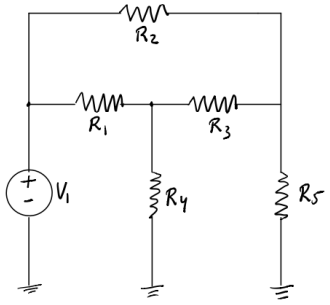
RAF201G – Heimadæmi 5

Ólafur Bjarki Bogason
Skilafrestur er til 10:00, 22. febrúar 2021

16. febrúar 2021

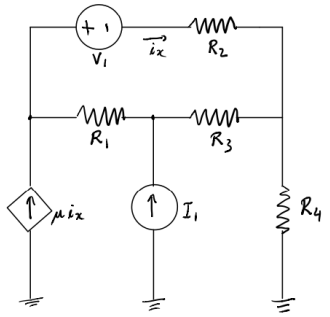
Í þessum heimadæmum á að finna spennur í öllum hnútpunktum. Sýnið alltaf útreikninga og látið kóða fylgja með ef á við. Ekki hika við að hafa samband á #heimadæmi. Gangi ykkur vel!

Dæmi 1 - Óháð lind og viðnám



Breyta	Gildi
V_1	9 V
R_1	7 Ω
R_2, R_5	3 Ω
R_3, R_4	1 Ω

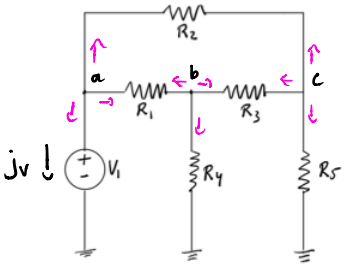
Dæmi 2 – Bland í poka



Breyta	Gildi
V_1	9 V
I_1	2 A
μ	2
R_1, R_3	4 Ω
R_2	7 Ω
R_4	1 Ω

Dæmi 1 - Óháð lind og viðnám

$N_{jöfn} = N_{hnútp} + N_{VS} - 1 = 4 + 1 - 1 = 4$



Breyta	Gildi
V_1	9 V
R_1	7 Ω
R_2, R_5	3 Ω
R_3, R_4	1 Ω

KCL a: $j_V + G_1(v_a - v_b) + G_2(v_a - v_c) = 0$

b: $G_1(v_b - v_a) + G_4(v_b - 0) + G_3(v_b - v_c) = 0$

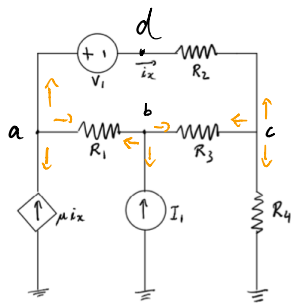
c: $G_2(v_c - v_a) + G_3(v_c - v_b) + G_5(v_c - 0) = 0$

$$\begin{array}{c} \\ a \\ b \\ c \\ j_V \end{array} \begin{array}{c} \begin{array}{cccc} a & b & c & j_V \end{array} \\ \left[\begin{array}{cccc} G_1+G_2 & -G_1 & -G_2 & 1 \\ -G_1 & G_1+G_3+G_4 & -G_3 & 0 \\ -G_2 & -G_3 & G_2+G_3+G_5 & 0 \\ \hline 1 & 0 & 0 & 0 \end{array}\right] \end{array} \begin{bmatrix} v_a \\ v_b \\ v_c \\ \hline j_V \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ \hline V_1 \end{bmatrix} \quad \text{svo} \quad \begin{bmatrix} v_a \\ v_b \\ v_c \\ \hline j_V \end{bmatrix} = \begin{bmatrix} 9\,V \\ 2\,V \\ 3\,V \\ \hline -3A \end{bmatrix}$$

Dæmi 2 – Bland í poka

$N_{jöfn} = N_{hnútp} + N_{VS} - 1 = 4 + 1 - 1 = 4$ Lítum á V_1 & R_2 sem eina rásaeiningu

Óþekktar stærðir eru v_a, v_b, v_c & i_x (þurfum jöfn fyrir allar)



Breyta	Gildi
V_1	9 V
I_1	2 A
μ	2
R_1, R_3	4 Ω
R_2	7 Ω
R_4	1 Ω

KCL í a: $-\mu i_x + i_x + G_1(v_a - v_b) = 0$

b: $G_1(v_b - v_a) - I_1 + G_3(v_b - v_c) = 0$

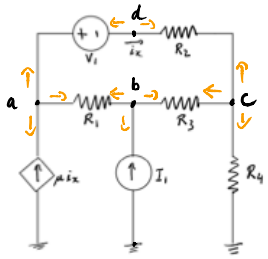
c: $G_3(v_c - v_b) + G_4(v_c - 0) - i_x = 0$

KVL yfir V_1 + R_2: $v_a - v_c = V_1 + i_x R_2$

$$\begin{array}{c} \\ a \\ b \\ c \\ V_1 \end{array} \begin{array}{c} \begin{array}{cccc} a & b & c & V_1 \end{array} \\ \left[\begin{array}{cccc} G_1 & -G_1 & 0 & 1-\mu \\ -G_1 & G_1+G_3 & -G_3 & 0 \\ 0 & -G_3 & G_3+G_4 & -1 \\ \hline 1 & 0 & -1 & -R_2 \end{array}\right] \end{array} \begin{bmatrix} v_a \\ v_b \\ v_c \\ \hline i_x \end{bmatrix} = \begin{bmatrix} 0 \\ I_1 \\ 0 \\ \hline V_1 \end{bmatrix} \quad \text{svo} \quad \begin{bmatrix} v_a \\ v_b \\ v_c \\ \hline i_x \end{bmatrix} = \begin{bmatrix} 20V \\ 16\,V \\ 4\,V \\ \hline 1A \end{bmatrix}$$

Þá $v_a - v_d = V_1$ eða $v_d = v_a - V_1 = 20 - 9 = 11\,V$

Dæmi 2 – Bland í poka (leyst aftur í tíma með V_d inni sem breyta)



Breyta	Gildi
V_1	9 V
I_1	2 A
μ	2
R_1, R_3	4 Ω
R_2	7 Ω
R_4	1 Ω

$N_{jöfn} = N_{hp} + N_{vs} - 1$ (N_{KCL} - 1, N_{KVL})

$= 5 + 1 - 1 = 5$ jöfn! (V_a, V_b, V_c, V_d, i_x)

Allt annað es þekkt!

KCL í a: $\underbrace{-\mu i_x + i_x + G_1(V_a - V_b)}_{\text{straumur út}} = 0$ ($\Rightarrow$ straumur inn) $\quad G_1(V_a - V_b) = i_x(\mu - 1) = i_x$

b: $G_1(V_b - V_a) - I_1 + G_3(V_b - V_c) = 0$

c: $G_2(V_c - V_d) + G_3(V_c - V_b) + G_4(V_c - 0) = 0$

d: $-i_x + G_2(V_d - V_c) = 0$

KVL yfir V_1: $V_a - V_d = V_1$

	a	b	c	d	V_1			
a	G_1	$-G_1$	0	0	$-\mu+1$	V_a	0	
b	$-G_1$	G_1+G_3	$-G_3$	0	0	V_b	I_1	
c	0	$-G_3$	$G_2+G_3+G_4$	$-G_2$	0	V_c	0	
d	0	0	$-G_2$	G_2	-1	V_d	0	
V_1	1	0	0	-1	0	i_x	V_1	

eða

V_a	=	20 V
V_b		16 V
V_c		4 V
V_d		11 V
i_x		1 A