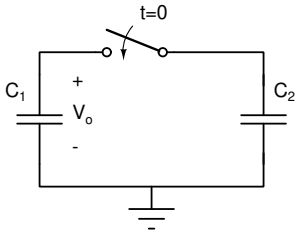
EC2015 Electric Circuits and Networks - Tutorial 5

September 13^{th}, 2019

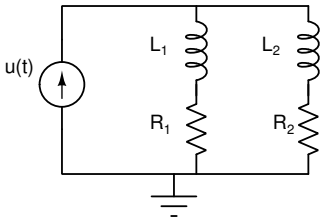
1. All plots must be roughly to scale

2. Key x and y axis values must be marked

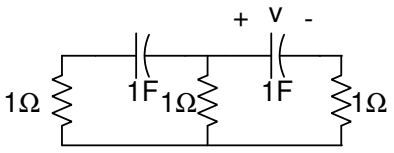
1. The initial voltage across C_1 is V_o. Find the voltage across the capacitors for $t > 0$.

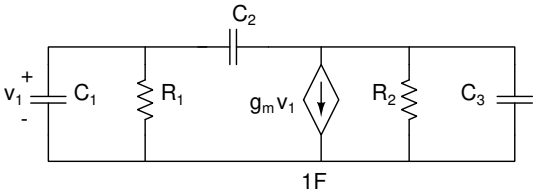


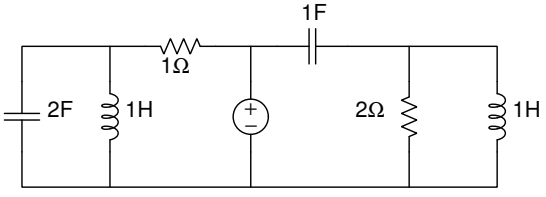
2. Find the step response of the following circuit.

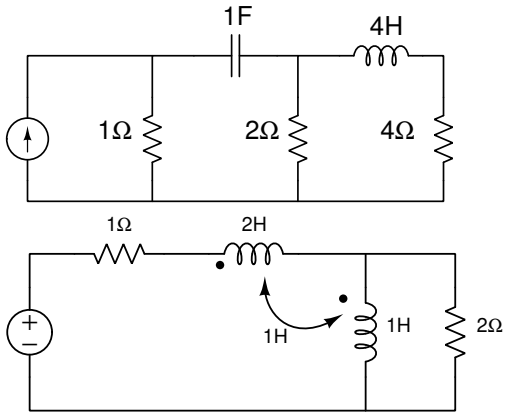


3. Find the natural frequencies of the following circuits by finding the zeros of the determinant of either the mesh/node basis matrix. In each case, check if the order of the circuit (no. of natural frequencies) corresponds to the number of independent initial conditions.









4. Construct the Bode plots for the following transfer functions
   (a) $H(s) = \frac{s(s+100)}{(s+2)(s+20)}$
   (b) $H(s) = \frac{(s+10)(s+40)}{s^2(s+100)}$
   (c) $H(s) = \frac{(s+10)(s+200)}{(s+20)^2(s+1000)}$

5. Define $Q = \frac{\omega_o}{2\alpha}$. Given an RLC circuit with a Q of 500, how many periods need one wait to have the envelop of the zero-input response reduced to 10 percent, 1 percent and 0.1 pecent of its peak value during the first period? In each case give an answer to the nearest 1/2 period.

6. A parallel RLC circuit has $\omega_o = 10rad/s$, $Q = 1/2$ and $C = 1F$. The initial conditions are $v_C(0) = 2V$ and $i_L(0) = 5A$.
   (a) Find the zero input response.
   (b) The input is a current source i_s connected in parallel to the network. Determine the step and impulse response
   (c) If the input is $i_s = \cos 2t\ u(t)$, find the zero state and the total response
   (d) With input at $i_s = \cos 2t\ u(t)$, is it possible to choose initial conditions so that there is no transient?

7. Find the zero state response of the following circuit if $I_{in}(t) = \cos t$.