EE 610
09/10/13

Note Title 9/7/2013

$$P_{in}(t) = v_b^T(t)\, i_b = v_1 i_1 + v_2 i_2 + v_3 i_3 + v_4 i_4 + v_5 i_5$$

$$= v_t^T \mathcal{C} \cdot \mathcal{J}^T i_\ell = v_t^T \mathcal{M} \cdot i_\ell = 0$$

$$v_b = \mathcal{C}^T v_t \,,\quad i_b = \mathcal{J}^T \cdot i_\ell$$

if choose $v_2 = v_3 = 0$, $i_5 = 0 =$

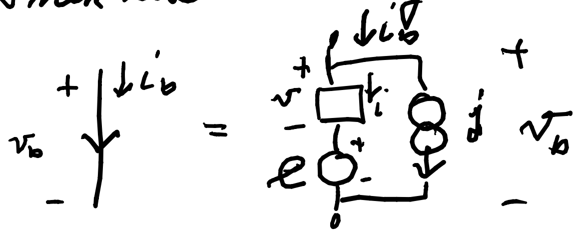
$$P_{in} = v_t^T \mathcal{M}\, i_\ell = [v_1\, v_2\, v_3] \begin{bmatrix} & \\ & \end{bmatrix} \begin{bmatrix} i_4 \\ i_5 \end{bmatrix} = v_1 \mathcal{M}_{14} \cdot i_4 = 0 \quad \text{for all } v_1 \,\&\, i_4$$

$$\Rightarrow \mathcal{M}_{11} \equiv 0$$

$$\Rightarrow \mathcal{M} = \mathcal{C}\mathcal{J}^T = 0_{t \times \ell}$$

Given a finite graph choose a tree & then know the connections: $v_b = \mathcal{C}^T v_t$, $i_b = \mathcal{J}^T i_\ell$, $\underline{0}_t = \mathcal{C}\, i_b$, $\underline{0}_\ell = \mathcal{J}\, v_b$

Then use laws of elements

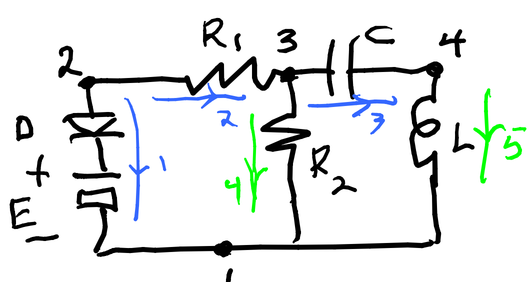


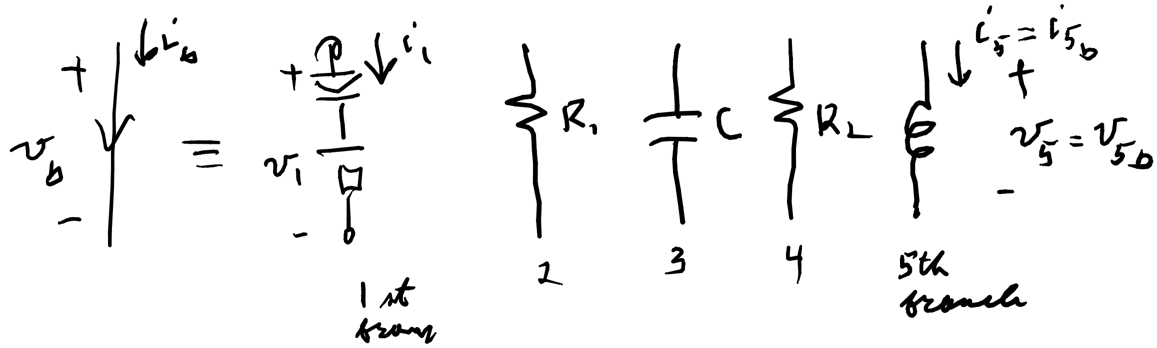
$\Rightarrow$

$$i_b = i + j$$
$$v_b = v + e$$

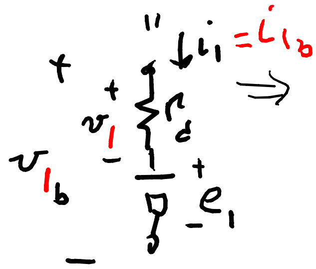
If linear then the component laws, $[v, i]$ are linearly related, if voltage controlled $i = g(v)$

$$A v = B i \quad ; \quad A \,\&\, B \text{ constant}$$





$$j = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} ; \quad e = \begin{bmatrix} E \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$



$\Rightarrow$ $A v = B i$

$$\left.\begin{aligned} v_1 &= r_d i_1 \\ v_2 &= R_1 i_2 \\ C s v_3 &= i_3 \\ v_4 &= R_2 i_4 \\ v_5 &= s L i_5 \end{aligned}\right\} \text{laws of components}$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & Cs & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \end{bmatrix} = \begin{bmatrix} r_d & 0 & 0 & 0 & 0 \\ 0 & R_1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & R_2 & 0 \\ 0 & 0 & 0 & 0 & sL \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \\ i_5 \end{bmatrix}$$

$s = d/dt$