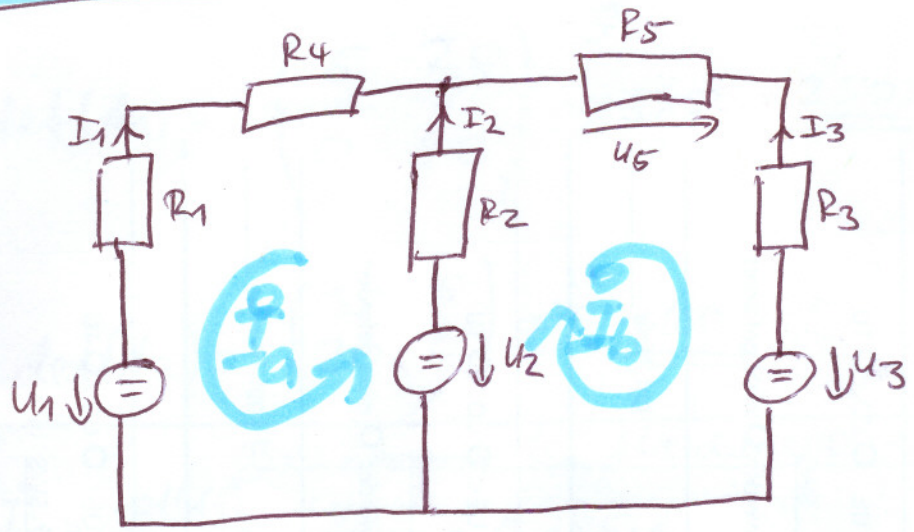
Übungsblatt 2

Aufgabe 2:



Werte: $R_1 = 10\Omega$; $R_2 = 20\Omega$; $R_3 = 20\Omega$; $R_4 = 5\Omega$; $R_5 = 10\Omega$

$U_1 = 10V$; $U_2 = 15V$; $U_3 = 15V$

Maschengleichungen:

M1: $R_2 \mathring{I}_a + R_2 \mathring{I}_b + R_4 \mathring{I}_a + R_1 \mathring{I}_a = -U_1 + U_2$

M2: $R_2 \mathring{I}_a + R_2 \mathring{I}_b + R_5 \mathring{I}_b + R_3 \mathring{I}_b = U_2 - U_3$

Matrixdarstellung:

$$\begin{pmatrix} R_1 + R_2 + R_4 & R_2 \\ R_2 & R_2 + R_3 + R_5 \end{pmatrix} \begin{pmatrix} \mathring{I}_a \\ \mathring{I}_b \end{pmatrix} = \begin{pmatrix} U_2 - U_1 \\ U_2 - U_3 \end{pmatrix}$$

Konkrete Darstellung:

$$\begin{pmatrix} 35 & 20 \\ 20 & 50 \end{pmatrix} \begin{pmatrix} \mathring{I}_a \\ \mathring{I}_b \end{pmatrix} = \begin{pmatrix} 5 \\ 0 \end{pmatrix}$$

$$\det(A) = 35 \times 50 - 20 \times 20 = \underline{\underline{1.350}}$$

$$\det(A_1) = \begin{pmatrix} 5 & 20 \\ 0 & 50 \end{pmatrix} \Rightarrow 5 \times 50 = \underline{\underline{250}}$$

$$\det(A_2) = \begin{pmatrix} 35 & 5 \\ 20 & 0 \end{pmatrix} \Rightarrow \underline{\underline{-100}}$$

Bestimmung der Maschenströme:

$$\mathring{I}_a = \frac{\det(A_1)}{\det(A)} = \frac{250}{1.350} = 0{,}185\,A$$

$$\mathring{I}_b = \frac{\det(A_2)}{\det(A)} = -\frac{100}{1.350} = -0{,}074\,A$$

---

gesucht: $I_1, I_2, I_3, \cancel{U_5}$

Bestimmung der gesuchten Ströme:

$$\underline{I_1 = -\mathring{I}_a = \underline{-0{,}185\,A}}$$

$$\underline{I_2 = \mathring{I}_a + \mathring{I}_b = 0{,}185\,\cancel{A} - 0{,}074\,A = \underline{0{,}111\,A}}$$

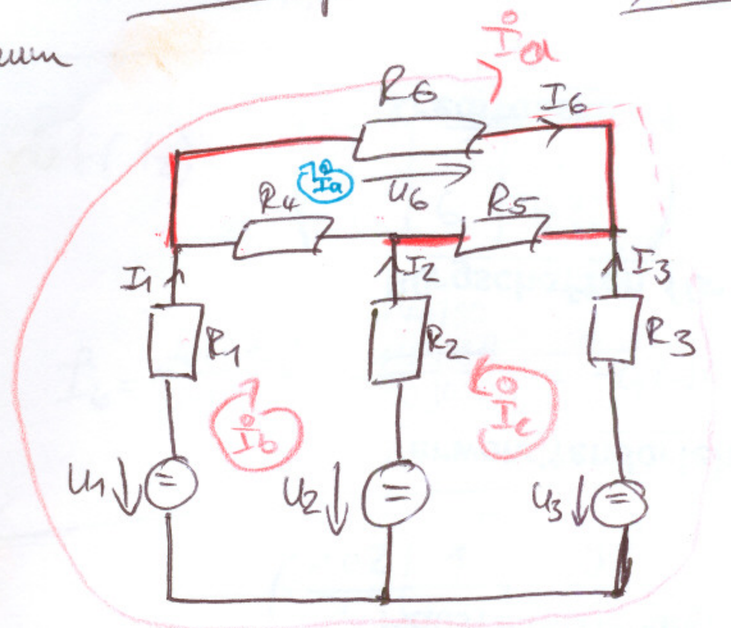
$$\underline{I_3 = -\mathring{I}_b = \underline{0{,}074\,A}}$$

$$\cancel{U_5 = R \cdot I_5}$$

$$\cancel{I_5 =}$$

Übungsblatt 2 — Aufgabe 3

— = Baum



$U_1 = 6V$
$U_2 = 9V$
$U_3 = 15V$
$R_1 = 1\Omega$
$R_2 = 1\Omega$
$R_3 = 1\Omega$
$R_4 = 270\Omega$
$R_5 = 470\Omega$
$R_6 = 100\Omega$

ges.: I_1, I_2, I_3 und I_6

$$M1: \; R_1\mathring{I}_a + R_1\mathring{I}_b + R_6\mathring{I}_a + R_3\mathring{I}_a - R_3\mathring{I}_c = U_1 - U_3$$

$$M2: \; R_1\mathring{I}_a + R_1\mathring{I}_b + R_4\mathring{I}_b + R_2\mathring{I}_b + R_2\mathring{I}_c = U_1 - U_2$$

$$M3: \; R_3\mathring{I}_c + -R_3\mathring{I}_a + R_5\mathring{I}_c + R_2\mathring{I}_c + R_2\mathring{I}_b = U_3 - U_2$$

$$\underbrace{\begin{pmatrix} R_1+R_3+R_6 & R_1 & -R_3 \\ R_1 & R_1+R_2+R_4 & R_2 \\ -R_3 & R_2 & R_2+R_3+R_5 \end{pmatrix}}_{A} \underbrace{\begin{pmatrix} \mathring{I}_a \\ \mathring{I}_b \\ \mathring{I}_c \end{pmatrix}}_{x} = \underbrace{\begin{pmatrix} U_1-U_3 \\ U_1-U_2 \\ U_3-U_2 \end{pmatrix}}_{b}$$

$$\det(A) = \begin{vmatrix} 102 & 1 & -1 \\ 1 & 272 & 1 \\ -1 & 1 & 472 \end{vmatrix} = 13095166 - 846 = \underline{\underline{13094320}}$$

$$\det(A_1) = \begin{vmatrix} -9 & 1 & -1 \\ -3 & 272 & 1 \\ 6 & 1 & 472 \end{vmatrix} = -1155447 + 3057 = \underline{\underline{-1152390}}$$

$$\mathring{I}_a = \frac{\det(A_1)}{\det(A)} = -0{,}088\,A \quad \underline{\underline{(=-88\,mA)}}$$

$$\det(A_2) = \begin{pmatrix} 102 & -9 & -1 \\ 1 & -3 & 1 \\ -1 & 6 & 472 \end{pmatrix} = -144429 + 3639 = \underline{\underline{\overset{-140790}{\cancel{148068}}}}$$

$$\mathring{I}_b = \frac{\det(A_2)}{\det(A)} = \frac{\overset{-140790}{\cancel{148068}}}{13094320} = -0{,}01075\,A \quad \underline{\underline{(=-10{,}75\,mA)}}$$

$$\det(A_3) = \begin{pmatrix} 102 & 1 & -9 \\ 1 & 272 & -3 \\ -1 & 1 & 6 \end{pmatrix}$$

$$= 166458 - 2148 = \underline{\underline{164310}}$$

$$\mathring{I}_c = \frac{\det(A_3)}{\det(A)} = \frac{164310}{13094320} = 0{,}012548\,A \quad \underline{\underline{(=12{,}548\,mA)}}$$

$$I_1 = \mathring{I}_a + \mathring{I}_b = -88\,mA - 10{,}75\,mA = \underline{\underline{-98{,}75\,mA}}$$

$$I_2 = -\mathring{I}_b - \mathring{I}_c = 10{,}75\,mA - 12{,}548\,mA = \underline{\underline{-1{,}798\,mA}}$$

$$I_3 = \mathring{I}_c - \mathring{I}_a = 12{,}548\,mA + 88\,mA = \underline{\underline{100{,}548\,mA}}$$

$$I_6 = \mathring{I}_a = \cancel{Aa}\ \underline{\underline{-88\,mA}}$$