EE 316: Electrical Circuits and Electronic Design Laboratory.

Lab 10

Amplification of a Signal at Low/High Frequencies Using BJTs.

Submitted by: **Dan Otieno.**

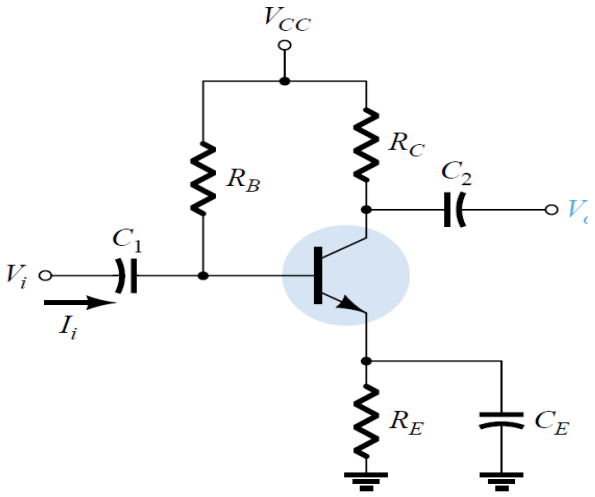
Date of Experiment: 10/31/22.

INTRODUCTION:

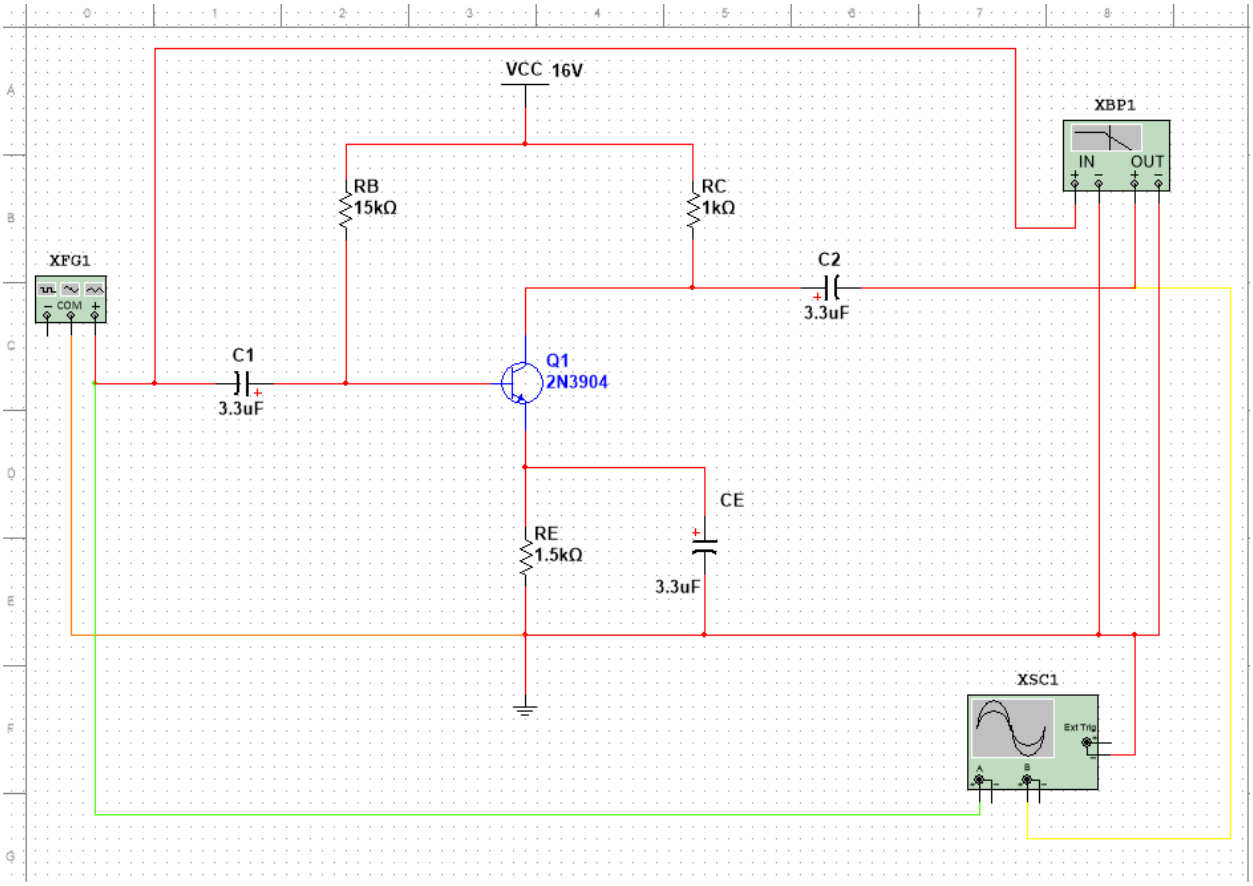
This lab involved designing and analyzing signal-amplifying circuits using BJTs. We used the same BJT configuration (2N3904) from the previous lab and analyzed circuit designs with two different inputs.

EXPERIMENTATION:

The first part of the lab was to design and simulate the circuit shown below:



The circuit was completed in Multisim as shown:



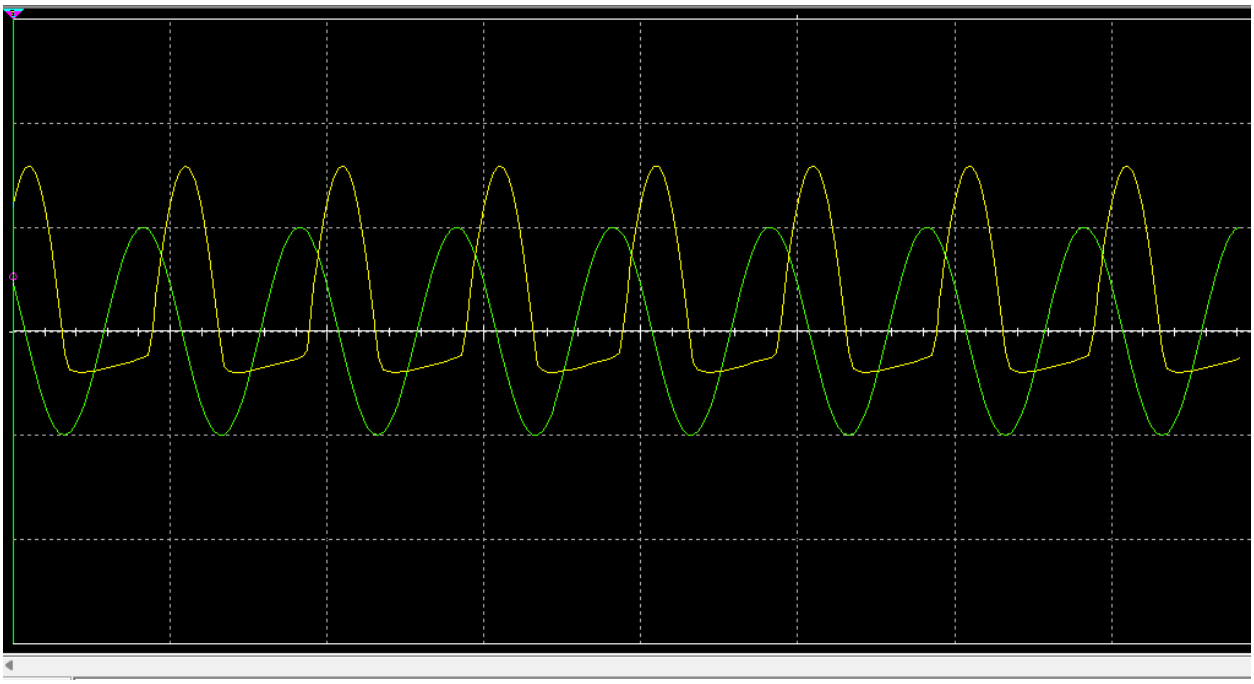
The input signal was 100mVpp (configured in the Function Generator). Resistor values tested at both input signals were; R_B = 15KΩ, R_C = 1KΩ, R_E=1.5KΩ and V_{cc} = 16V.

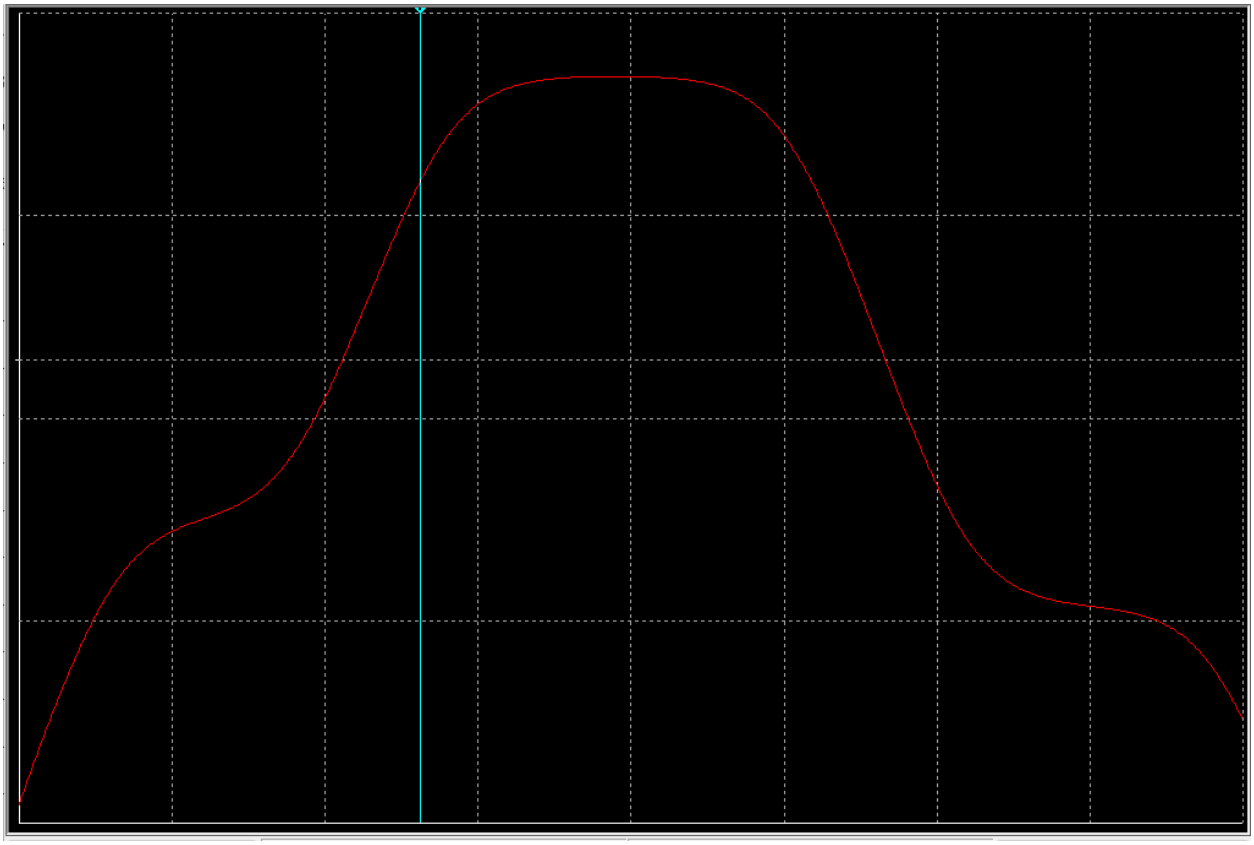
The following simulation results were obtained for an input signal of 100mVpp:

Frequency	Vout	Voltage Gain
10	**22 mV**	**-19.17 dB**
30	**54.5 mV**	**-11.29 dB**
60	**75.9 mV**	**-8.41 dB**
100	**85.4 mV**	**-7.39 dB**
200	**93.7 mV**	**-6.59 dB**
500	**519 mV**	**8.28 dB**
1 KHz	**1.98 V**	**-1.57 dB**
2 kHz	**4.88 V**	**3.12 dB**
5 KHz	**8.56 V**	**8.67 dB**

10 KHz	**9.19 V**	**11.09 dB**
15 KHz	**9.29 V**	**11.74 dB**
20 KHz	**9.31 V**	**11.98 dB**
50 KHz	**9.34 V**	**12.25 dB**
75 KHz	**9.35 V**	**12.27 dB**
100 KHz	**9.35 V**	**12.26 dB**
150 KHz	**9.33 V**	**12.23 dB**
200 KHz	**9.28 V**	**12.17 dB**
500 KHz	**9.34 V**	**11.49 dB**
750 KHz	**9.40 V**	**10.61 dB**
1 MHz	**9.31 V**	**9.38 dB**
1.5 MHz	**8.27 V**	**7.62 dB**
2.0 MHz	**8.53 V**	**5.84 dB**

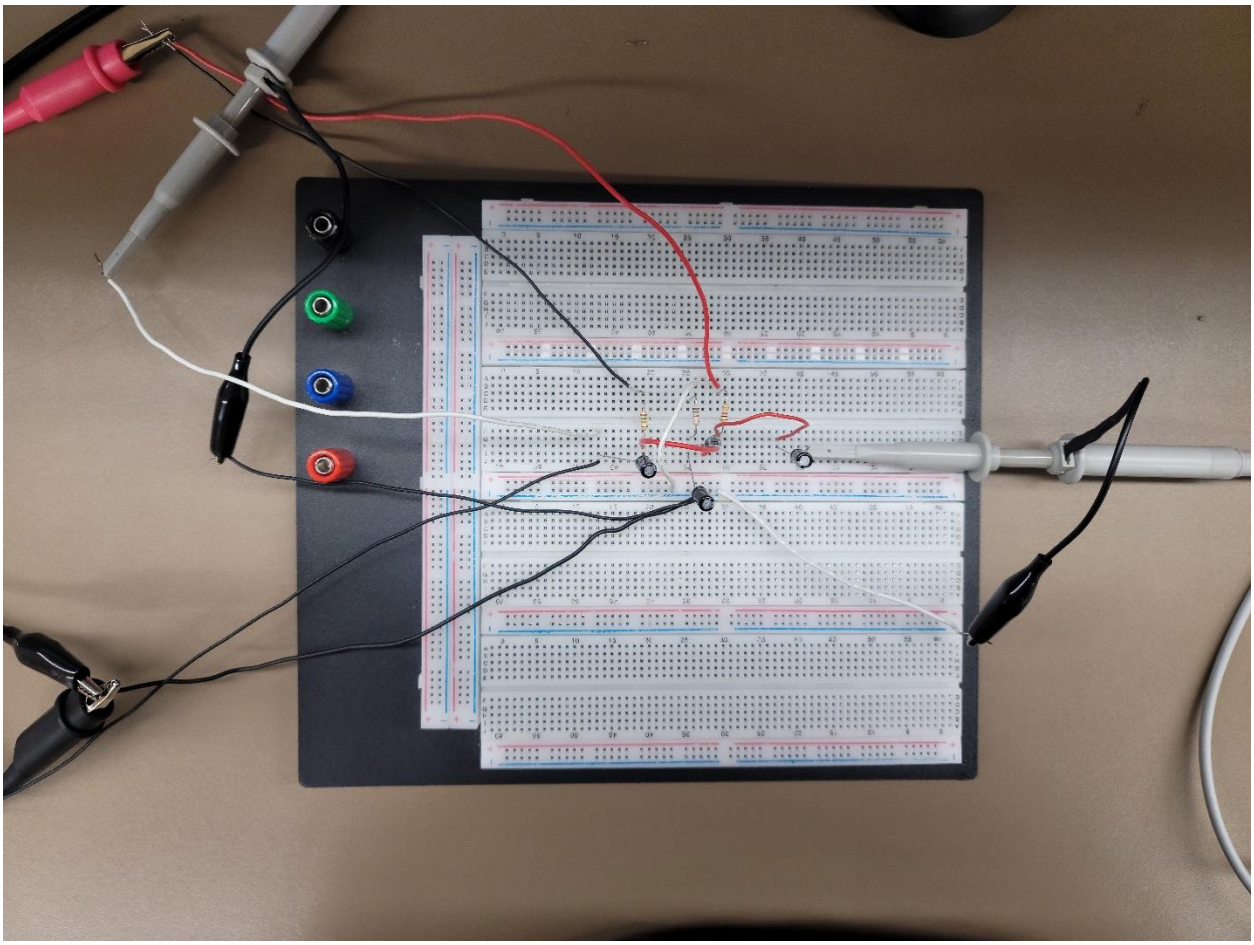
The simulation output wave (at 1KHz) and bandwidth plot are shown below:





For the digital design/analysis portion of the laboratory, we only used the 100mVpp input.

For the hardware experiment, I had the following setup:



The Resistor and Capacitor values were the same, but analysis was performed for both 100mVpp and 1Vpp input signals. The results obtained are in the tables below:

100mVpp input:

Frequency	Vout	Voltage Gain
10	44.15 mV	-13.12 dB
30	62.89 mV	-10.04 dB
60	95.71 mV	-6.40 dB
100	144.07 mV	-2.85 dB
200	283.91 mV	3.04 dB
500	675.57 mV	10.57 dB
1 KHz	1.295 V	16.22 dB
2 kHz	2.33 V	21.32 dB
5 KHz	3.83 V	25.64 dB

10 KHz	4.19 V	26.42 dB
15 KHz	4.29 V	26.63 dB
20 KHz	4.31 V	26.67 dB
50 KHz	4.34 V	26.73 dB
75 KHz	4.36 V	26.77 dB
100 KHz	4.37 V	26.79 dB
150 KHz	4.39 V	26.83 dB
200 KHz	4.39 V	26.83 dB
500 KHz	4.33 V	26.71 dB
750 KHz	4.28 V	26.61 dB
1 MHz	4.21 V	26.47 dB
1.5 MHz	4.11 V	26.26 dB
2.0 MHz	3.98 V	25.98 dB

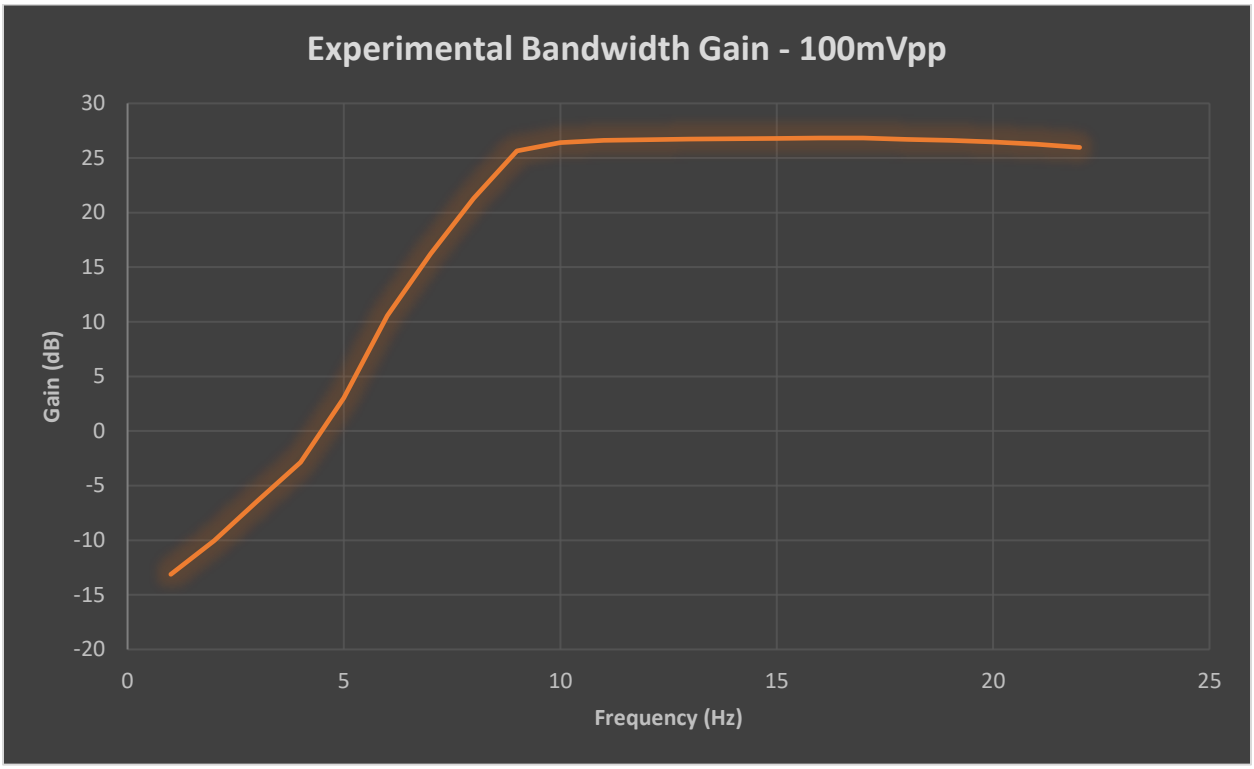
1Vpp input:

Frequency	Vout	Voltage Gain
10	480.5 mV	-6.37 dB
30	624.5 mV	-4.09 dB
60	967.5 mV	-0.287 dB
100	1.47 V	3.35 dB
200	2.73 V	8.72 dB
500	4.50 V	13.06 dB
1 KHz	4.69 V	13.42 dB
2 kHz	4.71 V	13.46 dB
5 KHz	4.72 V	13.48 dB
10 KHz	4.73 V	13.50 dB
15 KHz	4.74 V	13.52 dB
20 KHz	4.74 V	13.52 dB

50 KHz	**4.77 V**	**13.57 dB**
75 KHz	**4.78 V**	**13.59 dB**
100 KHz	**4.79 V**	**13.61 dB**
150 KHz	**4.81 V**	**13.64 dB**
200 KHz	**4.81 V**	**13.64 dB**
500 KHz	**4.72 V**	**13.48 dB**
750 KHz	**4.68 V**	**13.40 dB**
1 MHz	**4.63 V**	**13.31 dB**
1.5 MHz	**4.58 V**	**13.22 dB**
2.0 MHz	**4.48 V**	**13.03 dB**

The wave output signal from the experimental setup, using 1Vpp input:

Bandwidth Gain for 100mVpp Experimental data:



CONCLUSION:

From the hardware experiment, we can see that the pattern changes when we increase the input signal to 1Vpp. There is less voltage gain with a higher input signal. If we compare this to the 741, there's less output from the 741, so each configuration is best depending on the purpose its needed for. The BJT would be good for a higher gain.