Vysoké učení technické v Brně

Fakulta informačních technologii

IEL - Projekt

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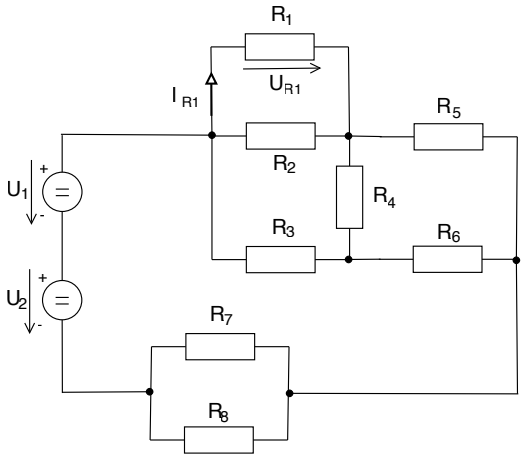
1 Skupina - H

$U_1 = 135V$ $U_2 = 80V$ $R_1 = 680\ \Omega$ $R_2 = 600\ \Omega$ $R_3 = 260\ \Omega$
$R_4 = 310\ \Omega$ $R_5 = 575\ \Omega$ $R_6 = 870\ \Omega$ $R_7 = 355\ \Omega$ $R_8 = 265\ \Omega$

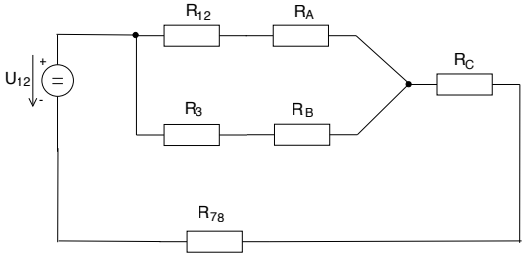


Obrázek 1: Východzí obvod projektu.

$$R_{78} = \frac{R_7 * R_8}{R_7 + R_8}$$
$$R_{78} = \frac{355 * 265}{355 + 265}$$
$$R_{78} = \frac{18815}{124}\Omega$$

$$R_{12} = \frac{R_1 * R_2}{R_1 + R_2}$$
$$R_{12} = \frac{680 * 600}{680 + 600}$$
$$R_{12} = \frac{1275}{4}\Omega$$

$$U_{12} = U_1 + U_2$$
$$U_{12} = 135 + 80$$
$$U_{12} = 215V$$



Obrázek 2: Evivalentný obvod.

$$R_A = \frac{R_4 * R_5}{R_4 + R_5} \qquad R_B = \frac{R_4 * R_6}{R_4 + R_6} \qquad R_C = \frac{R_5 * R_6}{R_5 + R_6}$$
$$R_A = \frac{310 * 575}{310 + 575} \qquad R_B = \frac{310 * 870}{310 + 870} \qquad R_C = \frac{575 * 870}{575 + 870}$$
$$R_A = 101,567\Omega \qquad R_B = \frac{17980}{117}\Omega \qquad R_C = \frac{33350}{117}\Omega$$

$$R_{C78} = R_C + R_{78} \qquad R_{A12} = R_A + R_{12} \qquad R_{B3} = R_B + R_3$$
$$R_{C78} = \frac{33350}{117} + \frac{18815}{124} \qquad R_{A12} = 101,567 + \frac{1275}{4} \qquad R_{B3} = \frac{17980}{117} + 260$$
$$R_{C78} = 436,7766\Omega \qquad R_{A12} = 420,317\Omega \qquad R_{B3} = \frac{48400}{117}\Omega$$

$$R_{AB123} = \frac{R_{A12} * R_{B3}}{R_{A12} + R_{B3}}$$
$$R_{AB123} = \frac{420,317 * \frac{48400}{117}}{420,317 + \frac{48400}{117}}$$
$$R_{AB123} = 208,4848\Omega$$

$$R_{EKV} = R_{AB123} + R_{C78}$$
$$R_{EKV} = 208,4848 + 436,7766$$
$$R_{EKV} = 645,2614\Omega$$

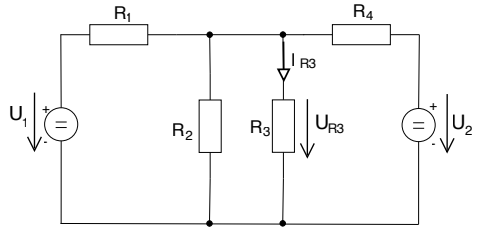
$$I = \frac{U_{12}}{R_{EKV}} \qquad U_{RAB123} = R_{AB123} * I \qquad I_{A12} = \frac{U_{RA12}}{R_{A12}}$$
$$I = \frac{215}{645,2614} \qquad U_{RAB123} = 208,4848 * 0,3332 \qquad I_{A12} = \frac{69,4671}{420,317}$$
$$I = 0,3332A \qquad U_{RAB123} = 69,4671V = U_{RA12} \qquad I_{A12} = 0,1653$$

$$U_{R12} = R_{12} * I_{A12} = 52,6894V = U_{R1} \tag{1}$$

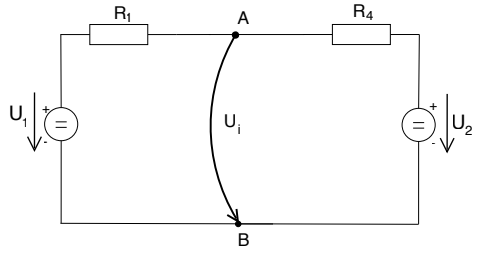
$$I_{R1} = \frac{U_{R1}}{R_1} = \frac{52,6894}{680} = 0,0775A \tag{2}$$

2 Skupina - A

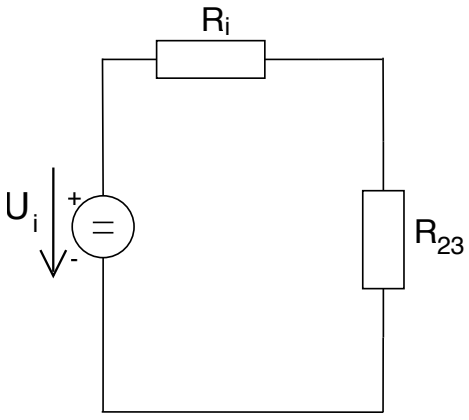
$U_1 = 50V$ $U_2 = 100V$ $R_1 = 525\ \Omega$
$R_2 = 620\ \Omega$ $R_3 = 210\ \Omega$ $R_4 = 530\ \Omega$



$$R_{23} = \frac{R_2 * R_3}{R_2 + R_3} = \frac{620 * 210}{620 + 210}$$
$$R_{23} = \frac{13020}{83}\Omega$$



$$U_1 + U_{R1} + U_{R4} - U_2 = 0$$
$$U_1 + R_1 I_X + R_4 I_X - U_2 = 0$$
$$50 + 525 I_X + 530 I_X - 100 = 0$$
$$1055 I_X = 50$$
$$I_X = \frac{10}{211}$$



$$R_4 I_X + U_i - U_2 = 0$$
$$(530 * \frac{10}{211}) + U_i - 100 = 0$$
$$U_i = 100 - \frac{5300}{211} = \frac{15800}{211}$$

$$R_i = \frac{R_1 * R_4}{R_1 + R_4} = \frac{525 * 530}{525 + 530}$$
$$R_i = 263,7441\Omega$$

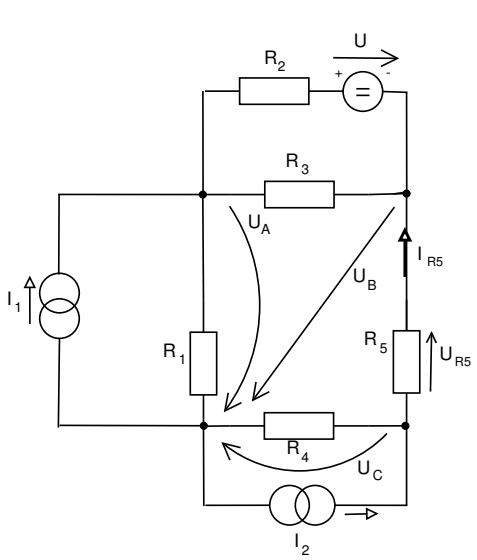
$$I_{R23} = \frac{U_i}{R_i + R_{23}}$$
$$I_{R23} = \frac{\frac{15800}{211}}{263,7441 + \frac{13020}{83}}$$
$$I_{R23} = 0,178A$$

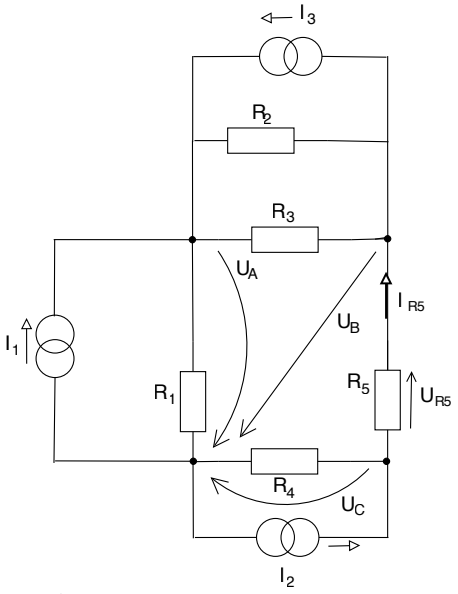
$$U_{R23} = R_{23} * I_{R23}$$
$$U_{R23} = \frac{13020}{83} * 0,178$$
$$U_{R23} = 27,9224V = U_{R3}$$

$$I_{R3} = \frac{U_{R23}}{R_3}$$
$$I_{R3} = \frac{27,9224}{210}$$
$$I_{R3} = 132,96mA$$

3 Skupina - C

U = 110V $\quad$ $I_1 = 0.85A$ $\quad$ $I_2 = 0.75A$ $\quad$ $R_1 = 44\ \Omega$
$R_2 = 31\ \Omega$ $\quad$ $R_3 = 56\ \Omega$ $\quad$ $R_4 = 20\ \Omega$ $\quad$ $R_5 = 30\ \Omega$





$I_3 = \frac{U}{R2} = \frac{110}{31}$ $\quad$ $G_1 = \frac{1}{R_1} = \frac{1}{44}$ $\quad$ $G_2 = \frac{1}{R_2} = \frac{1}{31}$
$G_3 = \frac{1}{R_3} = \frac{1}{56}$ $\quad$ $G_4 = \frac{1}{R_4} = \frac{1}{20}$ $\quad$ $G_5 = \frac{1}{R_5} = \frac{1}{30}$

$$\begin{bmatrix} G_1+G_2+G_3 & -G_2-G_3 & 0 \\ -G_2-G_3 & G_2+G_3+G_5 & -G_5 \\ 0 & -G_5 & G_4+G_5 \end{bmatrix} = \begin{bmatrix} I_1+I_3 \\ -I_3 \\ I_2 \end{bmatrix}$$

Nahradíme si postupne stĺpce v hlavnej matici a vypočítame determinanty.

$\Delta = \frac{4957}{22915200}$ $\quad$ $\Delta_B = \frac{-257713}{190960000}$ $\quad$ $\Delta_C = \frac{32243}{22915200}$ $\quad$ $U_B = \frac{\Delta_B}{\Delta}$ $\quad$ $U_C = \frac{\Delta_C}{\Delta}$

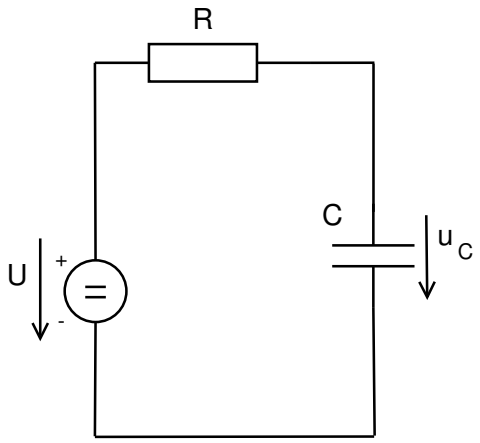
$$-U_{R5} = U_B - U_C$$
$$-U_{R5} = -6,2388 - 6,5045$$
$$-U_{R5} = -12,7433V$$

$$I_{R5} = \frac{U_{R5}}{R_5} = \frac{12,7433}{30}$$
$$I_{R5} = 0,4248A$$

4 Skupina - H

5 Skupina - A

U = 20V C = 50F R = 10Ω $\mathcal{U}_C(0) = 9V$



$$I = \frac{U_{R5}}{R_5}$$

$$U_R + U_C - U = 0$$
$$U_R = U - U_C$$

$$U'_C = \frac{I}{C} = \frac{U_R}{RC} = \frac{U - U_C}{RC}$$

$$U'_C + \frac{U_C}{RC} = \frac{U}{RC}$$

$$\lambda + \frac{1}{RC} = 0$$
$$\lambda = \frac{-1}{RC}$$

$$\mathcal{U}_C(t) = K(t)e^{\lambda t}$$
$$\mathcal{U}_C(t) = K(t)e^{\frac{t}{RC}}$$

$$\mathcal{U}'_C = K'(t)(\frac{-1}{RC})e^{\frac{-t}{RC}} + K(t)(\frac{-1}{RC})e^{\frac{-t}{RC}}$$

$$K'(t)e^{\frac{-t}{RC}} + K(t)(\frac{-1}{RC})e^{\frac{-t}{RC}} + K(t)(\frac{1}{RC})e^{\frac{-t}{RC}} = \frac{U}{RC}$$
$$K'(t)e^{\frac{-t}{RC}} = \frac{U}{RC}$$
$$K'(t) = \frac{U}{RC}e^{\frac{-t}{RC}}$$

Úloha	Skupina	Výsledky
1	H	$U_{R1} = 52,6894V, I_{R1} = 77,5mA$
2	A	$U_{R3} = 27,9224V, I_{R3} = 132,96mA$
3	C	$U_{R5} = 12,7433V, IR5 = 424,8mA$
4	H	
5	A	