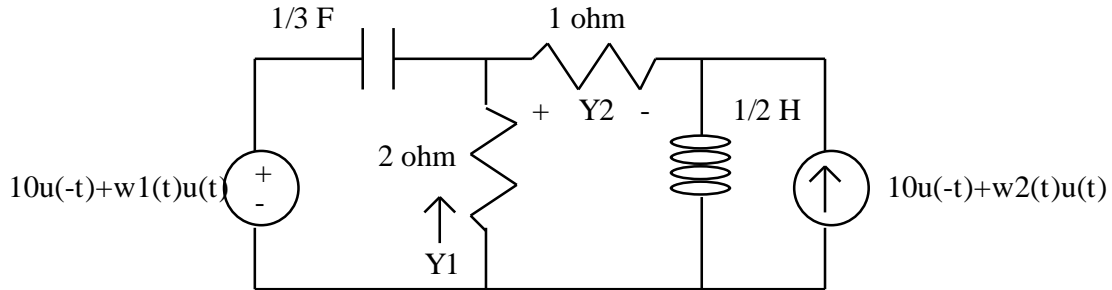
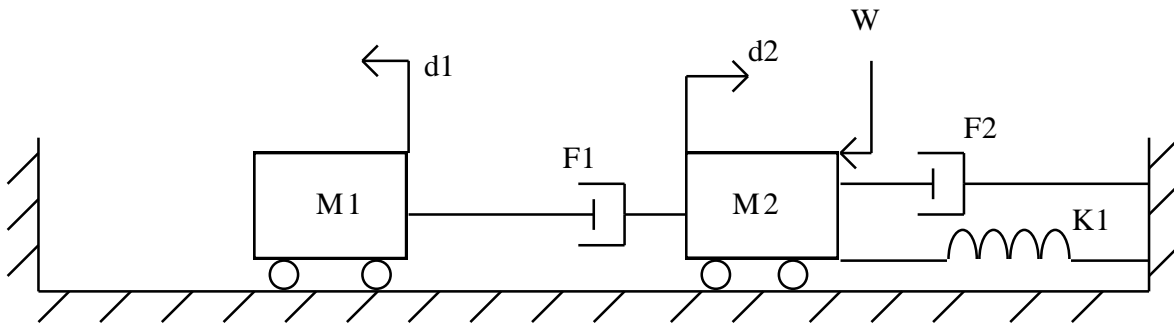


1. a) Find the state variable model of the form $\dot{x} = Ax + Bw, x(0^+)$
 $y = Cx + Dw$ for the following electrical network:



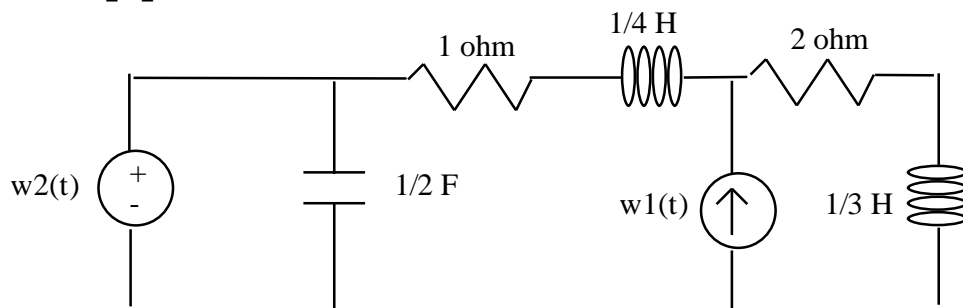
(make sure to include your initial conditions)

- b) Using the current-force analogy you learned today in class, find the analogous electrical circuit for the mechanical system below then write the state variable model .



2. a) Find a state variable model for the electrical network shown below. Be careful, there may be redundant state variables. (Hint: when there are redundant state variables, leave the corresponding element in the circuit (i.e., either the inductor or the capacitor). When you do the circuit analysis, use the V-I relationships $v=Ldi/dt$ or $i=Cdv/dt$ instead of Ohm's law when you encounter this element. The result is that instead of getting $Ax+Bw$ on the right hand side, you will get some extra derivatives of states or inputs or both.. If you have a derivative of a state variable on the right hand side, just move it over to the left hand side and include it with the other dx/dt terms. Then, divide both sides by resulting coefficient to leave just \dot{x} by itself. If you get a derivative of the input, just augment the input to include dw/dt as shown:

$$\dot{x} = Ax + B \begin{bmatrix} w \\ \dot{w} \end{bmatrix}$$



- b) I made the statement in class today that you could use a circuit emulation program (like PSPICE, Microcap, etc.) to find a state variable model for higher order circuits. For the 4th order circuit below, construct a tree and verify that the circuit is truly 4th order then use PSPICE or other circuit simulation program to find a state variable model for the circuit using superposition and replacing all of the capacitors by 1 volt voltage sources and replacing the inductors by 1 amp current sources. Assign the independent voltage and current sources to 1 volt/amp in turn, too. Use superposition to kill all but one of these sources at a time (i.e., make the value of the remaining sources equal to zero) thereby finding the contribution due to just one source at a time. Note that you will have to run PSPICE a total of 6 times to find the contribution of all 4 state variables (x) plus the two inputs (w).

