EE 316: Electrical Circuits and Electronic Design Laboratory.

Lab 12

Studying Gain and Bandwidth Characteristics of MOSFETs.

Submitted by: **Dan Otieno.**

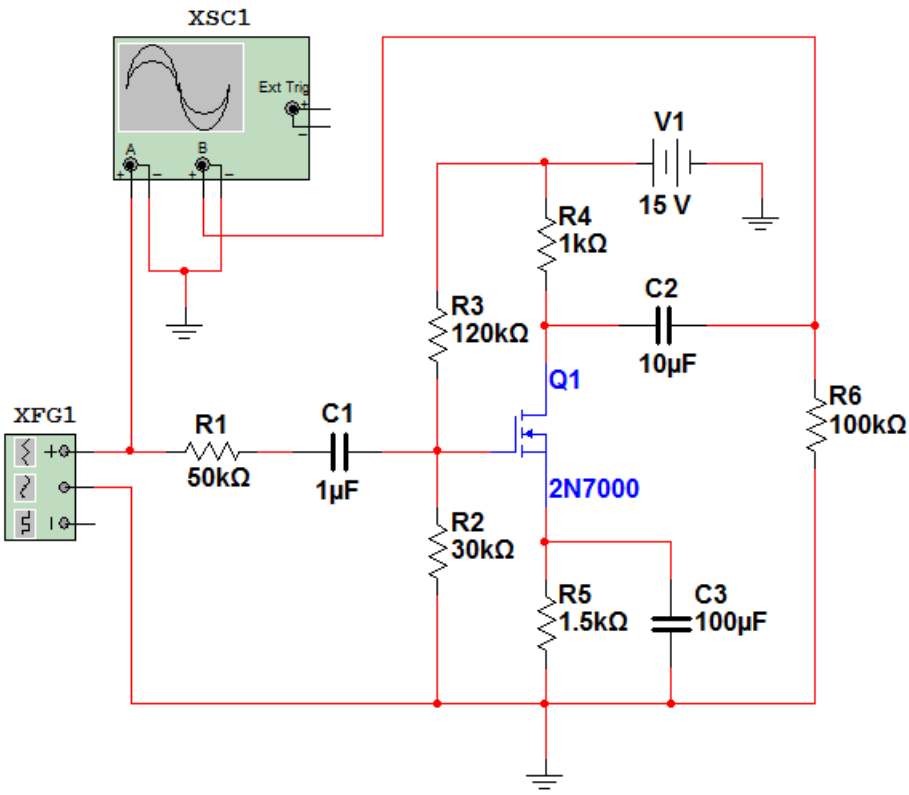
Date of Experiment: 11/14/22.

INTRODUCTION:

For this lab, we use the 2N70000 MOSFET configuration with a frequency range of 10Hz to 3MHz. This lab is almost a continuation of the previous lab. We set the input voltage at 100mV and measure the input and output voltages for each frequency.

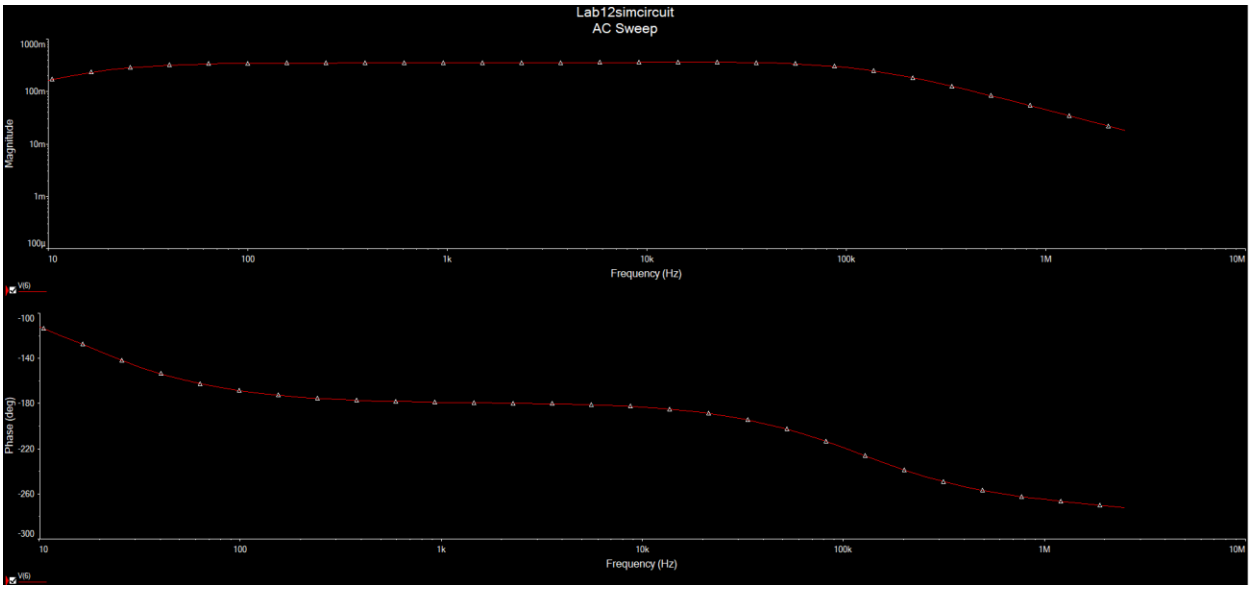
PART 1:

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



The circuit was completed in Multisim (**I didn't realize I did not screenshot the design, so I have embedded the file in this report, it should be clickable, I can also submit in canvas if needed**) and the data from an AC sweep was collected. The following graph was also generated from the AC sweep simulation:

Lab12simcircuit.ms14



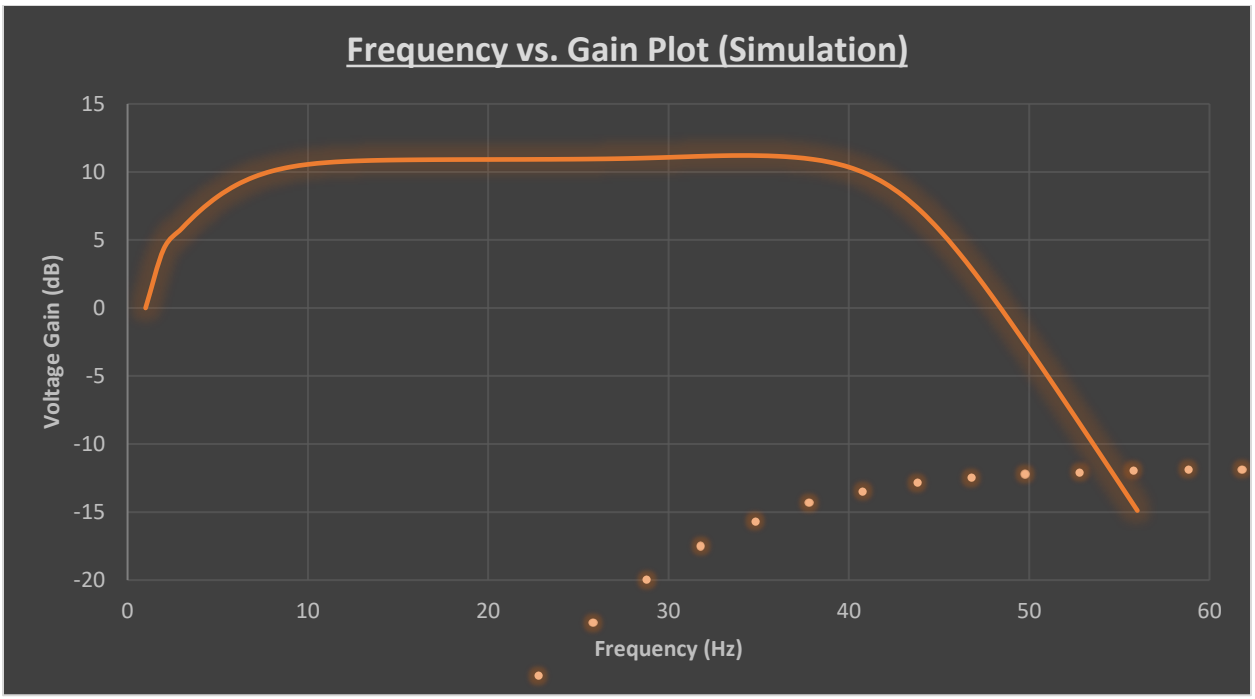
Simulation Data:

This was extracted from the AC sweep and decimals decreased. Gain was manually calculated by 20log(Vout/0.100V).

Frequency (Hz)	Vout (V)	Gain (dB)
10	0.164	4.320
13	0.196	5.833
16	0.227	7.128
20	0.257	8.188
25	0.282	9.013
32	0.303	9.625
40	0.318	10.059
50	0.329	10.356
63	0.337	10.554
79	0.342	10.684
100	0.345	10.768
126	0.348	10.822
158	0.349	10.856
200	0.350	10.878
251	0.350	10.892
316	0.351	10.901
398	0.351	10.907
501	0.351	10.911
631	0.351	10.914
794	0.351	10.917
1000	0.352	10.920

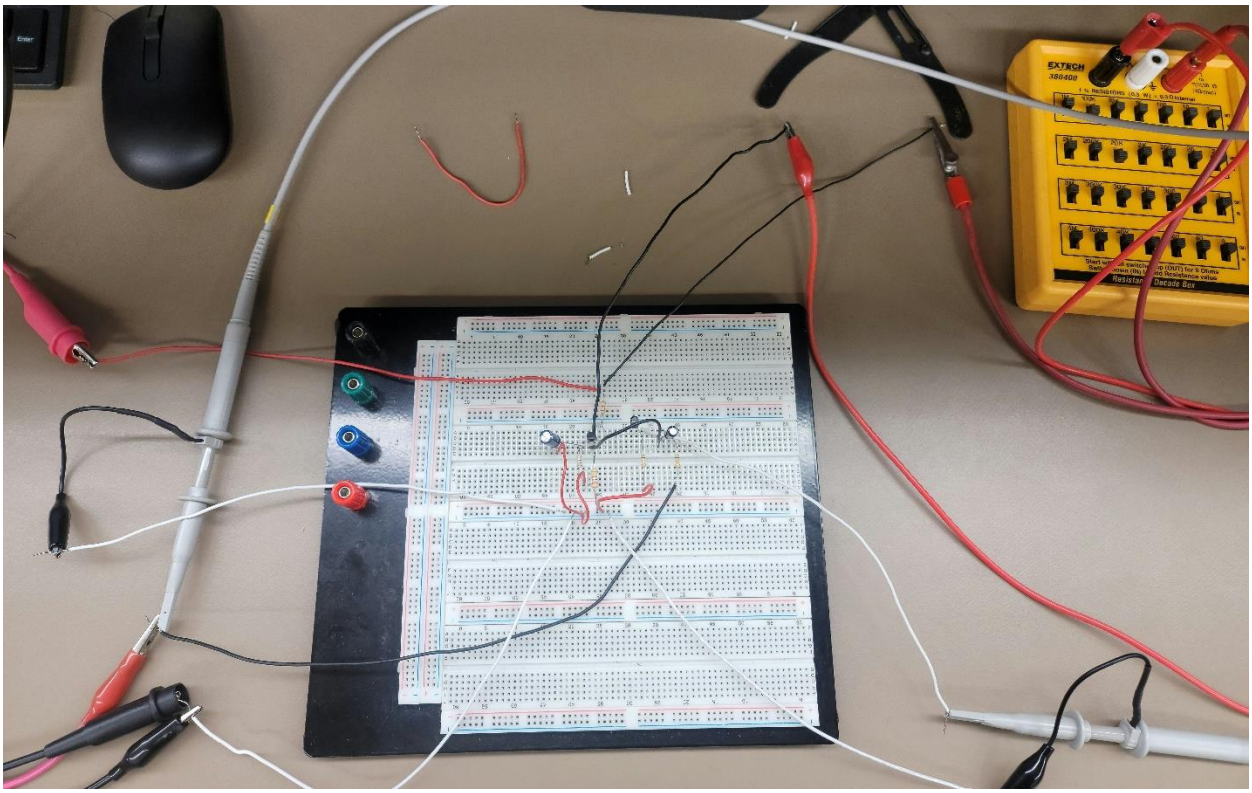
1259	0.352	10.924
1585	0.352	10.930
1995	0.352	10.939
2512	0.353	10.952
3162	0.354	10.970
3981	0.355	10.997
5012	0.356	11.031
6310	0.358	11.073
7943	0.360	11.118
10000	0.361	11.161
12589	0.363	11.193
15849	0.363	11.208
19953	0.363	11.199
25119	0.361	11.157
31623	0.358	11.072
39811	0.352	10.927
50119	0.343	10.698
63096	0.329	10.354
79433	0.311	9.855
100000	0.287	9.164
125893	0.259	8.252
158489	0.227	7.113
199526	0.194	5.759
251189	0.163	4.222
316228	0.134	2.542
398107	0.109	0.756
501187	0.088	-1.103
630957	0.071	-3.012
794328	0.057	-4.955
1000000	0.045	-6.919
1258925	0.036	-8.898
1584893	0.029	-10.887
1995262	0.023	-12.884
2511886	0.018	-14.888

From the table above, we get the following plot, where we have Gain plotted as a function of frequency:



PART 2:

Next, we set up the experiment using hardware components as below, with the same voltage setup as the simulation design:



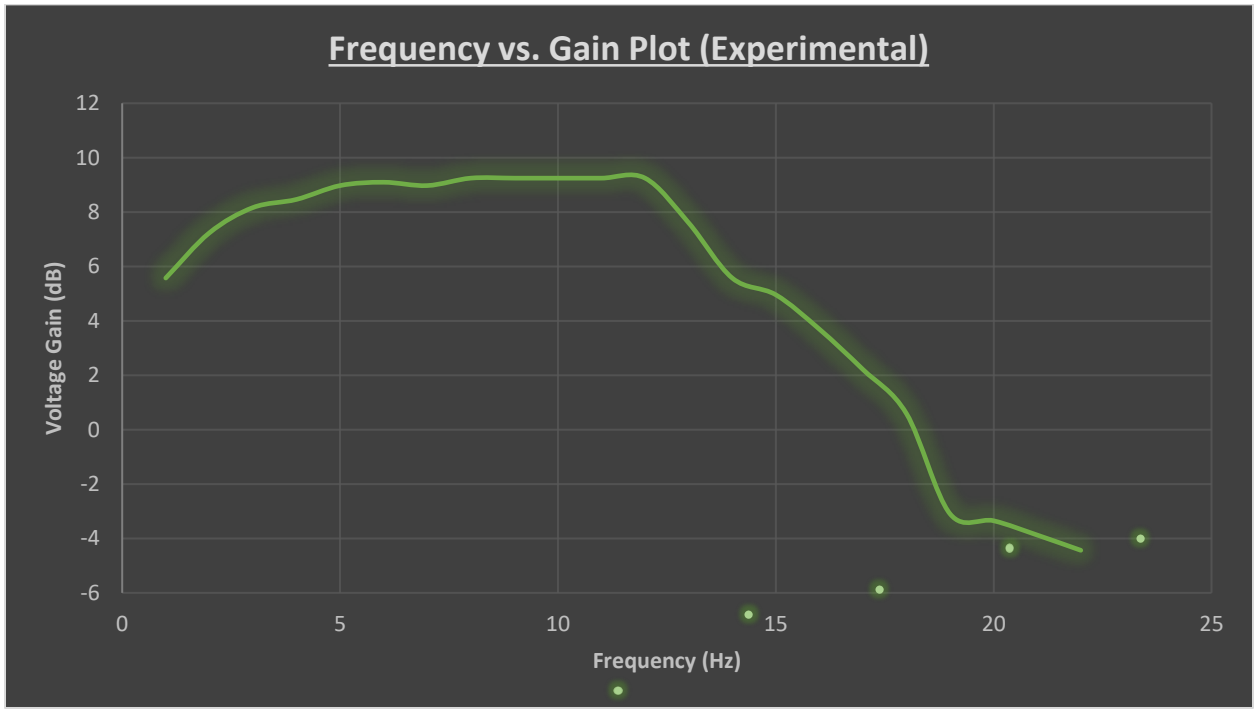
The data collected from the hardware experiment for this part of the lab is recorded in the tables below:

Experimental Data:

Frequency	Vout	Voltage Gain
10	190 mV	5.575
30	230 mV	7.235
60	256 mV	8.165
100	265 mV	8.465
200	281 mV	8.974
500	285 mV	9.097
1 KHz	281 mV	8.974
2 kHz	290 mV	9.248
5 KHz	290 mV	9.248
10 KHz	290 mV	9.248
15 KHz	290 mV	9.248
20 KHz	290 mV	9.248

50 KHz	240 mV	7.604
75 KHz	190 mV	5.575
100 KHz	177 mV	4.959
150 KHz	153 mV	3.694
200 KHz	129 mV	2.212
500 KHz	107 mV	0.588
750 KHz	70 mV	-3.098
1 MHz	68 mV	-3.350
1.5 MHz	64 mV	-3.876
2.0 MHz	60 mV	-4.437

The following Frequency vs Gain plot is achieved from the experimental data:



The following output signal was achieved at a specific frequency in the experimental analysis of the lab:

CONCLUSION:

I am not entirely sure from my data, but from the simulation, it looks like the highest voltage we achieve is at around 25Khz and the lowest voltage is at 2.5Mhz. For the experimental data, the highest voltage is analyzed at 20KHz, and the lowest voltage is at 2MHz. There are margins of error but there's not much difference in the values read by simulation and hardware analysis. In fact, the trend remains the same regardless of the output differences.