ELEC 4700 MNA Building

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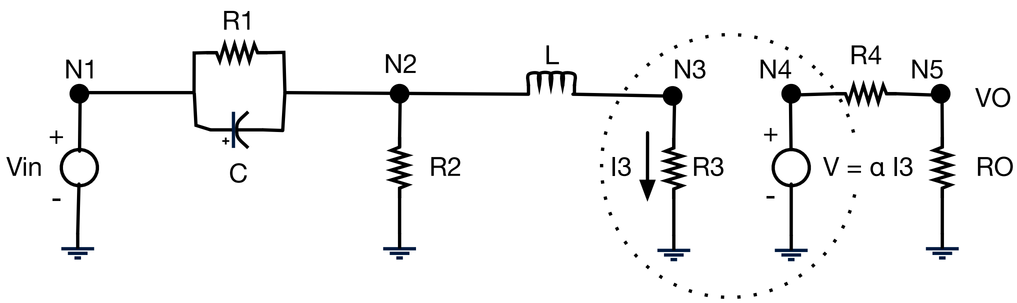
March 3[th], 2022. Due March 6[th] @ midnight.

Goal In this PA you will do a DC and AC analysis of a linear circuit using MNA techniques. The circuit you will analyze is:



with $R_1 = 1$, $C = 0.25$, $R_2 = 2$, $L = 0.2$, $R_3 = 10$, $\alpha = 100$, $R_4 = 0.1$ and $R_O = 1000$.

Tasks

1. Formulation:
   (a) Write out the 7 differential equations (you might use less or more depending on your formulation) that represent this network in the time domain using KCL ($\sum I = 0$ at each node). Equations of use:
      - $V = IR$
      - $I = C\frac{dV}{dt}$
      - $V = L\frac{dI}{dt}$ – for the inductor it is useful to declare a new variable I_L

   (b) Now write them in the frequency domain $\frac{dY}{dt} \rightarrow j\omega Y(\omega)$
   (c) Write down the matrices **C**, **G**, and the vector **F** that can be used to describe the network using:

$$\mathbf{C}\frac{d\mathbf{V}}{dt} + \mathbf{G}\mathbf{V} = \mathbf{F}$$

or

$$(\mathbf{G}{+}j\omega\mathbf{C})\mathbf{V} = \mathbf{F}(\omega)$$

2. Programing:
   (a) In Matlab create the **C**, **G** matrices.
   (b) For the DC case sweep the input voltage V_1 from -10V to 10V and plot V_O and the voltage at V_3.
   (c) For the AC case plot V_O as a function of ω also plot the gain $\frac{V_O}{V1}$ in dB.
   (d) For the AC case plot the gain as function of random perturbations on C using a normal distribution with $std = .05$ at $\omega = \pi$. Do a histogram of the gain.

Checkout When you are finished:

1. Create a new repo on your github account called MNPA
2. Clone the repo to your machine
3. Add your code to the repo, commit, and push it back to github
4. Check that it worked, if it did, you're all set