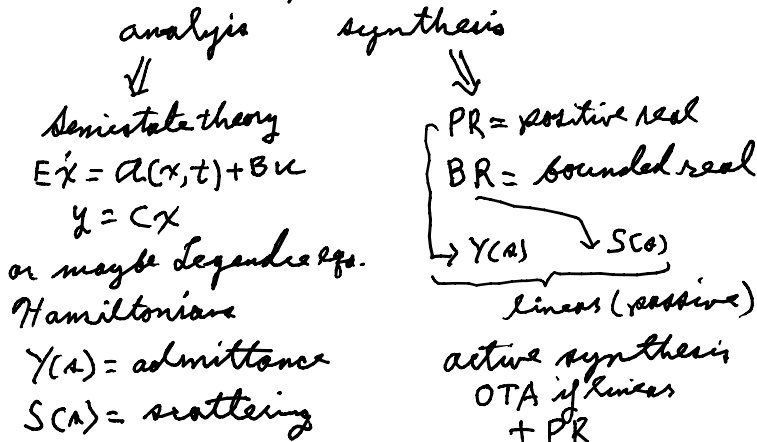
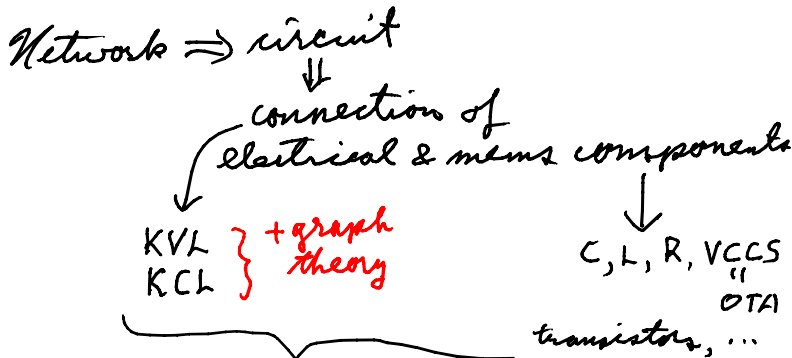
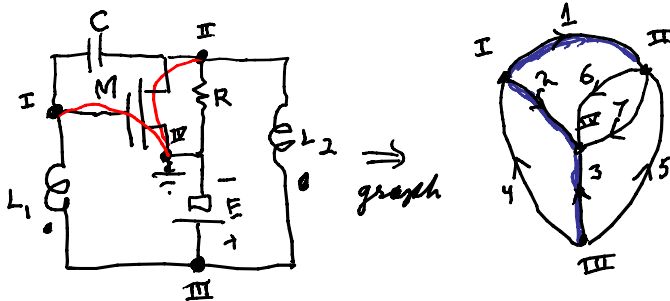


Electrical Network Theory

EE 610
08/31/10



Example: Hartley Oscillator

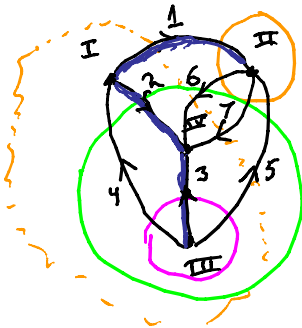


tree = connected set of branches which connect all nodes with no closed paths

- $n = \# \text{ of nodes} = 4$
- $b = \# \text{ of branches} = 7$
- $t = \# \text{ tree branches} = 3$
- $c = \# \text{ of cotree branches} = 4$
"leaves"

all for one "separate part". If more separate subgraphs have a tree for each and all the trees together are called a forest.

$$b = t + c, \quad t = n - 1, \quad c = b - t = b - n + 1$$



size $C = t \times b$

KCL:

$$1: 0 = i_1 + 0 \cdot i_2 + 0 \cdot i_3 + 0 \cdot i_4 + i_5 - i_6 - i_7$$

$$2: 0 = 0 \cdot i_1 + i_2 + 0 \cdot i_3 - i_4 - i_5 + i_6 + i_7$$

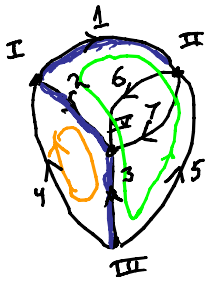
$$3: 0 = 0 \cdot i_1 + 0 \cdot i_2 + i_3 + i_4 + i_5 + 0 \cdot i_6 + 0 \cdot i_7$$

$$\begin{array}{c} + \\ - \\ - \end{array} \left| \begin{array}{c} i \\ i \\ i \end{array} \right.$$

Cut set equations

$$\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & -1 & -1 \\ 0 & 1 & 0 & -1 & -1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 0 & 0 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \\ i_4 \\ i_5 \\ i_6 \\ i_7 \end{bmatrix} \Rightarrow 0 = C i_b$$

\uparrow
cut set matrix



KVL:

$$4: 0 = 0 \cdot v_1 + v_2 - v_3 + v_4 + 0 \cdot v_5 + 0 \cdot v_6 + 0 \cdot v_7$$

$$5: 0 = -v_1 + v_2 - v_3 + 0 \cdot v_4 + v_5 + 0 \cdot v_6 + 0 \cdot v_7$$

$$6: 0 = v_1 - v_2 + 0 \cdot v_3 + 0 \cdot v_4 + 0 \cdot v_5 + v_6 + 0 \cdot v_7$$

$$7: 0 = v_1 - v_2 + 0 \cdot v_3 + 0 \cdot v_4 + 0 \cdot v_5 + 0 \cdot v_6 + v_7$$

$$\begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} = \begin{bmatrix} 0 & 1 & -1 & 1 & 0 & 0 & 0 \\ -1 & 1 & -1 & 0 & 1 & 0 & 0 \\ 1 & -1 & 0 & 0 & 0 & 1 & 0 \\ -1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \\ v_7 \end{bmatrix}; 0 = \mathcal{V} v_b$$

\uparrow
tie set matrix

size $\mathcal{V} = t \times b$

$$\begin{bmatrix} 0 & 1 & -1 & -1 \\ -1 & -1 & 1 & 1 \\ 1 & 1 & 0 & 0 \end{bmatrix} = K$$