Elektrotehnika (AVT-ELITE)

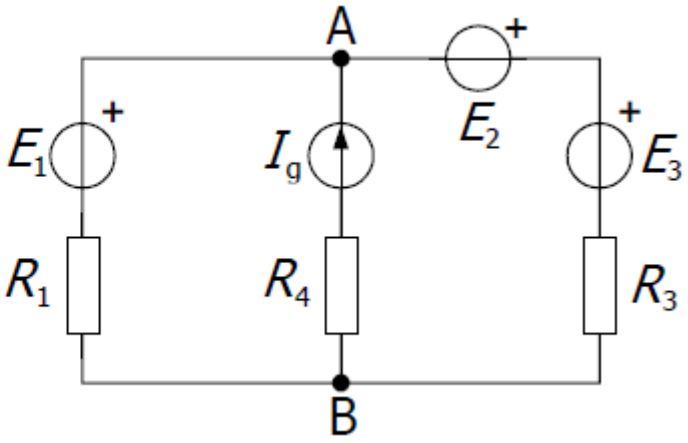
Vežbe 6

Konturne struje vežbanje

Visoka škola elektrotehnike i računarstva
strukovnih studija, Beograd 2019

Konturne struje

II.8.2.3 Generatori $E_1 = 12$ V, $E_2 = 24$ V, $E_3 = 24$ V i $I_g = 60$ mA, i otpornici $R_1 = 300\ \Omega$, $R_3 = 600\ \Omega$ i $R_4 = 500\ \Omega$ vezani su u kolo kao što je prikazano na slici. Metodom konturnih struja odrediti intenzitete struja u svim granama kola.



Konturne struje

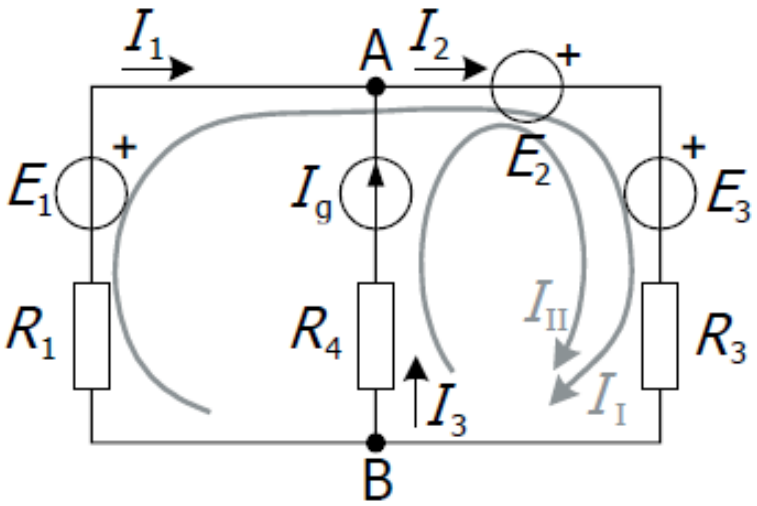
Zadatak II.8.2.3

Rešenje:

$$n_g - (n_č - 1) - n_{Ig} = 1$$

$$R_{11} I_I + R_{12} I_{II} = E_I$$

$$I_{II} = I_g$$



$$R_{11} = R_1 + R_3 = 900\ \Omega$$

$$R_{12} = R_3 = 600\ \Omega$$

$$E_I = E_1 + E_2 - E_3 = 12\ \text{V}$$

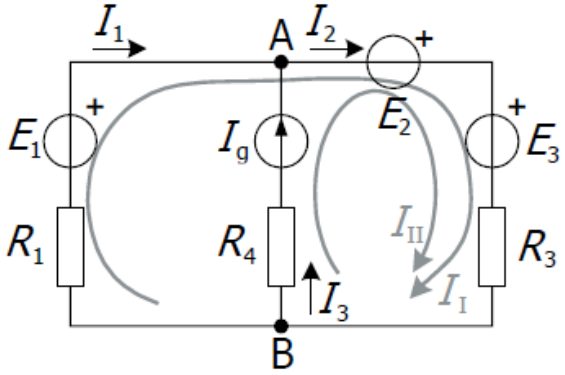
Konturne struje

Zadatak II.8.2.3

$$(R_1 + R_3)I_{\mathrm{I}} + R_3 I_{\mathrm{II}} = E_1$$

$$I_{\mathrm{II}} = I_{\mathrm{g}}$$

$$(R_1 + R_3)I_{\mathrm{I}} + R_3 I_{\mathrm{g}} = E_1 \quad \Rightarrow \quad I_{\mathrm{I}} = \frac{E_1 + E_2 - E_3 - R_3 I_{\mathrm{g}}}{R_1 + R_3} = \frac{-24\ \mathrm{V}}{900\ \Omega} = -0{,}0267\ \mathrm{A} = -26{,}7\ \mathrm{mA}$$



$$I_1 = I_{\mathrm{I}} = -26{,}7\ \mathrm{mA}\,, \quad I_2 = I_{\mathrm{I}} + I_{\mathrm{II}} = 33{,}3\ \mathrm{mA}\,, \quad I_3 = I_{\mathrm{II}} = I_{\mathrm{g}} = 60\ \mathrm{mA}$$

Konturne struje

II.8.2.4 U kolu na slici poznato je:

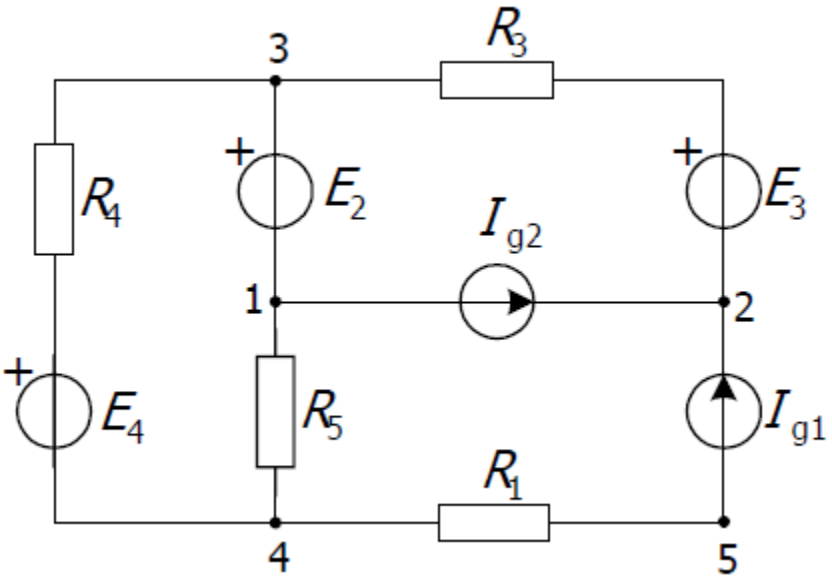
I_{g1} = 12 A, I_{g2} = 6 A,

E_2 = 30 V, E_3 = 20 V, E_4 = 40 V,

R_1 = 10 Ω, R_3 = 40 Ω, R_4 = 20 Ω, R_5 = 30 Ω

a) Odrediti struje svih grana kola primenom metode konturnih struja.

b) Odrediti snagu strujnog generatora I_{g1}.



Konturne struje

Zadatak II.8.2.4 a)

$$n_g - (n_č - 1) - n_{Ig} = 1$$

$$I_I = I_{g1}$$

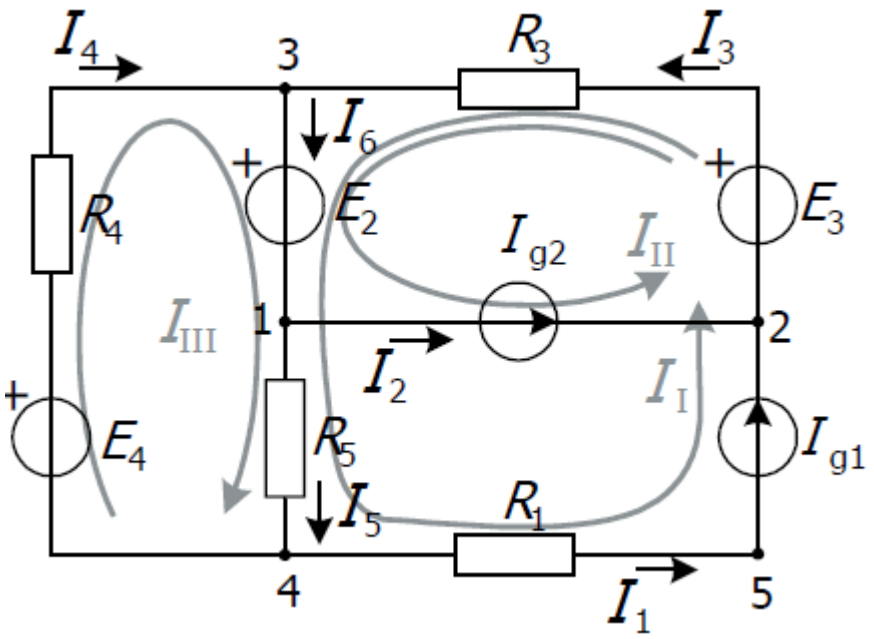
$$I_{II} = I_{g2}$$

$$R_{31}I_I + R_{32}I_{II} + R_{33}I_{III} = E_{III}$$

$$R_{33} = R_4 + R_5$$

$$R_{31} = R_5$$

$$R_{32} = 0$$



Konturne struje

Zadatak II.8.2.4 a)

$$R_5 I_{g1} + (R_4 + R_5) I_{III} = E_4 - E_2 \quad \Rightarrow \quad I_{III} = \frac{E_4 - E_2 - R_5 I_{g1}}{R_4 + R_5} = \frac{-350\ \text{V}}{50\ \Omega} = -7\ \text{A}$$

$$I_1 = I_I = I_{g1} = 12\ \text{A},$$

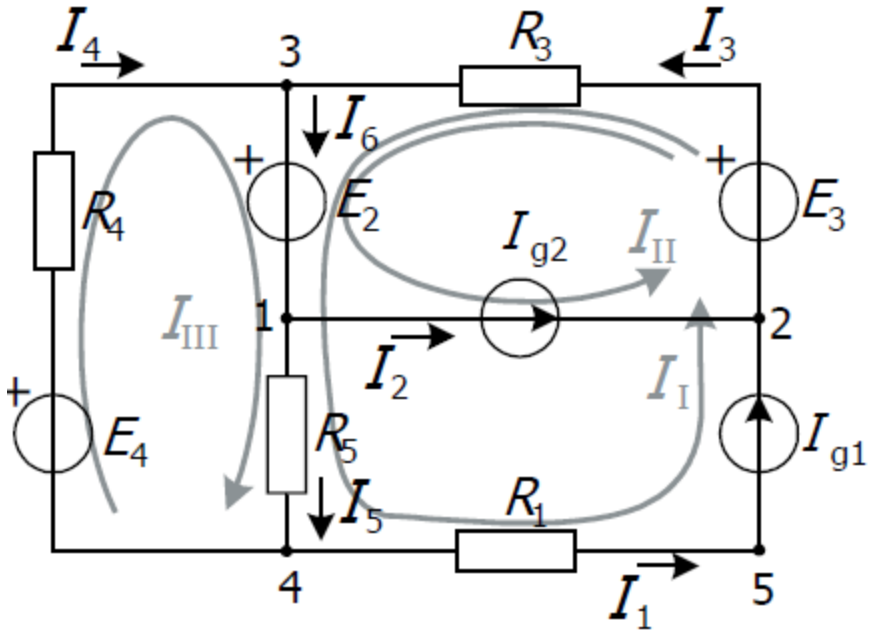
$$I_2 = I_{II} = I_{g2} = 6\ \text{A},$$

$$I_3 = I_I + I_{II} = 12\ \text{A} + 6\ \text{A} = 18\ \text{A},$$

$$I_4 = I_{III} = -7\ \text{A},$$

$$I_5 = I_I + I_{III} = 12\ \text{A} - 7\ \text{A} = 5\ \text{A},$$

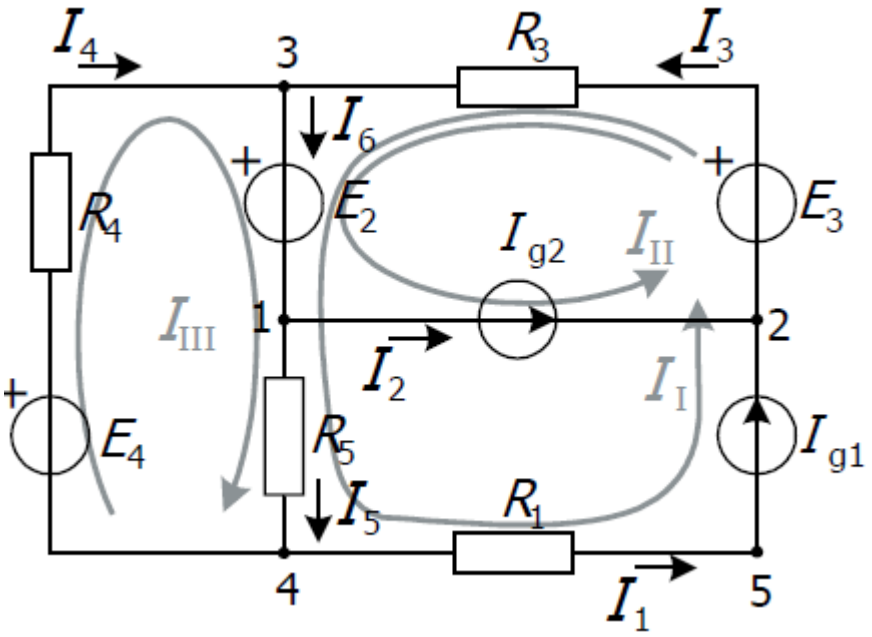
$$I_6 = I_I + I_{II} + I_{III} = 12\ \text{A} + 6\ \text{A} - 7\ \text{A} = 11\ \text{A}.$$



Konturne struje

Zadatak II.8.2.4 b)

$$P_{I_{g1}} = U_{25} \cdot I_{g1}$$



$$U_{25} = R_1 I_1 + R_5 I_5 + E_2 + R_3 I_3 - E_3 = 120\ \text{V} + 150\ \text{V} + 30\ \text{V} + 720\ \text{V} - 20\ \text{V} = 1000\ \text{V}$$

$$\Rightarrow \quad P_{I_{g1}} = U_{25} \cdot I_{g1} = 1000\ \text{V} \cdot 12\ \text{A} = 12000\ \text{W} = 12\ \text{kW}$$

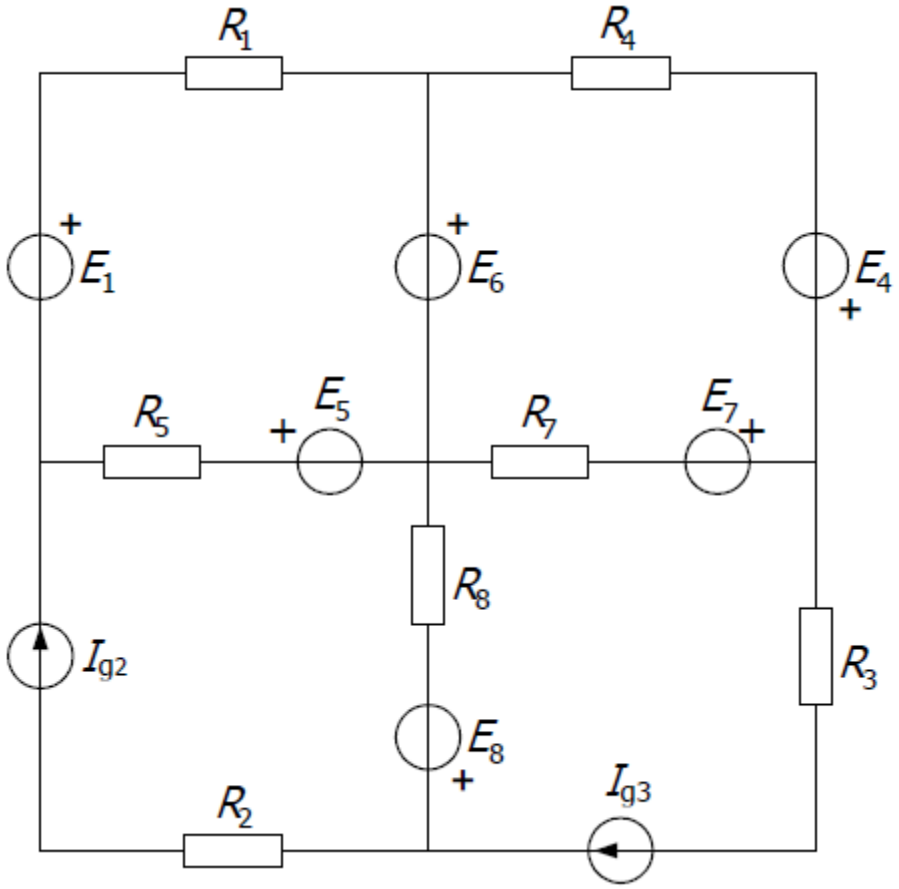
Konturne struje

II.8.2.5 U kolu na slici izračunati:

a) struje u svim granama kola primenom metode konturnih struja,

b) snagu strujnog generatora I_{g2}.

Vrednosti elemenata:
$E_1 = 1$ V, $E_4 = 4$ V, $E_5 = 5$ V,
$E_6 = 6$ V, $E_7 = 7$ V, $E_8 = 8$ V,
$I_{g2} = 2$ A, $I_{g3} = 3$ A,
$R_1 = R_2 = 10\ \Omega$, $R_3 = R_4 = R_5 = 20\ \Omega$,
$R_7 = R_8 = 30\ \Omega$.



Konturne struje

Zadatak II.8.2.5 a)

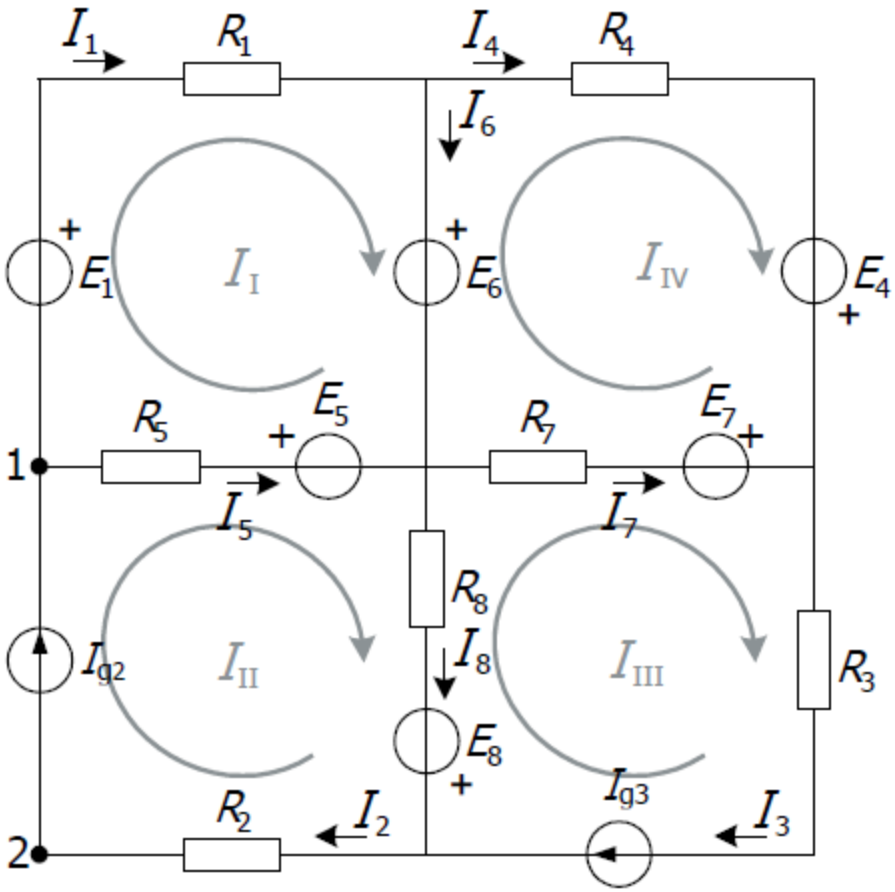
$$n_g - (n_č - 1) - n_{Ig} = 2.$$

$$R_{11}I_{\mathrm{I}} + R_{12}I_{\mathrm{II}} + R_{13}I_{\mathrm{III}} + R_{14}I_{\mathrm{IV}} = E_{\mathrm{I}}$$

$$I_{\mathrm{II}} = I_{g2}$$

$$I_{\mathrm{III}} = I_{g3}$$

$$R_{41}I_{\mathrm{I}} + R_{42}I_{\mathrm{II}} + R_{43}I_{\mathrm{III}} + R_{44}I_{\mathrm{IV}} = E_{\mathrm{IV}}$$



Konturne struje

Zadatak II.8.2.5 a)

$$R_{11} = R_1 + R_5 = 10\ \Omega + 20\ \Omega = 30\ \Omega,$$

$$R_{12} = -R_5 = -20\ \Omega,$$

$$R_{13} = 0$$

$$R_{14} = R_{41} = 0$$

$$R_{24} = 0$$

$$R_{43} = -R_7 = -30\ \Omega,$$

$$R_{44} = R_4 + R_7 = 20\ \Omega + 30\ \Omega = 50\ \Omega,$$

$$E_{\mathrm{I}} = E_1 - E_6 + E_5 = 1\ \mathrm{V} - 6\ \mathrm{V} + 5\ \mathrm{V} = 0\ \mathrm{V},$$

$$E_{\mathrm{IV}} = E_6 + E_4 - E_7 = 6\ \mathrm{V} + 4\ \mathrm{V} - 7\ \mathrm{V} = 3\ \mathrm{V}.$$

Konturne struje

Zadatak II.8.2.5 a)

$$(R_1 + R_5)I_{\mathrm{I}} - R_5 I_{\mathrm{II}} = E_1 - E_6 + E_5$$

$$I_{\mathrm{II}} = I_{g2}$$

$$I_{\mathrm{III}} = I_{g3}$$

$$-R_7 I_{\mathrm{III}} + (R_4 + R_7)I_{\mathrm{IV}} = E_6 + E_4 - E_7$$

$$(R_1 + R_5)I_{\mathrm{I}} - R_5 I_{g2} = E_1 - E_6 + E_5 \quad \Rightarrow \quad I_{\mathrm{I}} = \frac{E_1 - E_6 + E_5 + R_5 I_{g2}}{R_1 + R_5} = \frac{40\ \mathrm{V}}{30\ \Omega} = 1{,}33\ \mathrm{A}$$

$$-R_7 I_{g3} + (R_4 + R_7)I_{\mathrm{IV}} = E_6 + E_4 - E_7 \quad \Rightarrow \quad I_{\mathrm{IV}} = \frac{E_6 + E_4 - E_7 + R_7 I_{g3}}{R_4 + R_7} = \frac{93\ \mathrm{V}}{50\ \Omega} = 1{,}86\ \mathrm{A}$$

Konturne struje

Zadatak II.8.2.5 a)

$$I_1 = I_{\mathrm{I}} = 1{,}33\ \mathrm{A},$$

$$I_2 = I_{\mathrm{II}} = I_{g2} = 2\ \mathrm{A},$$

$$I_3 = I_{\mathrm{III}} = I_{g3} = 3\ \mathrm{A}$$

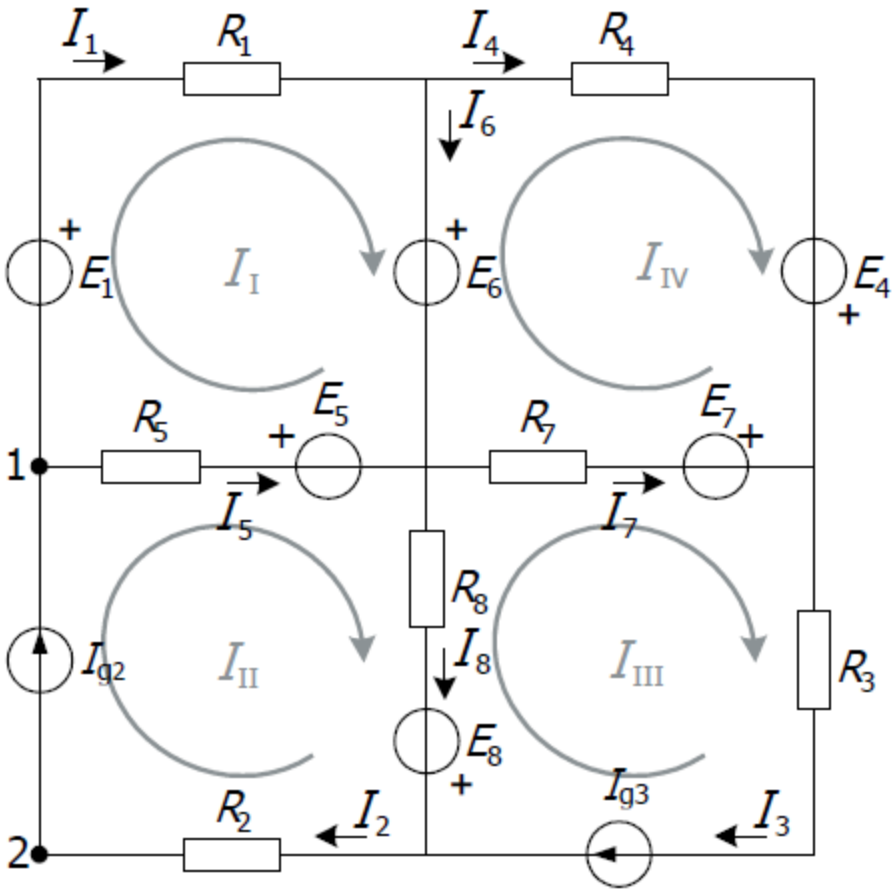
$$I_4 = I_{\mathrm{IV}} = 1{,}86\ \mathrm{A},$$

$$I_5 = -I_{\mathrm{I}} + I_{\mathrm{II}} = 0{,}67\ \mathrm{A},$$

$$I_6 = I_{\mathrm{I}} - I_{\mathrm{IV}} = -0{,}53\ \mathrm{A},$$

$$I_7 = -I_{\mathrm{IV}} + I_{\mathrm{III}} = 1{,}14\ \mathrm{A},$$

$$I_8 = I_{\mathrm{II}} - I_{\mathrm{III}} = -1\ \mathrm{A}.$$



Konturne struje

Zadatak II.8.2.5 b)

$$U_{12} = R_2 I_2 - E_8 + R_8 I_8 + E_5 + R_5 I_5 = 20\ \text{V} - 8\ \text{V} - 30\ \text{V} + 5\ \text{V} + 13{,}4\ \text{V} = 0{,}4\ \text{V},$$

$$P_{I_{g2}} = U_{12} \cdot I_{g2} = 0{,}4\ \text{V} \cdot 2\ \text{A} = 0{,}8\ \text{W}$$