file: c:\jiangyu\Courses_T\enee610\Fall04\HomeWork\HW2_1.mcd
HW2: Problem1 solution JY 10/27/04

a) (10)

Tree branches: 3, 4, 5, 6

Cut set 1: (3, 1, 7) i1+i3+i7=0
Cut set 2: (4, 2, 7) i2+i4-i7=0
Cut set 3: (5, 1, 2, 7) i1-i2+i5+i7=0
Cut set 4: (6, 1, 2, 7) -i1+i2+i6-i7=0

Cut set Matrix:

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

Tie set 1: (1, 3, 5, 6) V1-V3-V5+V6=0
Tie set 2: (2, 4, 5, 6) V2-V4+V5-V6=0
Tie set 3: (7, 3, 4, 5, 6) V7-V3+V4-V5+V6=0

Tie set Matrix:

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

b) (5)

Admittance matrix:

$$Ybb := \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ gm & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & gm & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & G & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & G & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

Using equality $-C*j=C*Ybb*C^T*Vt$

$$j := \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ i \end{bmatrix}$$

$$Left := -C \cdot j$$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & -1 \\ 1 & -1 & 0 & 0 & 1 & 0 & 1 \\ -1 & 1 & 0 & 0 & 0 & 1 & -1 \end{bmatrix} \cdot \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ i \end{bmatrix} = \begin{bmatrix} i \\ -i \\ i \\ -i \end{bmatrix} \qquad \text{Left} := \begin{bmatrix} -i \\ i \\ -i \\ i \end{bmatrix}$$

$Right=-C*Ybb*C^T*Vt$ Evaluate $C*Ybb*C^T$

$$\begin{bmatrix} 1 & 0 & 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 & -1 \\ 1 & -1 & 0 & 0 & 1 & 0 & 1 \\ -1 & 1 & 0 & 0 & 0 & 1 & -1 \end{bmatrix} \cdot \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ gm & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & gm & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & G & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & G & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 1 & -1 \\ 0 & 1 & -1 & 1 \\ 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & -1 & 1 & -1 \end{bmatrix}$$

$$C*Ybb*C^T= \begin{bmatrix} gm & 0 & gm & -gm \\ 0 & gm & -gm & gm \\ 0 & 0 & G & 0 \\ 0 & 0 & 0 & G \end{bmatrix}$$

$$\begin{bmatrix} -i \\ i \\ -i \\ i \end{bmatrix} = \begin{bmatrix} gm & 0 & gm & -gm \\ 0 & gm & -gm & gm \\ 0 & 0 & G & 0 \\ 0 & 0 & 0 & G \end{bmatrix} \times \begin{bmatrix} V3 \\ V4 \\ V5 \\ V6 \end{bmatrix}$$

$$\begin{bmatrix} V3 \\ V4 \\ V5 \\ V6 \end{bmatrix} = \begin{bmatrix} \frac{1}{gm} & 0 & \frac{-1}{G} & \frac{1}{G} \\ 0 & \frac{1}{gm} & \frac{1}{G} & \frac{-1}{G} \\ 0 & 0 & \frac{1}{G} & 0 \\ 0 & 0 & 0 & \frac{1}{G} \end{bmatrix} \cdot \begin{bmatrix} -i \\ i \\ -i \\ i \end{bmatrix} \quad \begin{bmatrix} \frac{-1}{gm}\cdot i + \frac{2}{G}\cdot i \\ \frac{1}{gm}\cdot i - \frac{2}{G}\cdot i \\ \frac{-1}{G}\cdot i \\ \frac{1}{G}\cdot i \end{bmatrix}$$

$$\begin{bmatrix} V3 \\ V4 \\ V5 \\ V6 \end{bmatrix} := \begin{bmatrix} \frac{-1}{gm}\cdot i + \frac{2}{G}\cdot i \\ \frac{1}{gm}\cdot i - \frac{2}{G}\cdot i \\ \frac{-1}{G}\cdot i \\ \frac{1}{G}\cdot i \end{bmatrix}$$

Vin=-V7=-V3+V4-V5+V6

$$Vin := 2\cdot\left(\frac{1}{gm} - \frac{1}{G}\right)\cdot i$$

Input admittance: Y(s)=i/Vin

$$Y(s) := \frac{1}{\left[2\cdot\left(\frac{1}{gm} - R\right)\right]}$$

c) (5)

as the example, replacing C by L:
This time look for zeros and poles of (Z(s)+Ls):

From note:09/15/04

$$Z(s) := 2\cdot\frac{((1 - gm\cdot R) + s\cdot R\cdot(4\cdot Cgd + Cgs))}{(gm + s\cdot Cgs)\cdot(1 + 4\cdot s\cdot R\cdot Cgs)}$$