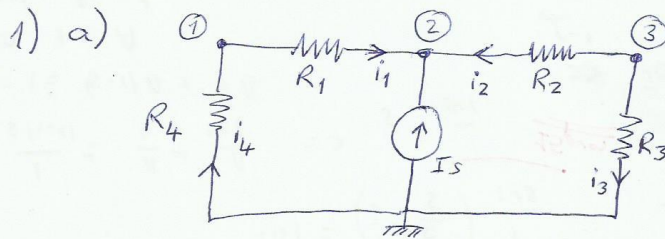


2017-2018 Spring BoEC
Solutions of the 4th HW



$$\textcircled{1} \quad i_1 - i_4 = 0$$

$$\textcircled{1} \quad G_1 V_1 - G_4 V_4 = 0$$

$$\textcircled{2} \quad -i_1 - i_2 - I_s = 0$$

\Rightarrow

$$\textcircled{2} \quad -G_1 V_1 - G_2 V_2 = I_s$$

$$\textcircled{3} \quad i_2 + i_3 = 0$$

$$\textcircled{3} \quad G_2 V_2 + G_3 V_3 = 0$$

$$V_1 = e_1 - e_2, \quad V_2 = e_3 - e_2, \quad V_3 = e_3, \quad V_4 = -e_1$$

$$\textcircled{1} \quad G_1(e_1 - e_2) - G_4(-e_1) = 0$$

$$\textcircled{2} \quad -G_1(e_1 - e_2) - G_2(e_3 - e_2) = I_s$$

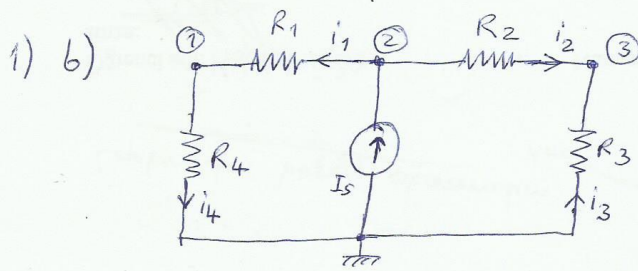
$$\textcircled{3} \quad G_2(e_3 - e_2) + G_3 e_3 = 0$$

$$\textcircled{1} \quad (G_1 + G_4)e_1 - G_1 e_2 = 0$$

$$\textcircled{2} \quad -G_1 e_1 + (G_1 + G_2)e_2 - G_2 e_3 = I_s$$

$$\textcircled{3} \quad -G_2 e_2 + (G_2 + G_3)e_3 = 0$$

$$\begin{bmatrix} G_1 + G_4 & -G_1 & 0 \\ -G_1 & G_1 + G_2 & -G_2 \\ 0 & -G_2 & G_2 + G_3 \end{bmatrix} \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} 0 \\ I_s \\ 0 \end{bmatrix}$$



$$\textcircled{1} \quad -i_1 + i_4 = 0$$

$$\textcircled{1} \quad -G_1 V_1 + G_4 V_4 = 0$$

$$\textcircled{2} \quad i_1 + i_2 - I_s = 0$$

$$\Rightarrow \textcircled{2} \quad G_1 V_1 + G_2 V_2 = I_s$$

$$\textcircled{3} \quad -i_2 - i_3 = 0$$

$$\textcircled{3} \quad -G_2 V_2 - G_3 V_3 = 0$$

$$V_1 = e_2 - e_1, \quad V_2 = e_2 - e_3, \quad V_3 = -e_3, \quad V_4 = e_1$$

$$\textcircled{1} \quad -G_1 (e_2 - e_1) + G_4 e_1 = 0$$

$$\textcircled{2} \quad G_1 (e_2 - e_1) + G_2 (e_2 - e_3) = I_s$$

$$\textcircled{3} \quad -G_2 (e_2 - e_3) - G_3 (-e_3) = 0$$

$$\textcircled{1} \quad (G_1 + G_4) e_1 - G_1 e_2 = 0$$

$$\textcircled{2} \quad -G_1 e_1 + (G_1 + G_2) e_2 - G_2 e_3 = I_s$$

$$\textcircled{3} \quad -G_2 e_2 + (G_2 + G_3) e_3 = 0$$

$$\begin{bmatrix} G_1 + G_4 & -G_1 & 0 \\ -G_1 & G_1 + G_2 & -G_2 \\ 0 & -G_2 & G_2 + G_3 \end{bmatrix} \begin{bmatrix} e_1 \\ e_2 \\ e_3 \end{bmatrix} = \begin{bmatrix} 0 \\ I_s \\ 0 \end{bmatrix}$$

\Rightarrow Matrix elements are the same.

$$\textcircled{2} \quad -G_1 e_1 + (G_1 + G_2) e_2 - G_2 e_3 - i_d = 0$$

$$a_1 = a G_3 (e_1 - e_3)$$

$$(3) \quad -G_3 e_1 - G_2 e_2 + (G_2 + G_3 + G_4) e_3 = 0$$

$$\begin{bmatrix} G_1 + G_3 & -G_1 & -G_3 & 1 \\ -G_1 - \alpha G_3 & G_1 + G_2 & -G_2 + \alpha G_3 & 0 \\ -G_3 & -G_2 & G_2 + G_3 + G_4 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} e_1 \\ e_2 \\ e_3 \\ I_V \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ V_S \end{bmatrix}$$