Aufgabe 6:

a) $u_1 = R_1 i_1 + R_3(i_1+i_2) = (R_1+R_3)i_1 + R_3 i_2$

$u_2 = R_2 i_2 + R_3(i_1+i_2) = R_3 i_1 + (R_3+R_2) i_2$

$$\underset{\sim}{R} = \begin{bmatrix} R_1+R_3 & R_3 \\ R_3 & R_3+R_2 \end{bmatrix}$$

b) passiv, spg-gest., stromgest., reziprok ($\underset{\sim}{R}=\underset{\sim}{R}^T$)

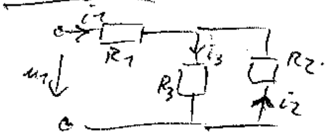
c) $\begin{bmatrix} u_1 \\ i_1 \end{bmatrix} = \underset{\sim}{A} \begin{bmatrix} u_2 \\ -i_2 \end{bmatrix}$

1. $i_2 = 0$

$$\left.\begin{aligned} u_1 &= R_1 i_1 + R_3 i_1 \\ u_2 &= R_3 i_1 \end{aligned}\right\} \Rightarrow u_1 = \frac{R_1+R_3}{R_3} u_2$$

$$i_1 = \frac{1}{R_3} u_2$$

2. $u_2 = 0$



$u_1 = R_1 i_1 - R_2 i_2$

$R_2 i_2 + R_3 i_3 = 0$ mit $i_3 = i_1 + i_2$ folgt

$(R_2+R_3) i_2 + R_3 i_1 = 0$ und damit $i_1 = -\frac{R_2+R_3}{R_3} i_2$

$$\Rightarrow u_1 = -\frac{R_1}{R_3}(R_2+R_3) i_2 - R_2 i_2 = -i_2\left(\frac{R_1 R_2}{R_3} + R_1 + R_2\right)$$

$$\Rightarrow \begin{bmatrix} u_1 \\ i_1 \end{bmatrix} = \begin{bmatrix} \frac{R_1+R_3}{R_3} & \frac{R_1 R_2}{R_3} + R_1 + R_2 \\ \frac{1}{R_3} & +\frac{R_2+R_3}{R_3} \end{bmatrix} \begin{bmatrix} u_2 \\ -i_2 \end{bmatrix}$$

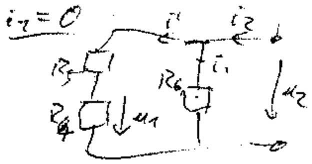
mit Umrechentabelle:

$$\underset{\sim}{A} = \frac{1}{r_{21}} \begin{bmatrix} r_{11} & \det R \\ 1 & r_{22} \end{bmatrix} = \frac{1}{R_3} \begin{bmatrix} R_1+R_3 & R_1R_3 + R_1R_2 + R_3R_2 \\ 1 & R_2+R_3 \end{bmatrix}$$

d) π-Glied:

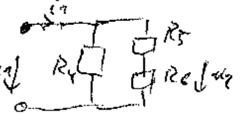
$\begin{bmatrix} u_1 \\ u_2 \end{bmatrix} = \underset{\sim}{R} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix}$

$i_1 = 0$



$$u_1 = \frac{R_6 R_4}{R_4+R_5+R_6} i_2 \qquad u_2 = \frac{(R_4+R_5)R_6}{R_4+R_5+R_6} i_2$$

$i_2 = 0$



$$u_2 = \frac{R_4 R_6}{R_4+R_5+R_6} i_1$$

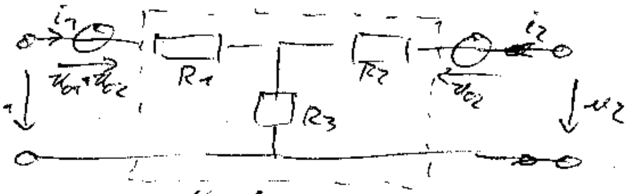
$$u_1 = \frac{(R_5+R_6)R_4}{R_4+R_5+R_6} i_1$$

$$\Rightarrow \underset{\sim}{R} = \begin{bmatrix} \frac{(R_5+R_6)R_4}{R_4+R_5+R_6} & \frac{R_6 R_4}{R_4+R_5+R_6} \\ \frac{R_4 R_6}{R_4+R_5+R_6} & \frac{(R_4+R_5)R_6}{R_4+R_5+R_6} \end{bmatrix}$$

e)

$$u_1 = R_1 i_1 + u_{01} + R_3(i_1+i_2) + u_{02}$$
$$u_2 = R_2 i_2 + R_3(i_1+i_2) + u_{02}$$

$$\begin{bmatrix} u_1 \\ u_2 \end{bmatrix} = \begin{bmatrix} R_1+R_3 & R_3 \\ R_3 & R_2+R_3 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \end{bmatrix} + \begin{bmatrix} u_{01}+u_{02} \\ u_{02} \end{bmatrix}$$



quellenfreies Zweitor

f) $$\underline{1}\,\underline{u} = \underline{R}\,\underline{i} + \begin{bmatrix} u_{01}+u_{02} \\ u_{02} \end{bmatrix}$$

$$\begin{bmatrix} u_1-u_{01}-u_{02} \\ u_2-u_{02} \end{bmatrix} = \underline{R}\,\underline{i} \Rightarrow \begin{bmatrix} 1 & 0 & \underbrace{-R_1-R_3 \quad -R_3}_{} \\ 0 & 1 & \underbrace{-R_3 \quad -R_2-R_3}_{-\underline{R}} \end{bmatrix} \begin{bmatrix} u_1-u_{01}-u_{02} \\ u_2-u_{02} \\ i_1 \\ i_2 \end{bmatrix} = \underline{0}$$

g) $$\left.\begin{array}{l} i_1 = 0A \\ i_2 = 1A \end{array}\right\} \Rightarrow \begin{array}{l} u_1 = 1A\,R_3 + u_{01} + u_{02} \\ u_2 = 1A(R_2+R_3) + u_{02} \end{array}$$

$$\left.\begin{array}{l} i_1 = 1A \\ i_2 = 0A \end{array}\right\} \Rightarrow \begin{array}{l} u_1 = (R_1+R_3)\cdot 1A + u_{01} + u_{02} \\ u_2 = 1A\,R_3 + u_{02} \end{array}$$

$$\begin{bmatrix} u_1 \\ u_2 \\ i_1 \\ i_2 \end{bmatrix} = \underbrace{\begin{bmatrix} 1A\cdot R_3 & 1A(R_1+R_3) \\ 1A(R_2+R_3) & 1A\cdot R_3 \\ 0A & 1A \\ 1A & 0A \end{bmatrix}}_{\text{Betriebsmatrix } \underline{B}} \underline{c} + \begin{bmatrix} u_{01}+u_{02} \\ u_{02} \\ 0 \\ 0 \end{bmatrix}$$