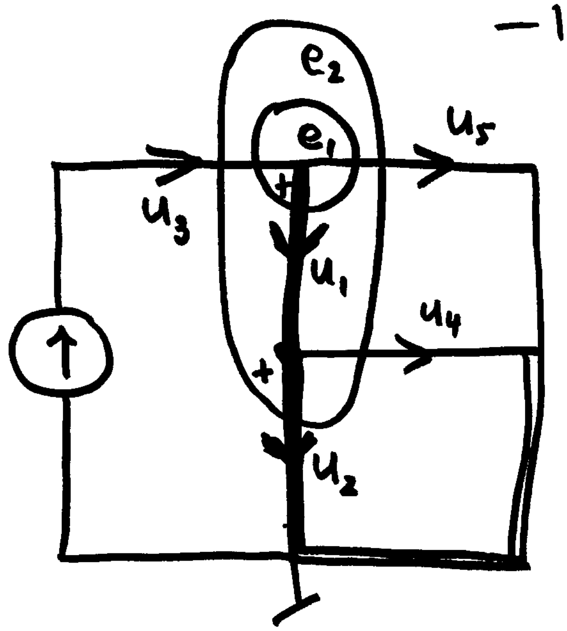

$$e_1 = u_1 = V_1 - V_2$$
$$e_2 = u_2 = V_2$$
$$u_3 = -e_1 - e_2$$
$$u_4 = e_2$$
$$u_5 = e_1 + e_2$$

Kirchhoff's current laws:

$$i_3 = i_1 + i_5 \qquad (1^{st} \text{ cutset})$$
$$i_3 = i_2 + i_4 + i_5 \qquad (2^{nd} \text{ cutset})$$

$$\Rightarrow \left| \begin{array}{l} I_0 = Y_1 \cdot e_1 + Y_C \cdot (e_1 + e_2) \\ I_0 = Y_L \cdot e_2 + Y_2 \cdot e_2 + Y_C \cdot (e_1 + e_2) \end{array} \right|$$

$$\Rightarrow \left| \begin{array}{l} I_0 = (Y_1 + Y_C) \cdot e_1 + Y_C \cdot e_2 \\ I_0 = Y_C \cdot e_1 + (Y_L + Y_2 + Y_C) \cdot e_2 \end{array} \right|$$

$$\Rightarrow \begin{bmatrix} I_0 \\ I_0 \end{bmatrix} = \begin{bmatrix} (Y_1 + Y_C) & Y_C \\ Y_C & (Y_L + Y_2 + Y_C) \end{bmatrix} \cdot \begin{bmatrix} e_1 \\ e_2 \end{bmatrix}$$

$$\Psi = \begin{array}{c} \\ e_1 \\ e_2 \end{array} \begin{array}{c} \begin{array}{ccccc} u_1 & u_2 & u_3 & u_4 & u_5 \end{array} \\ \left[\begin{array}{cc|ccc} 1 & 0 & -1 & 0 & 1 \\ 0 & 1 & -1 & 1 & 1 \end{array}\right] \end{array}$$

$$Y_b = \begin{array}{c} \\ i_1 \\ i_2 \\ i_3 \\ i_4 \\ i_5 \end{array} \begin{array}{c} \begin{array}{ccccc} u_1 & u_2 & u_3 & u_4 & u_5 \end{array} \\ \begin{bmatrix} 1/R_1 & & & & \\ & 1/sL & & 0 & \\ 0 & & 0 & & \\ & & & 1/R_2 & \\ & & & & sC \end{bmatrix} \end{array} ; \quad i_6 = \begin{bmatrix} 0 \\ 0 \\ I_0 \\ 0 \\ 0 \end{bmatrix}$$

$$\Rightarrow Y_n = \Psi \cdot Y_b \cdot \Psi^T$$

$$= \begin{bmatrix} \frac{1}{R_1} & 0 & 0 & 0 & sC \\ 0 & \frac{1}{sL} & 0 & \frac{1}{R_2} & sC \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ -1 & -1 \\ 0 & 1 \\ 1 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} \left(\frac{1}{R_1} + sC\right) & sC \\ sC & \left(\frac{1}{sL} + \frac{1}{R_2} + sC\right) \end{bmatrix}$$

$$\underline{v}_6 = -\Psi \cdot \underline{i}_6 = \begin{bmatrix} -1 & 0 & 1 & 0 & -1 \\ 0 & -1 & 1 & -1 & -1 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 0 \\ I_0 \\ 0 \\ 0 \end{bmatrix}$$

$$= \begin{bmatrix} I_0 \\ I_0 \end{bmatrix}$$

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