Networks and Systems EEL 3123, Section 1
HOMEWORK 3 – Assigned Oct 13, 2011, Due on Oct 19, 2011

Covers Chapter 14. If there are doubts, you are welcome to see me and discuss your problems. Your notes and the textbook should be ample material to solve these problems:

1. Draw an RC low pass filter and connect a resistor R_L in parallel with the capacitor C.

   (a) Derive the expression for the voltage transfer function V_o/V_i.

   (b) At what frequency will the magnitude of $H(j\omega)$ be maximum?

   (c) What is the maximum value of the magnitude of $H(j\omega)$?

   (d) At what frequency will the magnitude of $H(j\omega)$ equal its maximum value divided by $\sqrt{2}$?

2. Draw an RC high pass filter and connect a resistor R_c in series with the capacitor C.

   (a) Derive the expression for the voltage transfer function $H(s) = V_o/V_i$.

   (b) At what frequency will the magnitude of $H(j\omega)$ be maximum?

   (c) What is the maximum value of the magnitude of $H(j\omega)$?

   (d) At what frequency will the magnitude of $H(j\omega)$ equal its maximum value divided by $\sqrt{2}$?

3. Draw a bandpass filter with $R = 300\Omega$, $L = 400\mu H$, and $C = 25nF$. Find (a) ω_o,(b) f_0, (c) Q (d) ω_{c1}, (e) f_{c1}, (f) ω_{c2}, (g) f_{c2}, and (h) β.

4. Draw an LC parallel combo and put it in series with resistance R. The input voltage v_i is applied to this circuit and output voltage is measured across R.

   (a) Show via physical arguments that this is a bandreject filter.

   (b) Support your argment above by finding the voltage transfer function of the filter.

   (c) Derive the expression for center frequency.

   (d) Derive expressions for ω_{c1} and ω_{c2}.

   (e) Derive the expression for bandwidth.

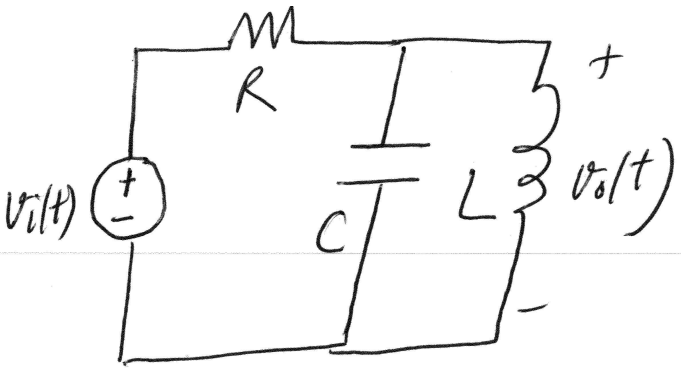
   (f) Derive the expression for quality factor.

5. In the above problem, let C = 5uF, specify L and R such that the filter has a center frequency of 4 KHz and a quality factor of 5.

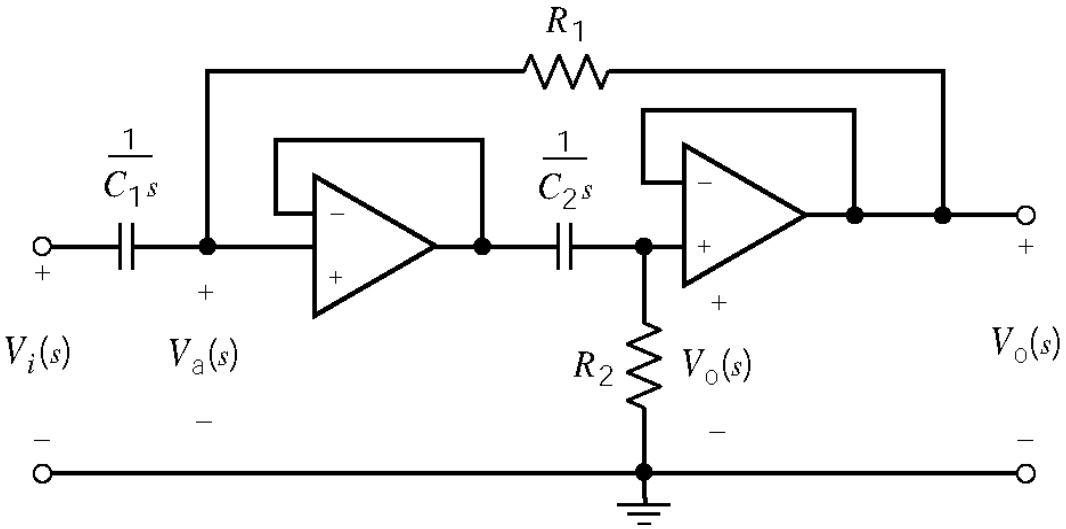
6. A general band-pass filter can be represented by the transfer function:

$$H_B(s) = k\left(\frac{\frac{\omega_0}{Q}s}{s^2 + \frac{\omega_0}{Q}s + \omega_0^2}\right)^m$$

Write the transfer function of the filter shown in the figure below and design it to have: k=1, ω_0=1000 rad/s, Q=1.



7. Consider the circuit shown in the Figure below. Solve the circuit equations and obtain its transfer function. What kind of a filter do you obtain? Justify your answer.


R_1
$\frac{1}{C_1 s}$
$\frac{1}{C_2 s}$
$V_i(s)$
$V_a(s)$
R_2
$V_o(s)$
$V_o(s)$