ELCT 201 – EE LABORATORY [#]

[PROJECT ONE: MEASURE A TRANSFER FUNCTION]

[KAILEN KING]
[2/2/2022]

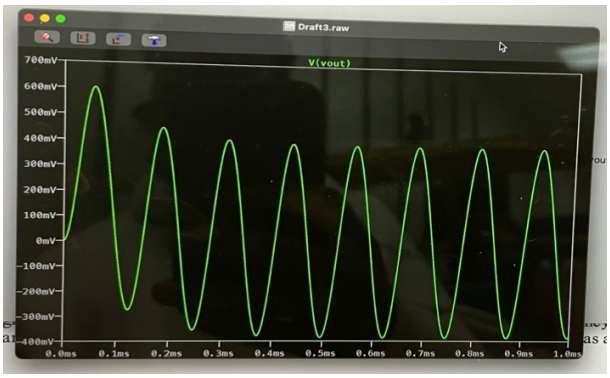
DEPARTMENT OF ELECTRICAL ENGINEERING
UNIVERSITY OF SOUTH CAROLINA
COLUMBIA, SC 29208

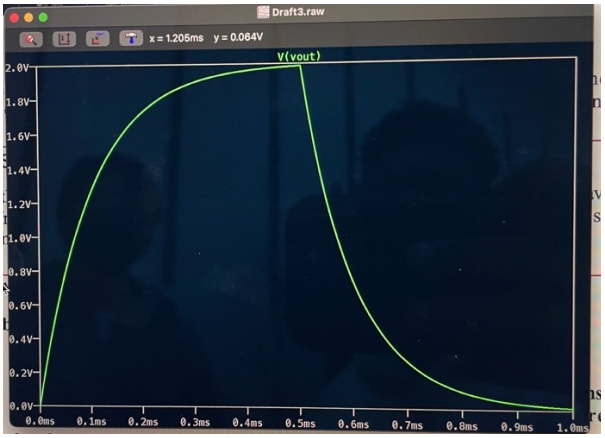
ABSTRACT

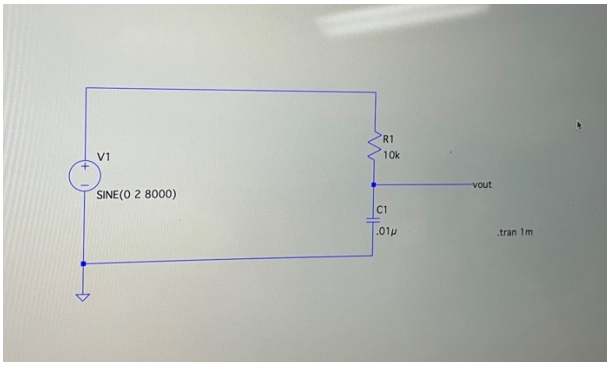
A set of exercises to measure a transfer function. The frequency of the circuit was measured along with different voltage amplitudes, and phase responses. Implement circuit theory concepts of impedance, transient response, and input output transfer function. Compare simulated circuit response with measured response. Measure the value of an unknown component using circuit response.

INTRODUCTION

First a prelab circuit was made using LTspice to simulate the actual circuit. The output voltage waveform as well as the transient response was recorded as shown in the figures below.







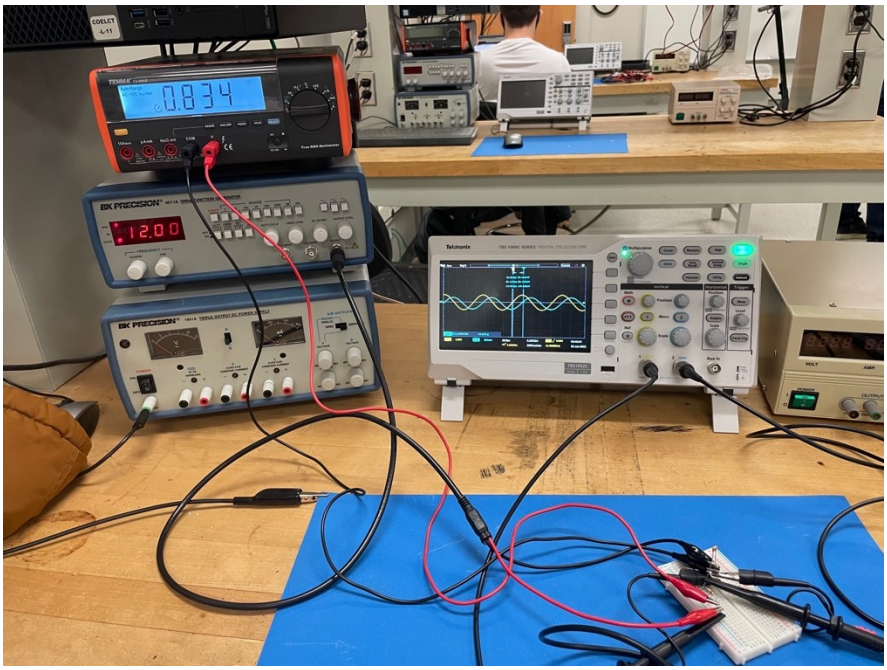
MAKING MEASUREMENTS

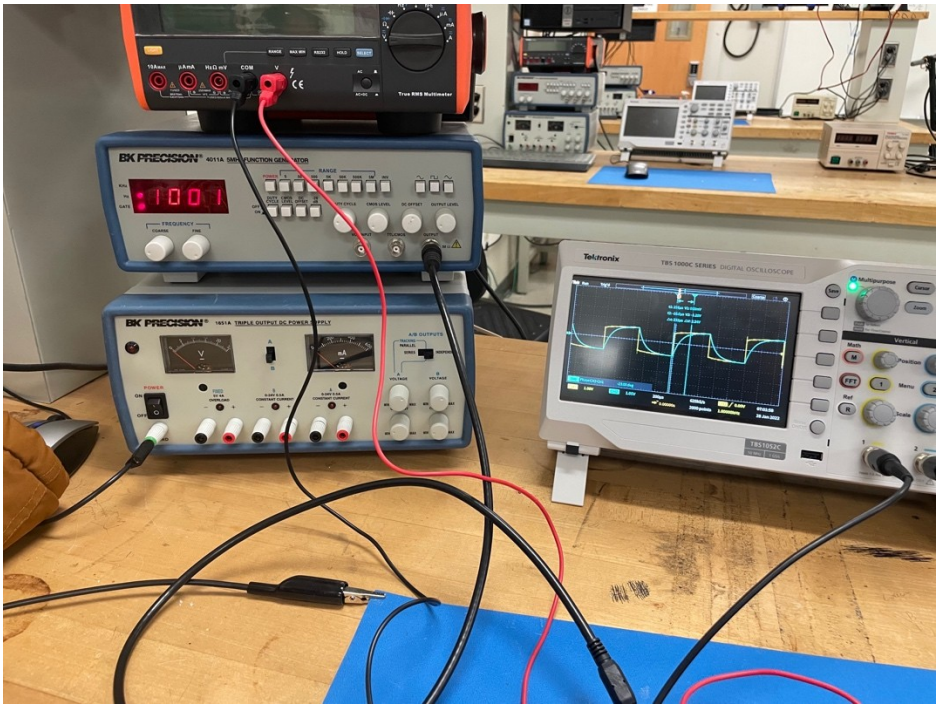
The circuit was recreated and measured to fin the input voltage, output voltage, frequency response and phase lag. To calculate the phase lag Change in time is divided by period times 360. A total of 11 measurements were made for each frequency up to 12k hz.

in	out	frequency	Phase lag
856	855	10	.35 degrees
855	848	50	1.73
855	849	150	3.24
850	826	350	8.06
845	802	500	11.5
853	618	1500	45.36
847	455	2500	57.6
839	314	4000	67.7
840	238	5500	77.6
836	168	8000	89.29
833	114	12000	99.36

MEASURING THE AC RESPONSE AND TRANSIENT RESPONSE WITH OSCILLOSCOPE

The ac response and transient response was measured and recorded in the screen shots below.





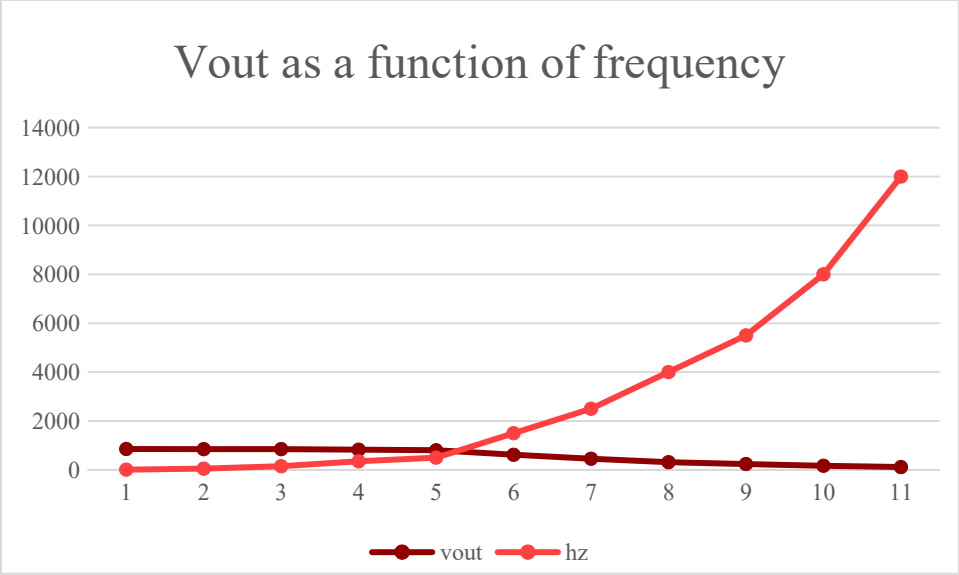
Vin = vin*sin(2*pi*f*t).

Vout = vout*sin(2*pi*f*t-phase lag)

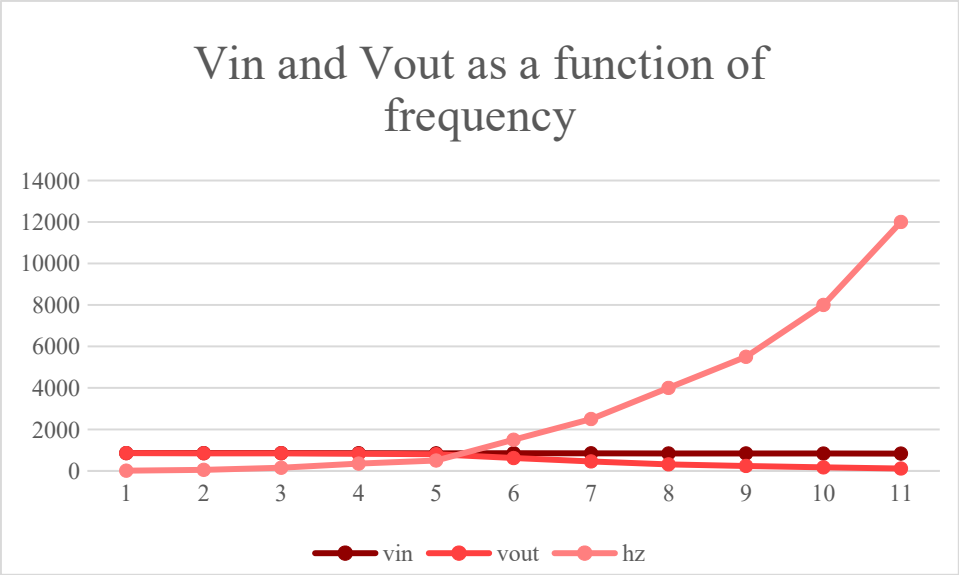
Both Vout and Vin are multiplied by the square root of 2 and the output over input is amplitude transfer function.

GRAPHS OF DATA

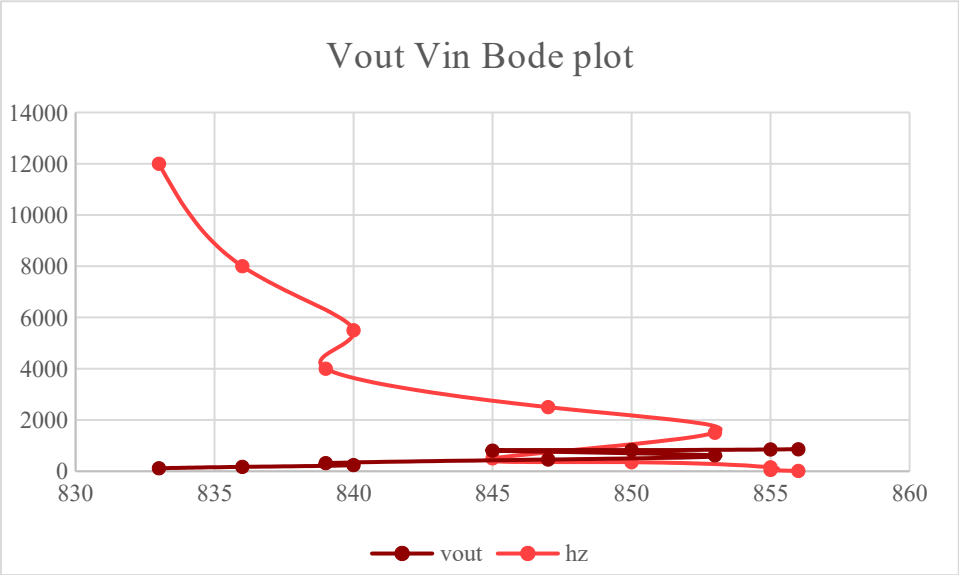
The ratio of the output voltage as a function of frequency ranging from 10hz to 100hz was recorded.



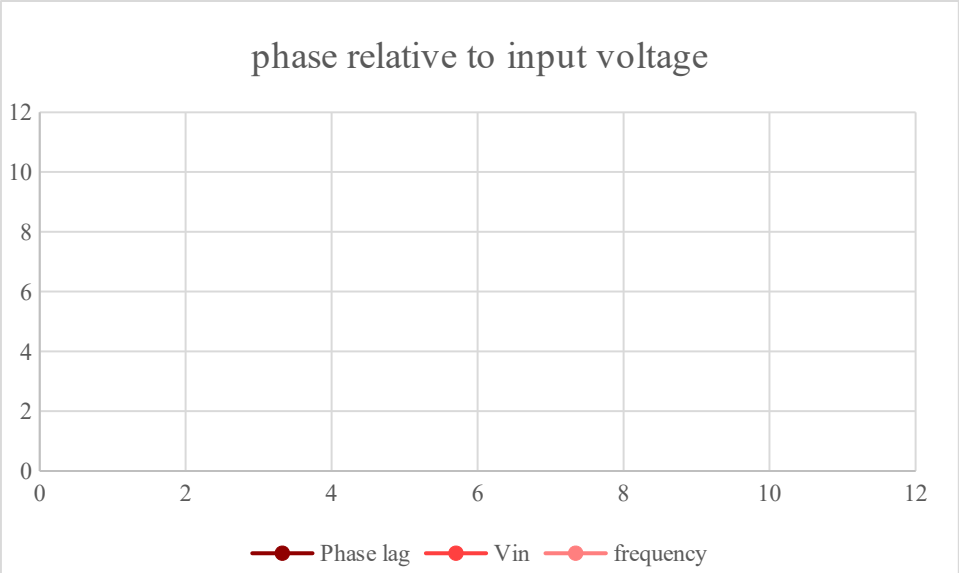
The ratio of the input and output voltage as a function of frequency.



The ratio of output voltage to input voltage, as a function of frequency from 10 Hz to 100 kHz, with the voltage ratio expressed in dB, and a logarithmic frequency axis.



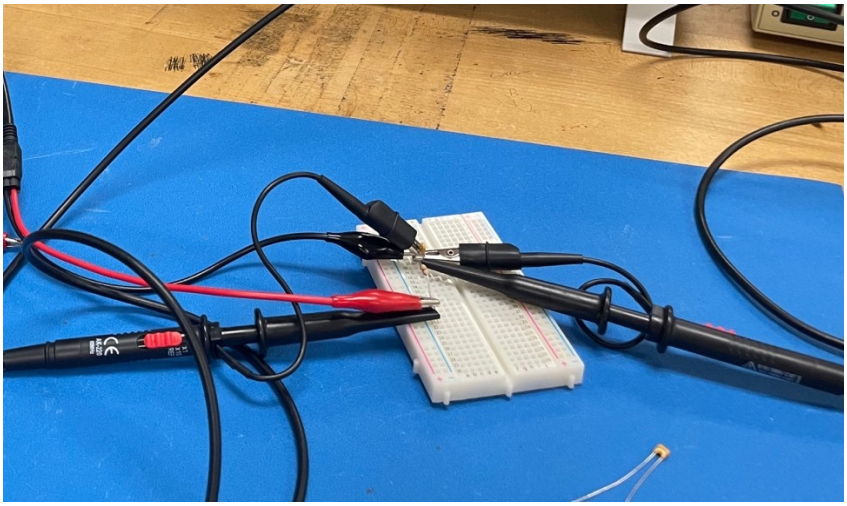
Phase of output voltage, relative to input voltage, as a function of frequency from 10 Hz to 100 kHz, with a logarithmic frequency axis



UNKNOWN CAPACITANCE

The capacitance was found in described in the following figures below.


Tek Run Trig'd
Fine
t1: 190µs V1: 640mV
t2: -8.00µs V2: 40.0mV
Δt: 198µs ΔV: 600mV
CH1 1.00V
CH2 1.00V
100µs
0.00000s
1.25MS/s
2000 points
CH1 125mV
1.00000kHz
07:21:06
28 Jan 2022




BK PRECISION
Tektronix

CONCLUSION

The design was set up by removing the original capacitor and replacing it with the unknown one. To get the capacitance the time constant is equal to resistance times capacitance, so tau divided by resistance was the capacitance.