ECE 463/663 - Homework #2

State-Space, Eigenvalues, Eigenvectors. Due Monday, Jan 22nd
Please submit as a hard copy or submit on BlackBoard

1) For the following RLC circuit with C6 = 0(remove C6)

- Specify the dynamics for the system (write N coupled differential equations)
- Express these dynamics in state-space form
- Determine the transfer function from Vin to Y

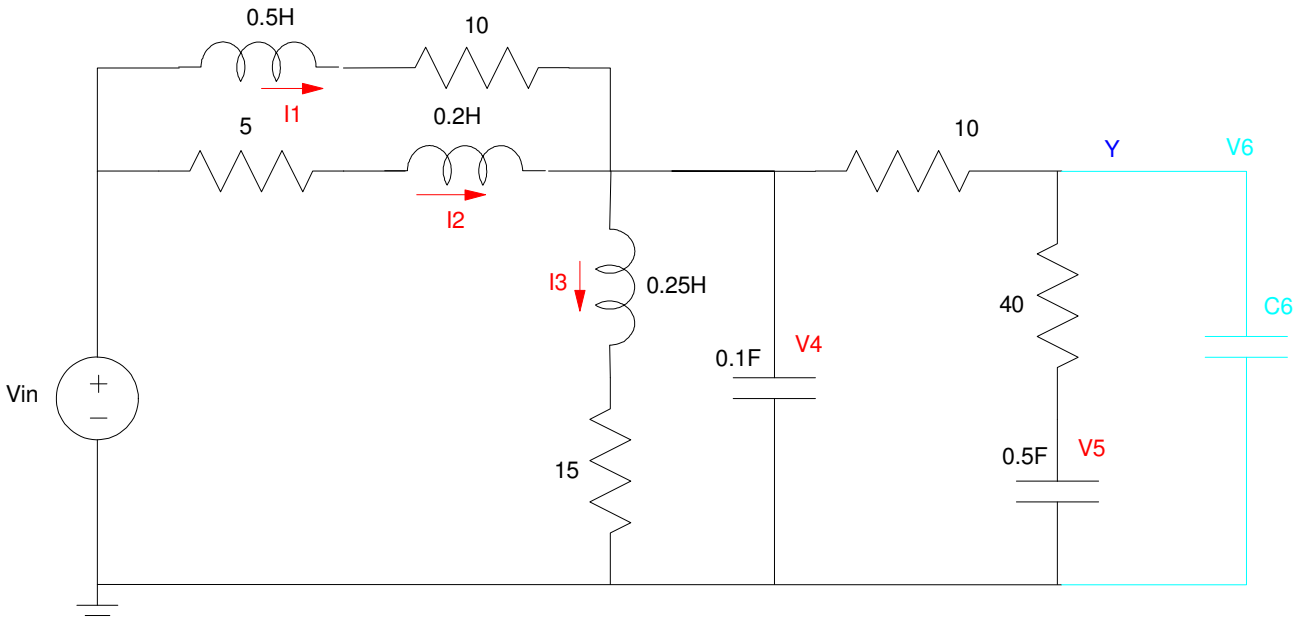
note: If you are having problems writing the equations with C6 = 0, change the problem. Let C6 = 0.001F then solve. This is a common engineering trick: change a problem so that it's easier to solve but doesn't change the flavor of the original problem

2) For the transfer function from V0 to V1

- Determine a 1st or 2nd-order approximation for this trasfer function
- Plot the step response of the actual 4th-order system and its approximation

3) For this circuit

- What initial condition will the energy in the system decay as slowly as possible?
- What initial condition will the energy in the system decay as fast as possible?



Problem 1 - 3. Set C6 = 0 or C6 = 0.001F (your pick)

Problem 4 - 7 (over)

Problem 4-7: 10-Stage RC Filter.

note: You can turn in the Matlab code along with screen shots of the plots if you like.

4) For the following 10-stage RC circuit

- Specify the dynamics for the system (write N coupled differential equations)
  - note: Nodes 1..9 have the same form. Just write the node equation for node 1 and node 10.
- Express these dynamics in state-space form
- Determine the transfer function from V0 to V10

5) For the transfer function for problem #4

- Determine a 2nd-order approximation for this trasfer function
- Plot the step response of the actual 10th-order system and its 2nd-order approximation

6) For the circuit for problem #4

- What initial condition will decay as slowly as possible?
- What initial condition will decay as fast as possible?

7) Modify the program *heat.m* to match the dynamics you calculated for this problem.

- Give the program listing
- Give the response for Vin = 0 and the initial conditions being
  - The slowest eigenvector
  - The fastest eigenvector
  - A random set of voltages