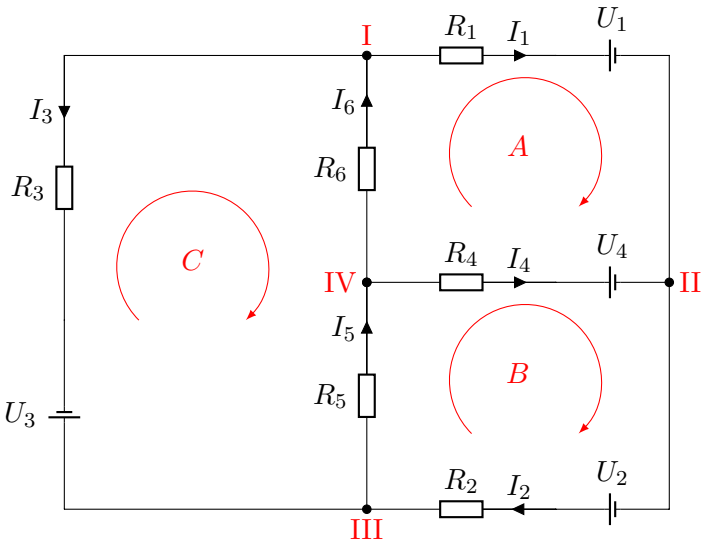
Tema:
Metoda konturnih struja

Nastavni sat predmeta *Osnove elektrotehnike*, listopad 2017.

Metoda konturnih struja



I. Kirchhoffov za čvorove I .. IV:

$$
\begin{aligned}
I)\quad & -I_1 - I_3 + I_6 = 0 \\
II)\quad & I_1 - I_2 + I_4 = 0 \\
III)\quad & I_2 + I_3 - I_5 = 0 \\
IV)\quad & -I_4 + I_5 - I_6 = 0
\end{aligned}
$$

II. Kirchhoffov za petlje (konture) A, B i C:

$$
\begin{aligned}
A)\quad & U_1 - I_1R_1 + I_4R_4 - U_4 - I_6R_6 = 0 \\
B)\quad & -U_2 - I_2R_2 - I_5R_5 + U_4 - I_4R_4 = 0 \\
C)\quad & I_6R_6 + I_5R_5 + I_3R_3 + U_3 = 0
\end{aligned}
$$

Iz mreže vidimo golim okom:

$$
\begin{aligned}
I_1 &= I_A \\
I_2 &= I_B \\
I_3 &= -I_C
\end{aligned}
$$

Iz I. K.Z.:

$$
\begin{aligned}
IV)\quad I_4 &= I_2 - I_1 = \\
&= I_B - I_A \\
III)\quad I_5 &= I_2 + I_3 = \\
&= I_B - I_C \\
I)\quad I_6 &= I_1 + I_3 = \\
&= I_A - I_C
\end{aligned}
$$

$$
\begin{aligned}
A)\quad & U_1 - I_AR_1 + (I_B - I_A)R_4 - U_4 - (I_A - I_C)R_6 = 0 \\
B)\quad & -U_2 - I_BR_2 - (I_B - I_C)R_5 + U_4 - (I_B - I_A)R_4 = 0 \\
C)\quad & (I_A - I_C)R_6 + (I_B - I_C)R_5 - I_CR_3 + U_3 = 0
\end{aligned}
$$

$$
\begin{aligned}
&A) \quad U_1 - I_A R_1 + I_B R_4 - I_A R_4 - U_4 - I_A R_6 + I_C R_6 &&= 0\\
&B) \quad -U_2 - I_B R_2 - I_B R_5 + I_C R_5 + U_4 - I_B R_4 + I_A R_4 &&= 0\\
&C) \quad I_A R_6 - I_C R_6 + I_B R_5 - I_C R_5 - I_C R_3 + U_3 &&= 0
\end{aligned}
$$

$$
\begin{aligned}
&A) \quad U_1 - U_4 - I_A R_1 - I_A R_4 - I_A R_6 + I_B R_4 + I_C R_6 &&= 0\\
&B) \quad -U_2 + U_4 + I_A R_4 - I_B R_2 - I_B R_4 - I_B R_5 + I_C R_5 &&= 0\\
&C) \quad U_3 I_A R_6 + I_B R_5 - I_C R_3 - I_C R_5 - I_C R_6 &&= 0
\end{aligned}
$$

$$
\begin{array}{llllll}
A) & U_1 - U_4 = & I_A(R_1 + R_4 + R_6) & -I_B R_4 & & -I_C R_6\\
B) & -U_2 + U_4 = & -I_A R_4 & +I_B(R_2 + R_4 + R_5) & & -I_C R_5\\
C) & U_3 = & -I_A R_6 & -I_B R_5 & & +I_C(R_3 + R_5 + R_6)
\end{array}
$$

$$
\begin{array}{llllll}
A) & I_A(R_1 + R_4 + R_6) & -I_B R_4 & -I_C R_6 & = U_1 - U_4\\
B) & -I_A R_4 & +I_B(R_2 + R_4 + R_5) & -I_C R_5 & = U_4 - U_2\\
C) & -I_A R_6 & -I_B R_5 & +I_C(R_3 + R_5 + R_6) & = U_3
\end{array}
$$

$$
\begin{array}{llllll}
 & & \overset{R_A}{} & & & \\
A) & I_A(& \boxed{R_1 + R_4 + R_6} &) \; -I_B R_4 & -I_C R_6 & = U_1 - U_4\\
 & & & \overset{R_B}{} & & \\
B) & -I_A R_4 & & +I_B(\; \boxed{R_2 + R_4 + R_5} \;) & -I_C R_5 & = U_4 - U_2\\
 & & & & \overset{R_C}{} & \\
C) & -I_A R_6 & & -I_B R_5 & +I_C(\; \boxed{R_3 + R_5 + R_6} \;) & = U_3
\end{array}
$$

$$
\begin{array}{llllll}
A) & I_A R_A & +I_B R_{AB} & +I_C R_{AC} & = U_A\\
B) & I_A R_{BA} & +I_B R_B & +I_C R_{BC} & = U_B\\
C) & I_A R_{CA} & +I_B R_{CB} & +I_C R_C & = U_C
\end{array}
$$

$$
\begin{aligned}
R_A &= R_1 + R_4 + R_6 \quad &&\longleftrightarrow \quad \text{suma svih otpora konture } A\\
R_B &= R_2 + R_4 + R_5 \quad &&\longleftrightarrow \quad \text{suma svih otpora konture } B\\
R_C &= R_3 + R_5 + R_6 \quad &&\longleftrightarrow \quad \text{suma svih otpora konture } C\\
R_{AB} = R_{BA} &= -R_4 \quad &&\longleftrightarrow \quad \text{neg. suma svih otpora zajedničkih konturama } A \text{ i } B\\
R_{AC} = R_{CA} &= -R_6 \quad &&\longleftrightarrow \quad \text{neg. suma svih otpora zajedničkih konturama } A \text{ i } C\\
R_{BC} = R_{CB} &= -R_5 \quad &&\longleftrightarrow \quad \text{neg. suma svih otpora zajedničkih konturama } B \text{ i } C
\end{aligned}
$$

Predznaci:

R_A, R_B **i** R_C ...uvijek su pozitivni.

R_{xy} ...predznak je negativan kad kroz taj otpornik konturne struje I_x i I_y teku u različitim smjerovima.

naponski izvori ...plus kad se smjer poklapa sa smjerom konturne struje.