\Omega$ $R_2=1\Omega$ $I_g=1A$



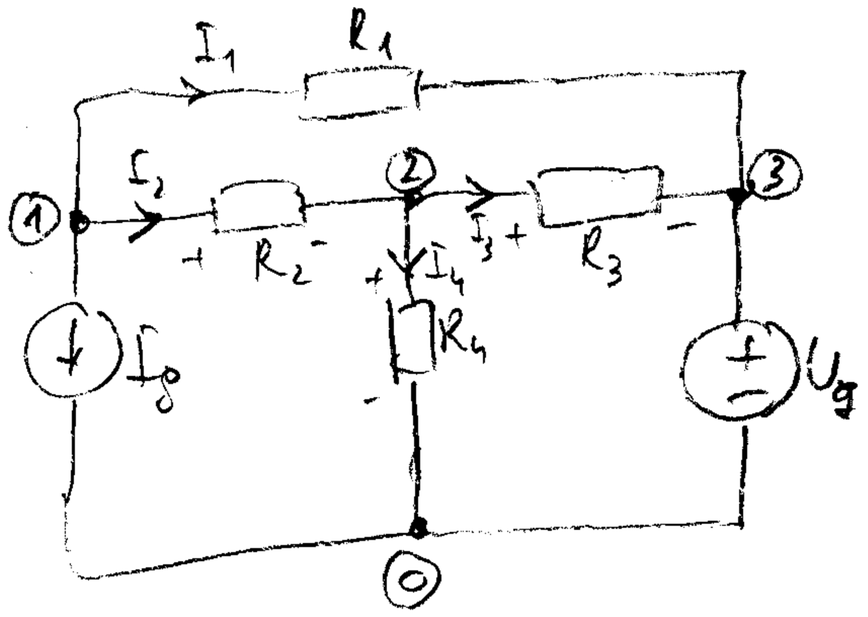
4. Izračunajte parametre nadomestnega modela svetleče LED diode za velike signale. Karakteristika diode je podana s spodnjim grafom. V podanih točkah naj se odsekoma linearna aproksimacija ujema z izmerjenimi vrednostmi. Določite velikost upora R, ki ga vežemo zaporedno s tremi svetlečimi diodami, da bo čez njih tekel tok *10 mA*.





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)



$U_3 = U_g$

KTZ ① $I_1 + I_2 + I_g = 0$

② $I_2 = I_3 + I_4$

$$\frac{V_1 - V_3}{R_1} + \frac{V_1 - V_2}{R_2} + I_g = 0$$

$$\frac{V_1 - V_2}{R_2} = \frac{V_2 - V_3}{R_3} + \frac{V_2}{R_4} \quad / \cdot R \qquad \Big| R_2 = R_3 = R_4$$

$$V_1 - V_2 = V_2 - V_3 + V_2$$

$$V_1 + V_3 = 3V_2 \Rightarrow V_2 = \frac{V_1 + U_g}{3} \doteq \underline{0.77\,V}$$

$$\frac{V_1 - 5}{2} + \frac{V_1 - \frac{V_1 + 5}{3}}{3} + 5 = 0$$

$$\frac{V_1}{2} + \frac{V_1}{3} - \frac{V_1}{9} = -5 + 2{,}5 + \frac{5}{9}$$

$$V_1 = -\underline{2{,}69\,V}$$

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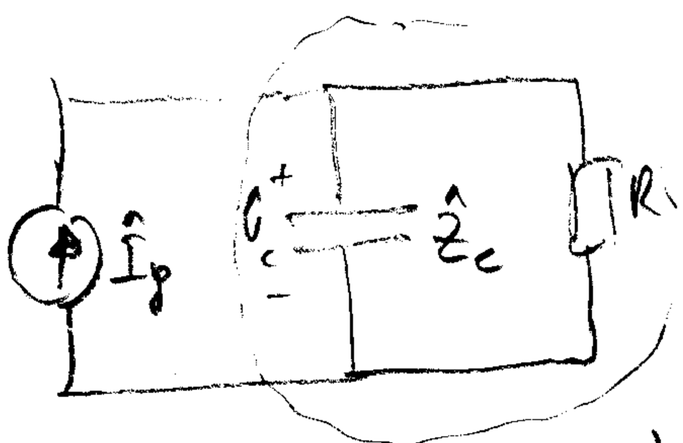
(2)



$u_C(t) = 100\,V \cos(10^3 t - 6{,}9°)$

$$\hat{Z}_c = \frac{1}{j\omega C} = \frac{1}{j \cdot 10^2\, 300 \cdot 10^{-6}} = \underline{-j33{,}3\,\Omega} \qquad \Big| \hat{I}_g = 5 \cdot e^{j30°}$$

$\underline{R = 25\,\Omega}$

$$\hat{Z} = R \,||\, \hat{Z}_c = \frac{-j33{,}3 \cdot 25}{25 - j33{,}3} = \frac{832{,}5\, e^{-j90°}}{41{,}64\, e^{-j53{,}1°}} \doteq 20\, e^{-j36{,}9°}\,\Omega$$

$$\hat{U}_c = 5 \cdot e^{j30°} \cdot 20 \cdot e^{-j36{,}9°} = 100\, e^{-j6{,}9°}\,V$$

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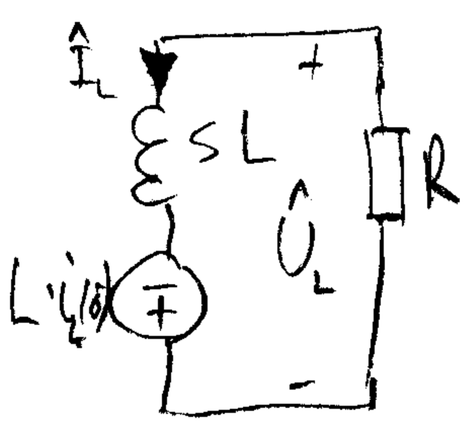
(3) $i_L(0^-) = I_g = 1A$



$u_L(t) = L \cdot \frac{di_L}{dt} \Rightarrow \hat{U}_L(s) = sL \cdot \hat{I}_L - L \cdot i_L(0^-) = -R \cdot \hat{I}_L$

$$\hat{I}_L = \frac{L \cdot i_L(0^-)}{R + sL} = \frac{1}{s+1} \Rightarrow i_L(t) = e^{-t} \cdot 1(t)\,A$$

$$\hat{U}_L = -R \cdot \hat{I}_L(s) = -\frac{1}{s+1} \Rightarrow u_L(t) = -\underline{e^{-t} \cdot 1(t)\,V}$$

$\underline{i_L(0^-) = 1A}$ ✓ ; $\underline{i_L(\infty) = 0A}$ ✓

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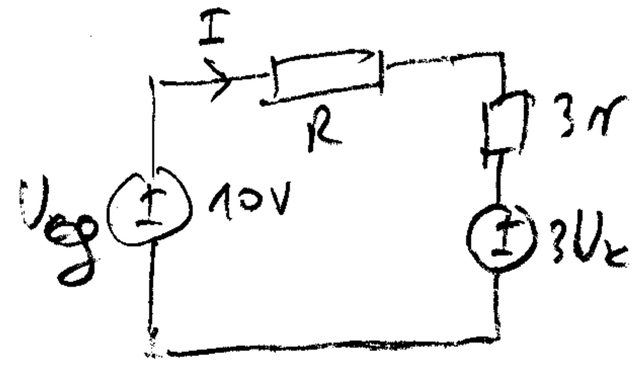
(4) $U_{D1} = U_k + r \cdot I_{D1}$

$U_{D2} = U_k + r \cdot I_{D2}$

$$r = \frac{U_{D2} - U_{D1}}{I_{D2} - I_{D1}} = \frac{0{,}5V}{9mA} = \underline{55{,}5\,\Omega}$$

$U_k = 2V - 55{,}5\,\Omega \cdot 10mA = \underline{1{,}44V}$



$U_g - 3U_k = I \cdot (R + 3r)$

$$\frac{10V - 3 \cdot 1{,}44V}{10mA} - 3 \cdot 55{,}5\,\Omega = R$$

$\underline{R = 400\,\Omega}$