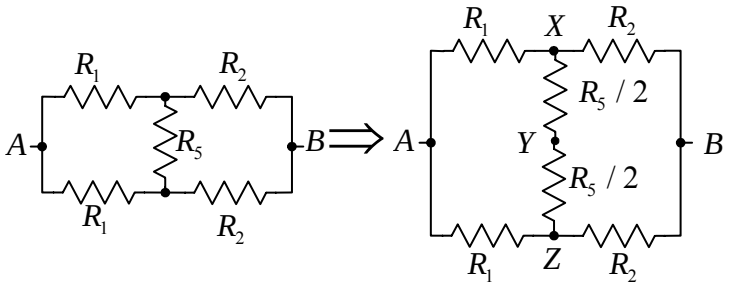
Osnovi elektronike - Odsek za SI

Januar 2009. - rešenja

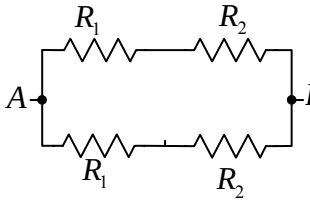
1. Ako se uzme u obzir ekvivalencija otpornika, kolo se može transformisati prema sledećim slikama



Jednačine po metodi potencijala čvorova za X i Z:

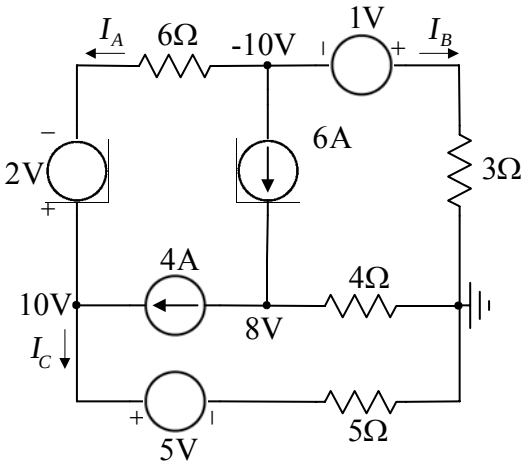
$$\left.\begin{aligned} V_X(1/R_1+1/R_2+2/R_5)-V_A/R_1-V_B/R_2-2V_Y/R_5=0 \\ V_Z(1/R_1+1/R_2+2/R_5)-V_A/R_1-V_B/R_2-2V_Y/R_5=0 \end{aligned}\right\} \Rightarrow V_X=V_Z$$

Jasno je da su potencijali čvorova X i Z jednaki pa kroz R_5 ne protiče struja. Zbog toga se R_5 može ukloniti iz kola:



$$R_{AB}=(R_1+R_2)\,\|\,(R_1+R_2)=\frac{R_1+R_2}{2}$$

2. Potencijali čvorova u kolu su prikazani na sledećoj slici:



Tražene struje su:
$I_A=-3\,\text{A},\ I_B=-3\,\text{A},\ I_C=1\,\text{A},$

a snage koje predaju strujni generatori:
$P_{4A}=8\,\text{W},\ P_{6A}=108\,\text{W}.$

3. Kako je $\cos\phi = 0.55 \Rightarrow \phi = 56.6^\circ \Rightarrow \tan\phi = 1.52$ dobija se da je bez kompenzacije
$\tan\phi = Q / P = X / R = \omega L / R = 1.52 \Rightarrow \omega L = 15.2\Omega$
Kada se poveže kondenzator u paralelu, dobija se admitansa

$$Y = G + jB = Y_1 + Y_2 = j\omega C + \frac{1}{R + j\omega L} = j\omega C + \frac{R - j\omega L}{R^2 + (\omega L)^2} = 0.03\Omega + j(\omega C - 0.046\Omega)$$

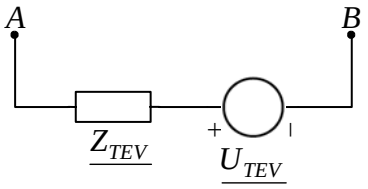
a) $\cos\phi = 0.7 \Rightarrow \phi \approx \pm 45^\circ \Rightarrow \tan\phi \approx \pm 1$
$\tan\phi = Q / P = -B / G = (0.046 - \omega C) / 0.03 = \pm 1 \Rightarrow \omega C = 0.016\Omega,$ ili 0.076Ω

b) $\cos\phi = 0.9 \Rightarrow \phi \approx \pm 26^\circ \Rightarrow \tan\phi \approx \pm 0.5$
$\tan\phi = Q / P = -B / G = (0.046 - \omega C) / 0.03 = \pm 0.5 \Rightarrow \omega C = 0.031\Omega,$ ili 0.06Ω

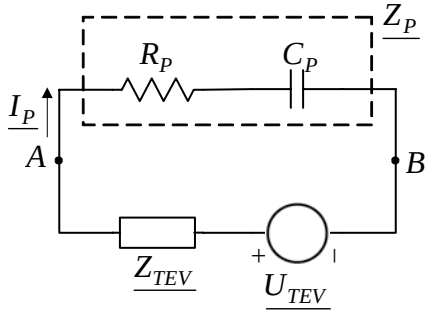
Napomena:
Kompenzacija se može ostvariti i rednim dodavanjem kondenzatora, što se retko primenjuje u praksi.

4. $\underline{V} = (4 + j4)V$
$\underline{I} = -j2A$
$\underline{Z_L} = j\omega \cdot 200\mu H = j2\Omega$

a) $\underline{U_{TEV}} = j12V$
$\underline{Z_{TEV}} = (5 + j)\Omega$



b) $\underline{Z_{C_P}} = -\frac{j}{\omega C_P} = -j3\Omega$
$\underline{Z_P} = (1 - j3)\Omega$
$\underline{I_P} = \frac{\underline{U_{TEV}}}{\underline{Z_{TEV}} + \underline{Z_P}} = (-\frac{3}{5} + j\frac{9}{5})A$



$\underline{S_P} = \underline{U_P} \cdot \underline{I_P^*} = \underline{Z_P} \cdot I_P^2 = \frac{18}{5} - j\frac{54}{5}$

$P = \frac{18}{5}W;$ $\quad Q = -\frac{54}{5}VAr;$ $\quad S = \frac{18\sqrt{10}}{5}VA;$ $\quad \cos\phi = \frac{P}{S} = \frac{1}{\sqrt{10}}$

6. $v_I = -\frac{R_4}{R_3}\left(1 + \frac{R_2}{R_1}\right)v_G;$ $\quad R_4 = 10\,\mathrm{k}\Omega.$

7. Za naizmeničnu komponentu kondenzator predstavlja kratak spoj pa je $a_d = 100$, dok je za jednosmerni signal otvorena veza $A_D = 50$

Pošto je $v_D = V_D + v_d = v_2 - v_1 = 5\text{mV} - 35\text{mV} \cdot \cos(\omega t)$ dobija se da je

$v_I = V_I + v_i = A_D \cdot 5\text{mV} - a_d \cdot 35\text{mV} \cdot \cos(\omega t) = 250\text{mV} - 3.5\text{V} \cdot \cos(\omega t)$

8. a) $V_G = 4{,}8\,\text{V};\ V_S = 2{,}51\,\text{V};\ V_D = 7\,\text{V};\ I_D = 418\,\mu\text{A}.$

b) $a_v = -\dfrac{g_m(R_D \,||\, R_P)}{1 + g_m R_{S2}} = -4{,}2\ ;\ R_{ul} = R_1 \,||\, R_2 = 600\,\text{k}\Omega;\ R_{izl} = R_D = 12\,\text{k}\Omega.$