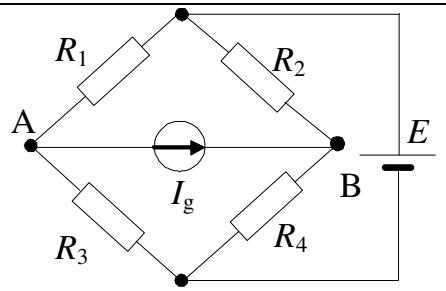
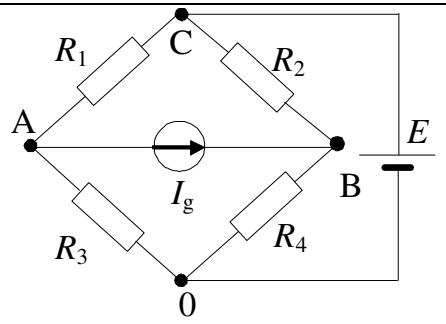
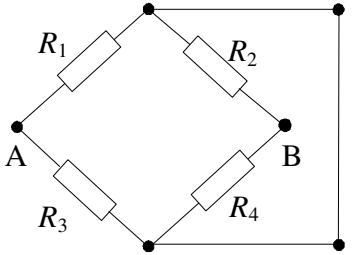
1. Vrednosti elemenata u kolu na slici 1 su:
R_1=R_2=800 Ω, R_3=600 Ω, R_4=400 Ω, I_g=20 mA, E=10 V
Primenom Tevenenove teoreme odrediti ekvivalentni Tevenenov generator kojim se može zameniti ovo kolo između tačaka A i B.



slika 1



slika 1-1



slika 1-2

$n_g = 6$
$n_{č} = 4$
$n_{ks} = 6-(4-1) = 3 \rightarrow 2\,(I_g)$
$n_{nč} = 4-1 = 3 \rightarrow 2\,(E)$

$V_{\mathrm{C}} = E = 10\,\mathrm{V}$

$$\left(\frac{1}{R_1}+\frac{1}{R_3}\right)\cdot V_{\mathrm{A}} - \frac{1}{R_1}V_{\mathrm{C}} = -I_{\mathrm{g}}$$

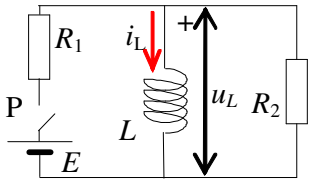
$$\left(\frac{1}{R_2}+\frac{1}{R_4}\right)\cdot V_{\mathrm{B}} - \frac{1}{R_2}V_{\mathrm{C}} = I_{\mathrm{g}}$$

$V_{\mathrm{A}} = -2{,}57\,\mathrm{V}$
$V_{\mathrm{B}} = 8{,}67\,\mathrm{V}$
$E_{\mathrm{T}} = U_{\mathrm{AB}} = V_{\mathrm{A}} - V_{\mathrm{B}} = -11{,}24\,\mathrm{V}$

$R_{\mathrm{T}} = R_1 \| R_3 + R_2 \| R_4$
$R_{\mathrm{T}} = 609\,\Omega$

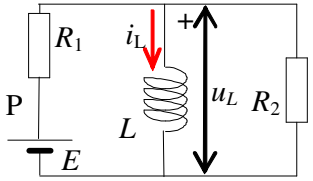
2. Za kolo dato na slici 2 su poznate sledeće vrednosti elemenata: E=12 V, R_1=60 Ω, R_2=40 Ω, L=20 mH
Kolo se nalazi u stacionarnom režimu sa otvorenim prekidačem P. U trenutku t_0=0 zatvori se prekidač.
a)Odrediti vrednost napona na zavojnici u t_1=2 ms.
b)Nacrtati dijagrame napona na zavojnici i struje kroz zavojnicu.
c)U trenutku t_2=3 ms greškom dolazi do kratkog spoja krajeva otpornika R_2.Nacrtati promene na dijagramima napona i struje zavojnice koje nastaju u t_2.

a)
Stacionarno stanje:



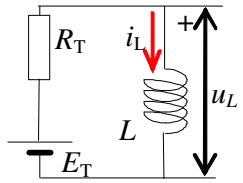
$i_L(t=0^-)=0$
$u_L(t=0^-)=0$

Zatvoren prekidač:



$$E_T = E\cdot\frac{R_2}{R_1+R_2} = 4{,}8\ \text{V}$$

$$R_T = \frac{R_1\cdot R_2}{R_1+R_2} = 24\ \Omega$$



$$E_T = R_T\cdot i_L + u_L$$

$$u_L = L\cdot\frac{di_L}{dt}$$

$$i_L = i_{Lp} + i_{Lh}$$

$$i_{Lp} = \frac{E_T}{R_T}$$

$$i_{Lh} : R_T\cdot i_L + L\cdot\frac{di_L}{dt} = 0$$

$$i_{Lh} = K\cdot e^{\frac{-R_T}{L}\cdot t}$$

$$i_L = \frac{E_T}{R_T} + K\cdot e^{\frac{-R_T}{L}\cdot t}$$

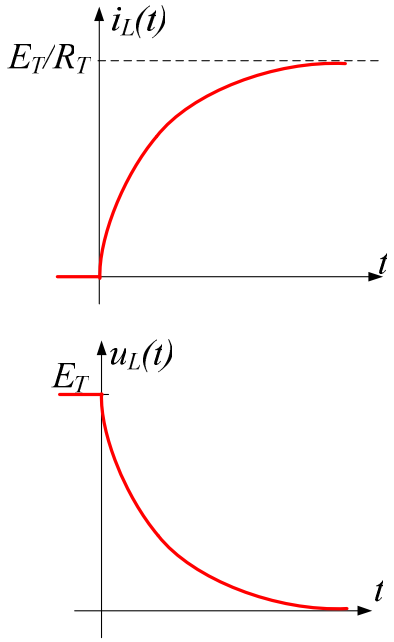
$$i_L(t=0^-) = i_L(t=0^+) \Rightarrow K = -\frac{E_T}{R_T}$$

$$i_L(t) = \frac{E_T}{R_T}\cdot\left(1-e^{\frac{-R_T}{L}\cdot t}\right)$$

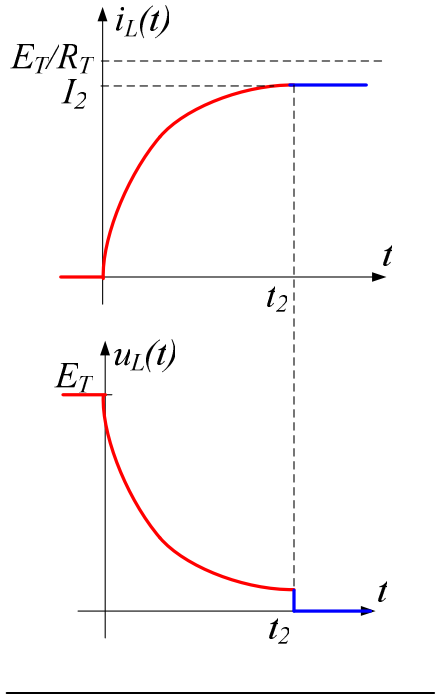
$$u_L(t) = E_T\cdot e^{\frac{-R_T}{L}\cdot t}$$

$$u_L(0^+) = U_0 = E_T = 4{,}8\ \text{V}$$
$$u_L(t_1^-) = 0{,}44\ \text{V}$$
$$i_L(t_1^-) = 0{,}18\ \text{A} = I_1$$

b)



c)



Kratak spoj krajeva otpornika R_2:
$t \geq t_2$
$u_L(t) = 0$

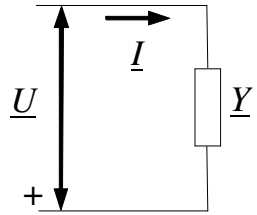
$$L\cdot\frac{di_L}{dt} = 0 \Rightarrow i_L(t) = K$$

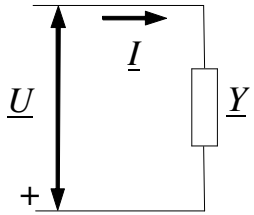
$$i_L(t_2^-) = i_L(t_2^+) = I_2$$
$$i_L(t) = I_2$$

3. Za kolo prikazano na slici 3 poznato je: $u(t)=6\sin(10^3 t-\pi/3)$ V i $i(t)=3\cos(10^3 t-\pi/3)$ mA

a) Odrediti vrednost elementa kojim se može zameniti admitansa $\underline{Y}$.

b) Odrediti kompleksnu snagu koja se razvija na admitansi $\underline{Y}$.





a)

$$u(t)=6\cdot\cos\left(\frac{\pi}{2}-10^3\cdot t+\frac{\pi}{3}\right)\text{V}$$

$$u(t)=6\cdot\cos\left(-10^3\cdot t+\frac{5\cdot\pi}{6}\right)\text{V}$$

$$u(t)=6\cdot\cos\left(10^3\cdot t-\frac{5\cdot\pi}{6}\right)\text{V}$$

$$\underline{U}=\frac{6}{\sqrt{2}}\cdot e^{-j\cdot\frac{5\cdot\pi}{6}}\ \text{V}$$

$$\underline{I}=\frac{3}{\sqrt{2}}\cdot e^{-j\cdot\frac{\pi}{3}}\ \text{mA}$$

$$\underline{Y}=-\frac{\underline{I}}{\underline{U}}=-0{,}5\cdot e^{j\cdot\frac{\pi}{2}}\ \text{mS}$$

$$\underline{Y}=0{,}5\cdot e^{-j\cdot\frac{\pi}{2}}\ \text{mS}$$

$B<0\Rightarrow$ zavojnica

$$\frac{1}{\omega\cdot L}=0{,}5\,\text{mS}$$

$$L=2\,\text{H}$$

b)

$$\underline{S}=-\underline{U}\cdot\underline{I}^{*}$$

$$\underline{S}=9\cdot e^{j\cdot\frac{\pi}{2}}\ \text{mVA}$$

4. Pretežno kapacitivni trofazni prijemnik vezan u trougao priključen je na simetričan trofazni sistem linijskog napona mreže 380 V i učestanosti 50 Hz. Faktor snage prijemnika je $\cos\varphi = 0{,}75$. Efektivna vrednost linijske struje iznosi $I_l = 15$ A.
a) Odrediti aktivnu i reaktivnu snagu prijemnika.
b) Naći vrednost otpornosti i kapacitivnosti po fazi prijemnika.
c) Nacrtati fazorski dijagram faznih napona i struja.

a)

$$U_f = U_l = 380\ \text{V}$$

$$I_f = \frac{I_l}{\sqrt{3}} = 8{,}66\ \text{A}$$

$$P = 3 \cdot U_f \cdot I_f \cdot \cos\varphi$$

$$P = 7404\ \text{W}$$

$$\sin\varphi = -\sqrt{1-\cos^2\varphi} = -0{,}66$$

$$Q = 3 \cdot U_f \cdot I_f \cdot \sin\varphi$$

$$Q = -6515\ \text{VA}_\text{r}$$

b)

$$Z = \frac{U_f}{I_f} = 43{,}88\,\Omega$$

$$R = Z \cdot \cos\varphi = 32{,}9\ \Omega$$

$$-\frac{1}{\omega \cdot C} = Z \cdot \sin\varphi \Rightarrow C = -\frac{1}{\omega \cdot Z \cdot \sin\varphi} = 0{,}11\,\text{mF}$$

c)

$$\varphi = -41{,}3°$$