Lab 1 Report

Objective:

The purpose of the lab is to investigate the frequency response of first-order circuits and learn the fundamentals about circuit analysis and design in the frequency domain.

Introduction:

To teach the objective is done by analyzing both a 1st order low and high pass filter consisting of only a couple of resistors and capacitors. First, I derived the transfer functions for both the high and low pass filters. Then, using the derived transfer functions, I was able to calculate some resistor and capacitor values that I could use in order to perform the practical portion of the lab. From there, I calculated and sketched both the Bode magnitude and phase plots. Then I calculated the output voltage for both circuits for the 2 inputs: . and . After doing all of this by hand, I put both of my circuits into Multisim to confirm whether or not my calculations were correct, testing for the same inputs as earlier. Then after I finished my simulations, I put the circuit together and measured them to make sure that my values would work in real life.

Calculations:

Simulation Plots:

Experimental Plots:

Calculated vs. Experimental Values:

For the Bode plots, for both the high and low pass circuits, the experimental values mostly matched the calculated simulated values. Any variations in the values could mostly be attributed to extra resistances or any other unaccounted for variables it the wires or in the equipment used. However, the waveforms were vastly off from many of the calculated waveforms and values from those waveforms. For the low pass filter waveforms of both frequencies and amplitudes, the experimental phase shift was completely different. The calculated phase shift for the low pass filter was 38.659 and 45.8294 degrees for the 4 kHz and 6 kHz inputs respectively. However, the phase shifts for both experimental values was 0 for both. I believe that the discrepancy in values was due to incorrect use of the probes. While the circuit was set up correctly, the way the output was measured (using which wires going to different parts of the circuit) was incorrect and led to faulty values.

This problem carried into all of the other waveforms (though to a lesser degree). While the phase angles were close to the calculated values, the amplitudes of the output voltages were off for a couple of the plots. I suspect this is due to where the probe wire was located in relation to the parallel junction, such as before or after a split in the circuit.

Possible Uses for These Filters:

A great use for these filters is to filter out any unwanted frequencies in audio equipment such as any piercing noises (using low pass filter) or getting rid of junk signals using both filters. The 2 filters together could be combined to make a band pass filter. The filters, both by themselves and in conjunction with each other, are used in image filtering as well as audio equalization. They are in all modern audio equipment from earphones to speakers for concerts.