Spring 2004; E4215: Analog Filter Synthesis and Design; HW2

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due on 11 Feb. 2004

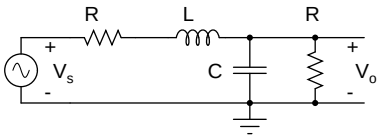

Figure 1:

1. (3 pts.) Determine $V_o(s)/V_i(s)$ for the filter in Fig. 1. Determine R in terms of L and C such that the Q is maximum. What is the maximum Q? What is ω_p under this condition?

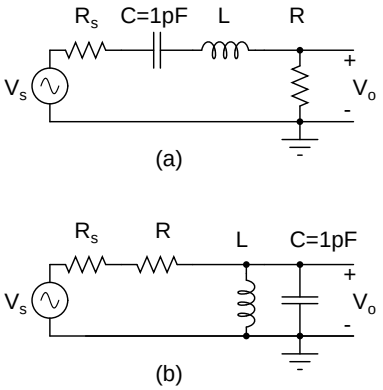

Figure 2:

2. (4 pts.) For each of Fig. 2(a) and Fig. 2(b), (a) Assuming $R_s = 0$ determine L and R so that a bandpass filter with $\omega_p/2\pi = 2.5\,\text{GHz}$[1] and a -3dB bandwidth of 0.5 GHz is realized. (b) If $v_s(t)$ is a 1V sinusoid at 2.5 GHz, what is the current flowing through the input source? (c) What is the value of R_s, the source resistance, that results in a 10% deviation in Q?

[1]This means that $\omega_p = 2\pi \times 2.5\,\text{Grad/s}$

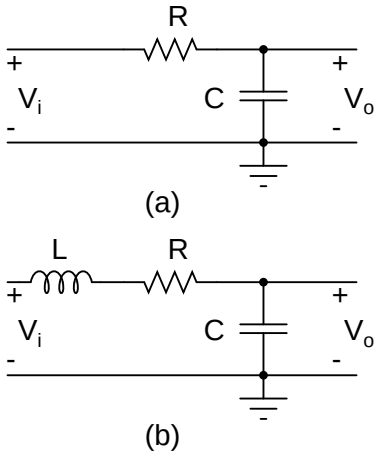

Figure 3:

3. (3 pts.) What is the bandwidth of the circuit in Fig. 3(a)? If you were allowed to place a series inductor L as in Fig. 3(b), what value would you choose for it to maximize the bandwidth without introducing peaking in the magnitude response? What is the resulting bandwidth? Sketch the frequency responses of the two circuits.

4. (3 pts.) (a) Design a second order opamp-RC Butterworth filter with dc gain=2 and -3dB bandwidth=1 MHz. Assume that all capacitors are of equal value of 100 pF. Give the transfer function and all the component values in the opamp-RC filter schematic.

   (2 pts.) (b) Sketch the magnitude and phase re-

sponse of the transfer function from the input to the output of each of the opamps.

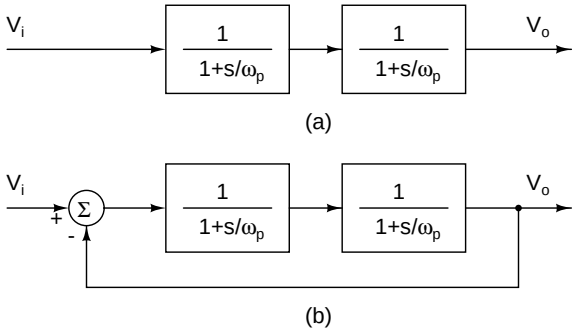

Figure 4:

5. (5 pts.) Evaluate the transfer function $V_o(s)/V_i(s)$ in Fig. 4(a, b). What is the resonant frequency and the quality factor of the two transfer functions? Sketch the magnitude and phase responses in the two cases (overlaid on the same axes).