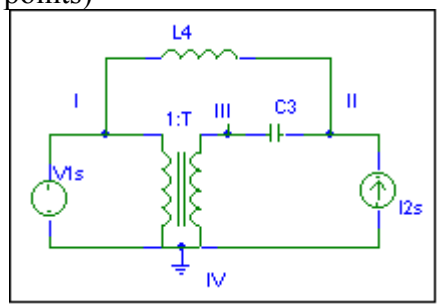
File: E:\courses\fall2007\610\hmwrk3.doc RWN 10/03/07

ENEE 610
Homework Problems for Grading, Set 4 (200 points)
Due at class W 10/10/07
Semi-state & state equations, lossless synthesis and complex Richards' functions

1.(100 points)



a) Draw the graph for the circuit numbering the nodes as shown, I to IV, and the branches by the element numbers (using 5 & 6 for the transformer). Orient the branches with arrows pointing down or to the right and choose the tree as branches 1 to 3.
b) Set up the semi-state equations choosing $u=[v1s\ i2s]^T$ and y as the voltage at node II with respect to ground.
c) Reduce the semi-state equations to state variable form.
d) Give the transfer function matrix, T(s) for Y(s)=T(s)U(s).
e) Determine if the entries of T(s) are positive real for positive element values, C3, L4 and T (the turns ratio).

2. (50 points)

Synthesize $z(s)=[s(s^2+5)/(s^2+3)]$ by the Foster and Cauer circuits.

3. (50 points)

Show that the Richards' type function $y_R(s)=y(k)[ky(k)-sy(s)]/[ky(s)-sy(k)]$ is "positive" when y(s) is positive real and $k=k_r+jk_i$ is a complex zero of the even part of y(s) with $k_r=Re(k)>0$.

Here "positive" is the "last" one of the defining three positive real conditions and means $Re(y_R(s))\geq 0$ for those $s=\sigma+j\omega$ for which $\sigma=Re(s)>0$. Re(.) means taking the real part; also $j=\sqrt{(-1)}$.