03.3 ssan.mthd Methodology for impedance-based circuit analysis

It turns out we can follow essentially the same algorithm presented in Lec. 02.2 can.mthd for analyzing circuits in steady-state with impedance. There are enough variations that we re-present it here.
Let n be the number of passive circuit elements in a circuit, which gives $2n$ (v and i for each element) unknowns. The method is this.

1. Draw a *circuit diagram*.
2. Label the circuit diagram with the *sign convention* by labeling each element with the “assumed” direction of current flow.
3. Write *generalized Ohm’s law* for each circuit element and define the impedance of each element.
4. For every node not connected to a voltage source, write Kirchhoff’s current law (KCL).
5. For each loop not containing a current source, write Kirchhoff’s voltage law (KVL).
6. You probably have a linear system of $2n$ *algebraic* equations (and $2n$ unknowns) to be solved simultaneously. If only certain variables are of interest, these can be found by eliminating other variables such that the remaining system is smaller. The following steps can facilitate this process.
   a) Eliminate n (half) of the unknowns by substitution into the elemental equations (generalized Ohm’s law equations).
   b) Try substition to eliminate to get down to only those variables of interest and inputs.
   c) Solve the remaining system of linear algebraic equations for the unknowns

of interest.

Example 03.3 ssan.mthd-1

re: steady-state RL circuit analysis with a sinusoidal source

Given the RL circuit shown with current input $I_s(t) = A \sin \omega t$, what are $i_L(t)$ and $v_L(t)$ in steady-state?. Note that this is very similar to Example 02.3 can.exa-1, but we will use impedance methods.