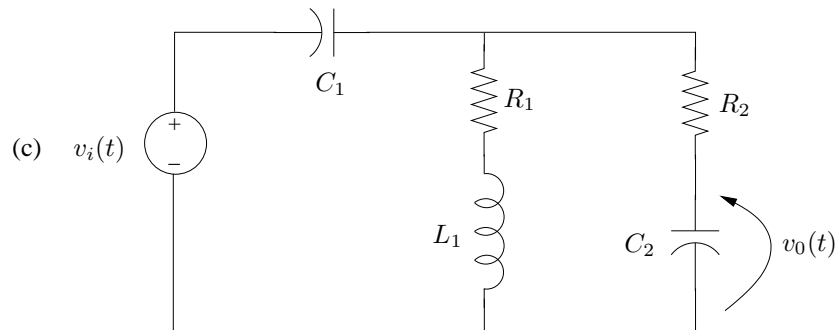
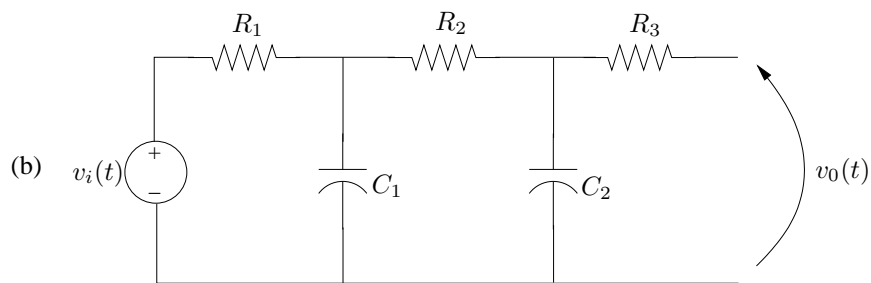
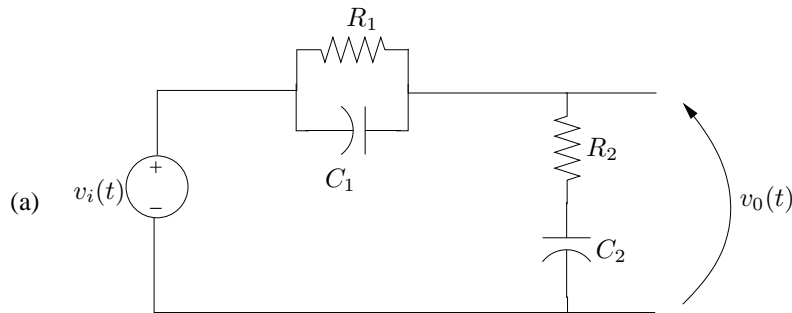


ELEC240 - Tutorial # 5

1. For each of the three circuits below, and assuming zero initial capacitor voltages, and zero initial inductor currents:

(a) Use direct Laplace Transform modelling methods to derive the transfer function $H(s) = V_o(s)/V_i(s)$.

(b) Using $H(s)$, determine the differential equation relating $v_o(t)$ to $v_i(t)$.



2. In circuit (c) above, use direct Laplace Transform domain modelling techniques to determine the relationship between $V_o(s)$ and $V_i(s)$ when the initial voltage across capacitor C_1 is $10V$ and the initial current through L_1 is $5A$.

3. Plot straight line approximations for the Bode Magnitude and Phase frequency responses of the following transfer functions.

(a)

$$H(s) = \frac{100}{s + 100}$$

(b)

$$H(s) = \frac{1000}{(s^2 + 110s + 1000)}$$

(c)

$$H(s) = \frac{1000(s + 1)}{(s^2 + 110s + 1000)}$$

(d)

$$H(s) = \frac{1000(s - 1)}{(s^2 + 110s + 1000)}$$

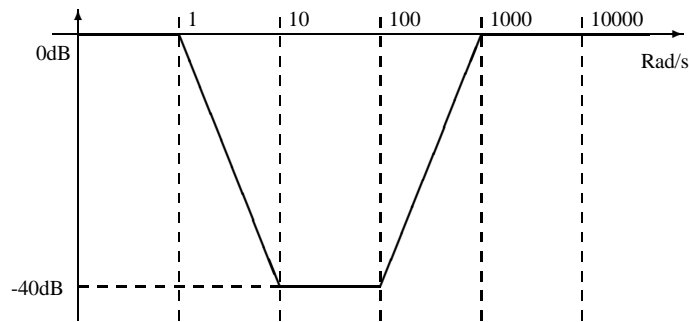
(e)

$$H(s) = \frac{100}{(s^2 + 4s + 100)}$$

(f)

$$H(s) = \frac{10}{s^2 + 10s}$$

4. Design a filter transfer function $H(s)$ that achieves the ‘notch’ filter effect shown below. Is this filter unique? Plot the straight line approximation to the Bode phase response of the filter you design.



5. A system has impulse response

$$h(t) = \begin{cases} 2e^{-3t} & ; t \geq 0 \\ 0 & ; \text{Otherwise} \end{cases}$$

and is fed the input signal

$$u(t) = \begin{cases} 3 \cos 2t & ; t \geq 0 \\ 0 & ; \text{Otherwise} \end{cases}$$

- (a) In steady state (in the limit as $t \rightarrow \infty$) what is the output $y(t) = [h \otimes u](t)$ of the system?
(b) Assuming that $y(t)$ and all its derivatives are zero for $t < 0$, compute the complete (not just steady state - transient component as well) response $y(t) = [h \otimes u](t)$ using any method you wish.

6. A system has impulse response

$$h(t) = \begin{cases} \cos \omega_0 t & ; t \in [0, T] \\ 0 & ; \text{Otherwise} \end{cases}$$

Derive and sketch the magnitude frequency response of this system. What sort of filtering action is being implemented?