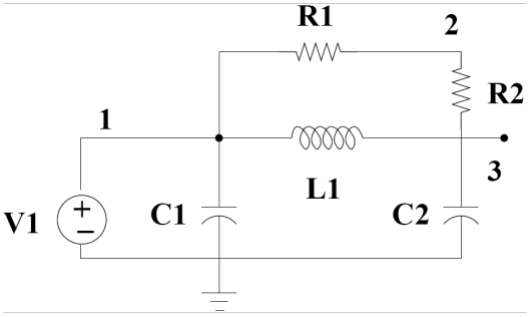
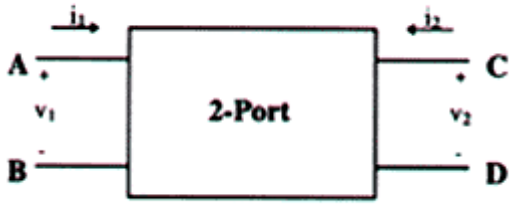
EE213 (Fall 2018)

Homework #1

Question 1
Use the element stamp method to build the MNA equations for the following RLC circuit:



Question 2
The 2-port shown below is defined in terms of its *h*-parameters

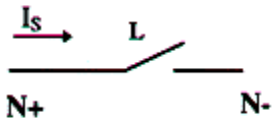


The h-parameters are defined as

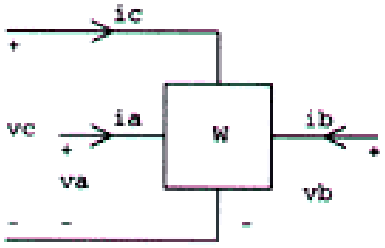
$$v_1 = h_{11}i_1 + h_{12}v_2$$
$$i_2 = h_{21}i_1 + h_{22}v_2$$

a) Write the MNA stamp for this element.
b) When can a plain nodal analysis be used for this element? Write the nodal stamp.

Question 3
The Boolean switch shown below is controlled by the logic variable L. The switch is closed when L=1 and open when L=0. Write the MNA stamp that is valid for the switch in both on and off conditions. Note the stamp will be a function of the values of L.



Question 4
Consider a 4-terminal element

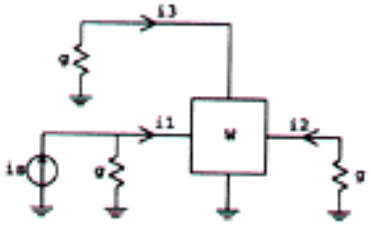


Described by the constitutive relation:

$$\begin{bmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix} \begin{bmatrix} v_a \\ v_b \\ v_c \end{bmatrix} + \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & -1 \\ 1 & 0 & 1 \end{bmatrix} \begin{bmatrix} i_a \\ i_b \\ i_c \end{bmatrix} = 0$$

a) Explain why you can *not* use plain nodal analysis for circuits with such an element.

b) Using any equation formulation approach you wish, generate the set of equations for the following circuit:



Question 5
Given a RLCM circuit (M here means the mutual inductance) in MNA form,

$$\begin{bmatrix} G + sC & A_l^T \\ -A_l & sL \end{bmatrix} \begin{bmatrix} v_n \\ i_l \end{bmatrix} = \begin{bmatrix} i_n(s) \\ 0 \end{bmatrix}$$

where, G is matrix for resistive components, C is matrix for capacitive elements and L is the matrix for inductive elements. A_l is the incident matrix for inductive branches. $I_n(s)$ is the

independent input current source. v_n and i_l is the node voltages and inductive branch current vectors.

(a) Drive the nodal analysis (NA) formation of the RLCM circuit based on the node reduction formula (Schur decomposition).
(b) In what condition that the NA formulation is not equivalent to the MNA formulation for the RLCM circuits.