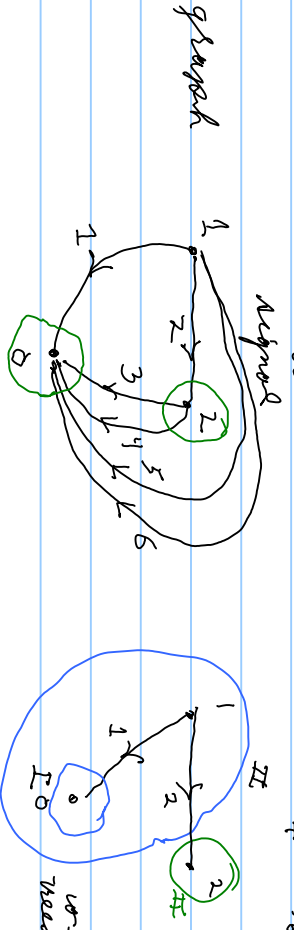


EE610  
08/19/17

analysis connections = KCL, KVL  
component descriptions



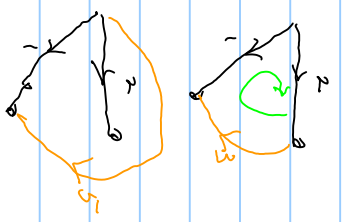
KCL and I:  $0 = i_1 + 0.1i_2 + i_3 + i_4 + i_5 + i_6$   
cut II:  $0 = 0.1i_1 + i_2 - i_3 - i_4 + 0.1i_5 + 0.6$

$M = 3 = \# \text{ nodes}$   
 $t = 2 = \# \text{ tree branches}$   
 $M - t = 1 = \# \text{ links}$   
 $b = 6 = \# \text{ branches}$

KVL  $\Rightarrow \Sigma$  of voltages around a closed path = 0

$$\begin{bmatrix} 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 1 & 1 & 1 & 1 \\ 0 & 1 & -1 & -1 & 0 & 0 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{bmatrix} \Rightarrow \mathbf{Q}_2 = \mathbf{Q}_1^t = \mathbf{Q}_7 = \text{KCL} \text{ (independent equations)}$$

extract matrix equations



for branch 3:  $0 = -v_1 + v_2 + v_3$

4:  $0 = -v_1 + v_2 + v_4$

5:  $0 = -v_1 + 0.5v_2 + 0.5v_3 + v_5$

6:  $0 = -v_1 + v_6$

$$\mathbf{Q} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} -1 & 1 & 1 & 1 & 0 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 0 \\ -1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{bmatrix}$$

$$\begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{bmatrix}$$

$KVL = \underline{0} = \mathcal{G}^T v$ ,  $\mathcal{G}^T = \text{stia adj matrix}$

$$\mathcal{E} = \begin{bmatrix} 1 & K \\ 1 & K \end{bmatrix}, \quad \mathcal{G}^T = \begin{bmatrix} -K & 1 \\ 1 & 1 \end{bmatrix}; \quad K \text{ is } 1 \times 1$$

$$\mathcal{E} \cdot \mathcal{G}^T = \begin{bmatrix} 1 & K \\ 1 & K \end{bmatrix} \begin{bmatrix} -K & 1 \\ 1 & 1 \end{bmatrix} = 1 \cdot (-K) + K(1) = 0$$