ECEN 214 - Lab Report

Lab Number: 9

Lab Title: AC Response of a 2nd Order Circuit

Section Number: 502

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Introduction:

In this lab, we were able to further our knowledge about 2nd order circuits. Instead of using a direct current (DC) input, we use an alternating current (AC) input into the circuit. This is done by using sinusoidal voltage while focusing on the steady- state response.

Task 1:

The first portion of the lab was to make the circuit presented in the lab manual as figure 9.1. After building the circuit, we used the various component values from the prelab to complete the circuit for the various Q values. One will then use a sine wave to input the voltage. We will then be able to measure the values for the amplitude of input voltage, amplitude of output voltage, and phase difference between input and output voltage. We also measured the frequencies asked in the manual.

Task 2:

The same process was done for task two. The only difference was instead of using the original circuit, we used the circuit in Figure 9.4..

Data and Results:

Theoretical:

Calculating R1,R2, C1, and C2:

$$\omega_0 = \sqrt{\frac{1}{R_1 C_1 R_2 C_2}} = \sqrt{\frac{1}{(10{,}000)(1*10^{-6})(500)(25*10^{-6})}} = 89.44$$

$$Q = \sqrt{\frac{C_1}{C_2} * \frac{R_{eq}}{R_1+R_2}} = \sqrt{\frac{(1*10^{-6})}{(25*10^{-6})} * \frac{10{,}500}{(10{,}000)+(500)}} = 0.5$$

Calculating Phase Difference:

$$T = \frac{1}{f} = \frac{1}{32} = 0.0312$$

$$\text{Pd} = \frac{360*Td}{T} = \frac{360*(0.0312)(0.01)}{(0.0312)} = 3.5$$

Calculating Cut-off Frequency:

$$Cut - off\ Frequency = \frac{|V_{out}(t)|}{|V_{in}(t)|} = \frac{|1|}{|\sqrt{2}|} = 0.707$$

Measured:

Task 1:

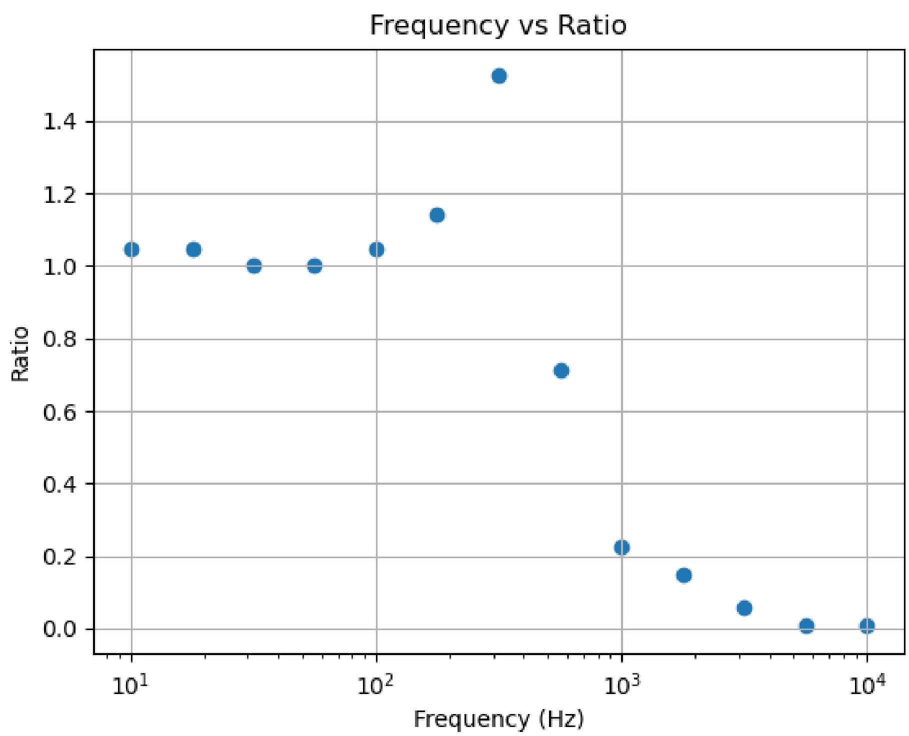
Freq(Hz)	Input Voltage	Output Voltage	Phase Difference	Ratio
10	2.1	2.2	6.75	1.047
18	2.1	2.2	3.16	1.047
32	2.1	2.1	3.32	1
56	2.1	2.1	5.03	1
100	2.1	2.2	7.12	1.047
178	2.1	2.4	18.904	1.143
316	2.1	3.2	50.872	1.524
562	2.1	1.5	137.2576	0.714
1000	2.1	0.47	158.08	0.224
1778	2.1	0.31	165.1008	0.148
3162	2.1	0.12	159.0048	0.057
5623	2.1	0.015	232.5936	0.007
10000	2.1	0.015	287.68	0.007

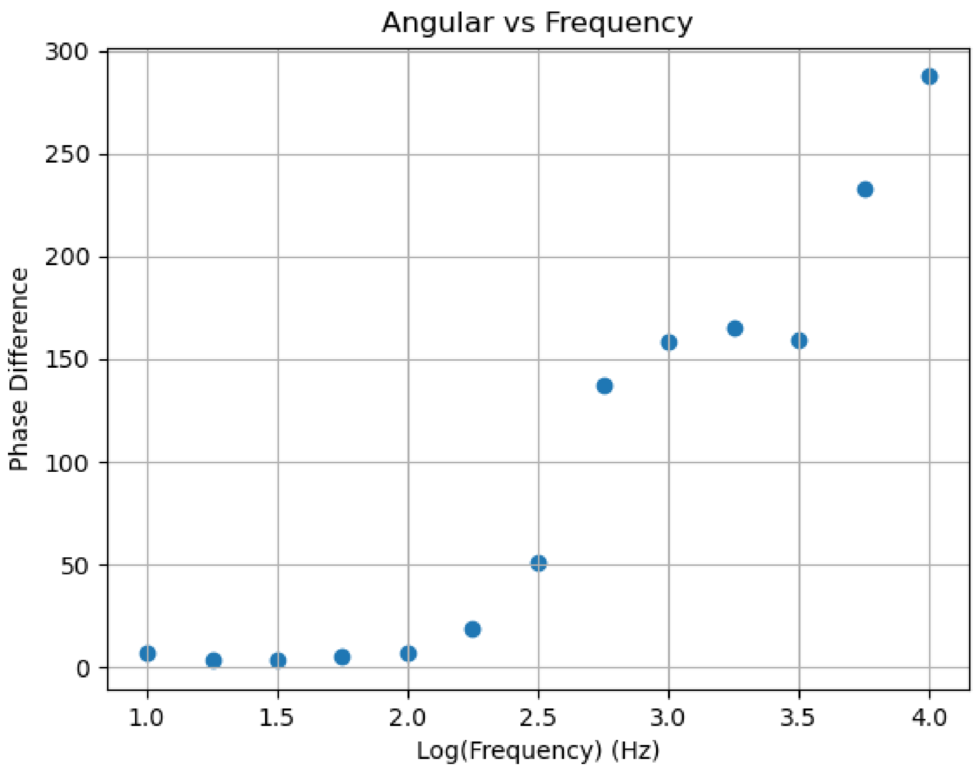
Task 2:

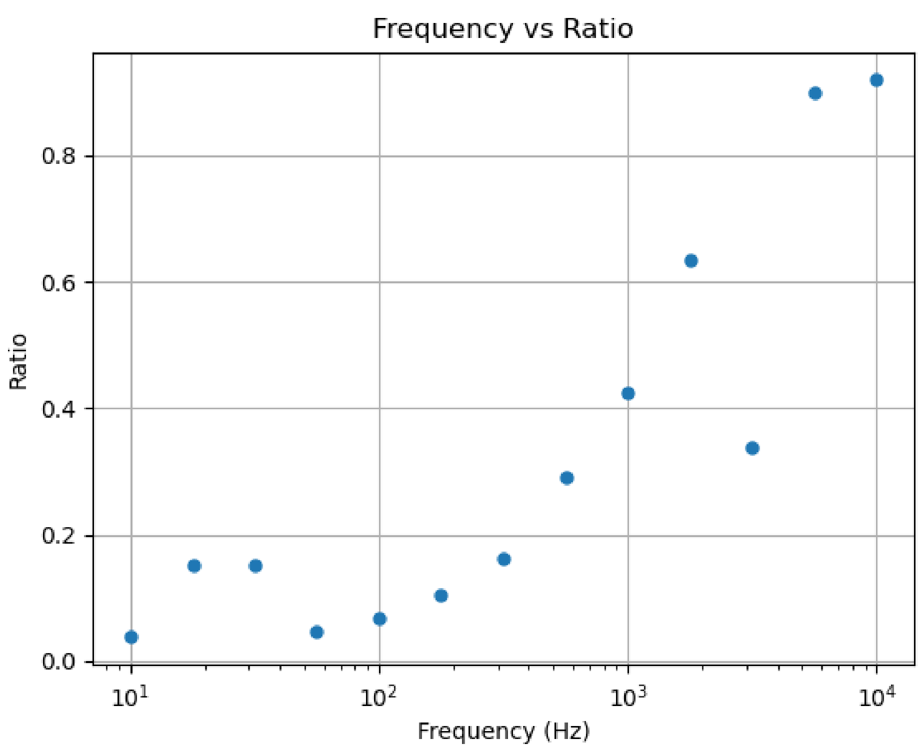
Freq(Hz)	Input Voltage	Output Voltage	Phase Difference	Ratio
10	2.1	0.08	6982	0.038
18	2.1	0.32	1489	0.152
32	2.1	0.32	11092	0.152

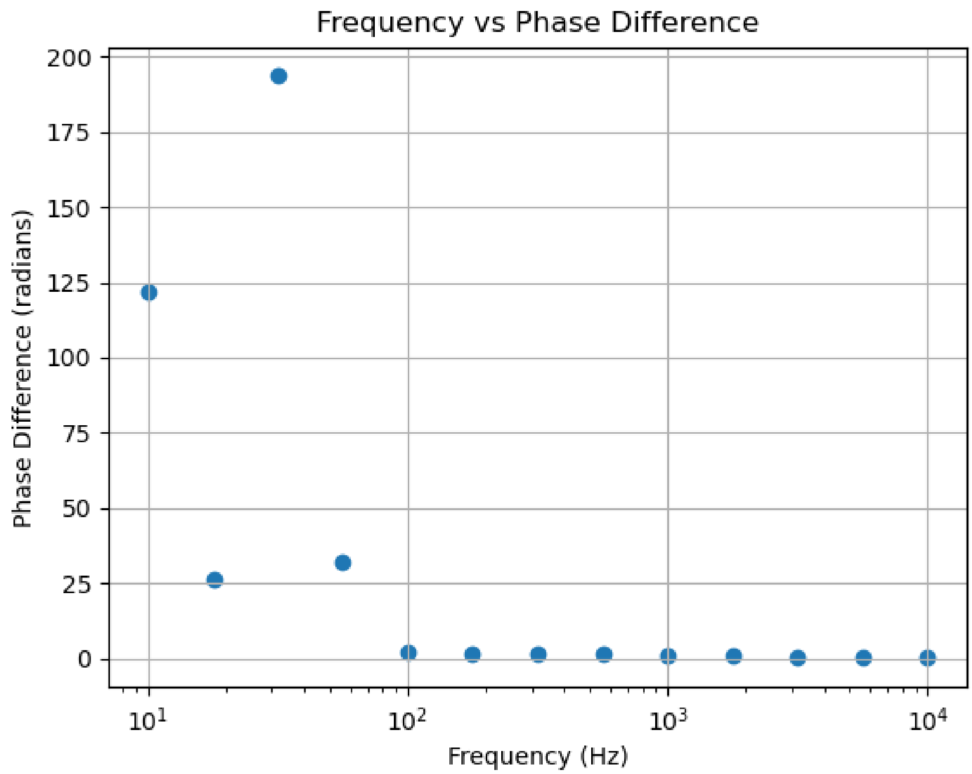
56	**2.1**	**0.10**	**1822**	**0.048**
100	**2.1**	**0.14**	**127**	**0.067**
178	**2.1**	**0.22**	**98**	**0.105**
316	**2.1**	**0.34**	**89.6**	**0.162**
562	**2.1**	**0.61**	**79**	**0.29**
1000	**2.1**	**0.89**	**64**	**0.424**
1778	**2.1**	**1.33**	**48**	**0.633**
3162	**2.1**	**0.71**	**33**	**0.338**
5623	**2.1**	**1.89**	**15**	**0.90**
10000	**2.1**	**1.93**	**6.53**	**0.919**

Plots:




Angular vs Frequency
Phase Difference
Log(Frequency) (Hz)
0
50
100
150
200
250
300
1.0
1.5
2.0
2.5
3.0
3.5
4.0


Frequency vs Ratio
Ratio
Frequency (Hz)
0.0
0.2
0.4
0.6
0.8
10^1
10^2
10^3
10^4



Discussion:

The frequencies in the first task showed that as it increased, the frequencies continued to decrease. This showed an inverse relationship. The second task showed that the frequencies also decreased. Since the frequencies have an inverse relationship, in the first task, it would be appropriate to increase the capacitor as the resistor values decrease. We would do the opposite for the second task. Some changes that could have been made were the capacitor values for the different Q values. The capacitor and resistor values needed could have been changed in order to match the values allowed for this course. We would like to experiment with different values of the capacitors and resistors to get the closest approximation to those measured values from courses allowed with different components