Assignment 5

1 Design Exercises

1.1 (5 points)

Design a low-pass shelving filter with its gains ratio $|G(f_{low})|/|G(f_{high})| = 5$ using combination of resistors and a capacitor. Do not worry about its roll off frequency position. Show the general expression for the transfer function. Keep the expression for the transfer function in the complex form: do not separate magnitude and phase.

1.2 (5 points)

Using Multisim, simulate the filter from the above problem. Tune components values to achieve magnitude of the amplitude gain of about 1/2 at frequency of 10 kHz. You filter should maintain its characteristics for loads with resistance above 10 kΩ. Generate and show the relevant Bode plot.

1.3 (5 points) (Can be done after the lab)

Derive the transfer function expression for the notch filter shown in figure 1 Keep the expression for the transfer function in the complex form: do not separate magnitude and phase.

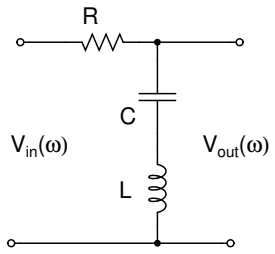

Figure 1: A notch filter circuit.

1.4 (5 points) (Can be done after the lab)

Using Multisim, simulate the filter from the above problem. Chose R=100 Ω. Tune components values to achieve maximum suppression at f=1 kHz. What are the values for C and L? Generate and show the relevant Bode plot.

Make resistor factor of 10 larger. In which case stop band (a band with maximum attenuation) is smaller? Show a plot which proves it.

2 Lab 5: AC filters

Always start with a circuit diagram and only then build it in hardware.

Your notebooks must be complete, understandable, and address all activities, design exercises, observations, and questions noted in the laboratory's procedures. Remember to use your notebook as a laboratory journal and record your data, design calculations, notes and scratch work. *Make sure to write a conclusion for each exercise and each week.*

Task 0

Demand

- a tutorial on potentiometers or variable resistors

Task 1 (20 points) Filter with exact f_{3dB}, Duration 1 hour

Build a low-pass filter which has $f_{3dB} = 1250$ Hz, the filter should be capable to drive loads as low as 100 kΩ. Show all steps for design and tests. I.e. how did you set the frequency and how did you check the filter performance.

Task 2 (30 points) Low-pass shelving filter, Duration: 1 hour

Build the low-pass shelving filter from DE 2. Confirm that it operates according to the design by measuring the Bode plot.

Connect a load of 10 kΩ and prove that the filter performance is unchanged.