Lab Report

Lab Session-2

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Aim:

To find out the frequency response for a sinusoidal excitation in RC series circuit using bode plot.

Components used:

Resistor(10KΩ), Capacitor(10nF), Function Generator, Oscilloscope, Bread board, wires.

Theory:

Bode plot is a frequency response plot (because it plots the output responses against frequency). It contains two graphs, magnitude and phase. The first plot is the magnitude plot of the sinusoidal transfer function versus frequency ω. Here the magnitude plot is plotted by taking 20logG on the Y-axis where $G=V_{out}/V_{in}$. The units on the Y-axis come out to be decibels.

Bode plot helps us to determine the systems stability

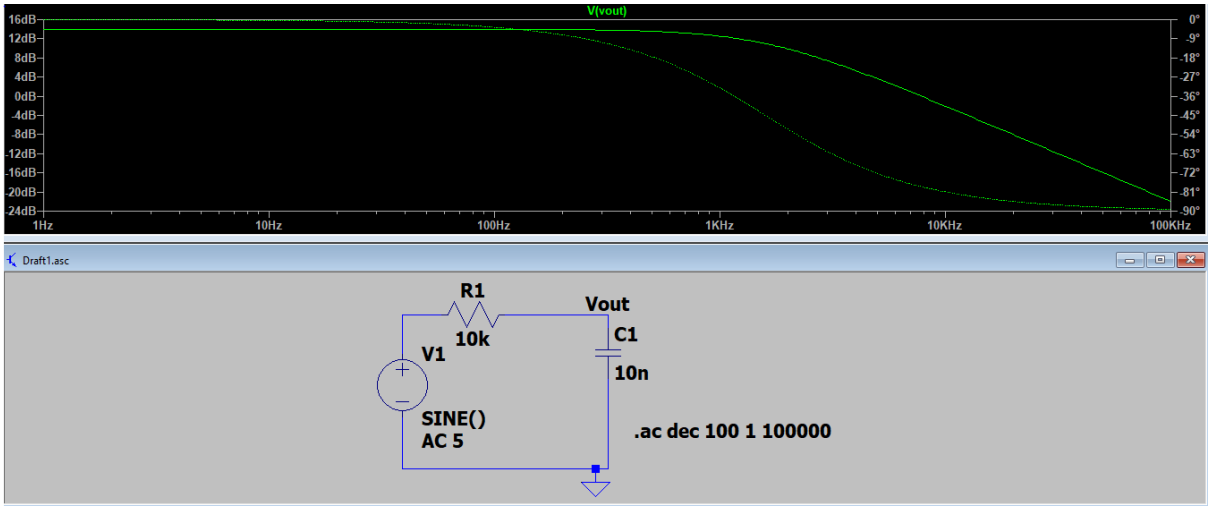
The V_{out} expression for the voltage across capacitor in the series RC circuit with sinusoidal excitation comes out to be

$V_{out}=\frac{Vo}{R+\frac{1}{j\omega C}} j\omega c = \frac{Vo}{1+j\omega RC}$. where Vo is the amplitude of the input independent voltage source, ϕ represents phase, ω represents frequency, R the resistance and C the capacitance.

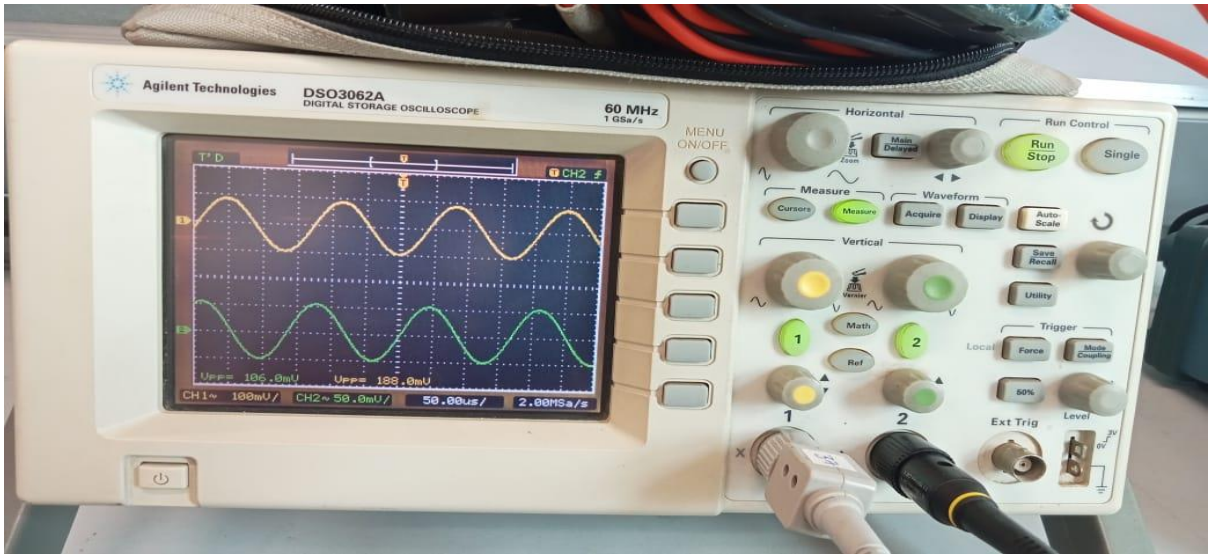
The phase expression for the voltage across capacitor in the series RC circuit with sinusoidal excitation comes out to be:

Φ=arctan(ωRC).

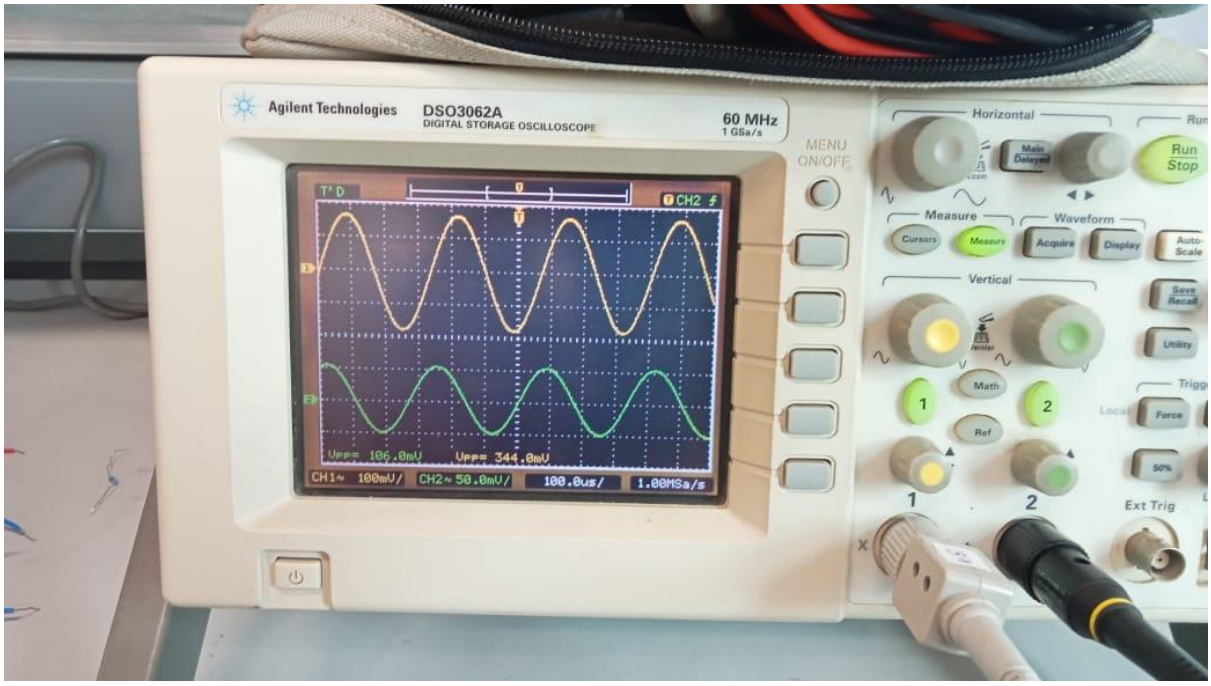
We got phase values by calculating 360*Δx*f, where we get Δx values from the oscilloscope and f is the frequency. The phase values on the bode plot are having degrees as the units.



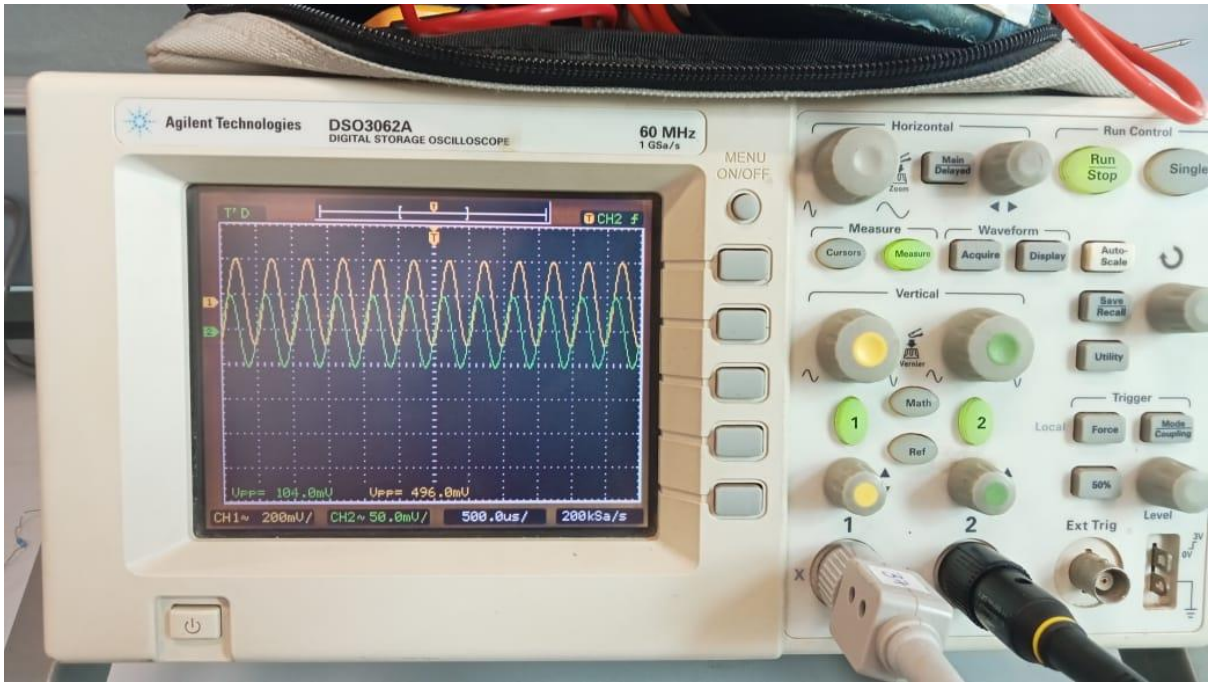
The LTspice model suggests that both the magnitude and the phase of the output voltage across the capacitor do not vary much till a frequency of about 100Hz. Then the phase starts dipping in a non-linear fashion till about 10kHz and then remains close to zero. The magnitude also starts dropping after 10kHz in an almost linear fashion till it drops to zero value with the graph being the same all the way till zero.



Frequency=6000Hz



Frequency=2000Hz



Frequency=1000Hz

Procedure

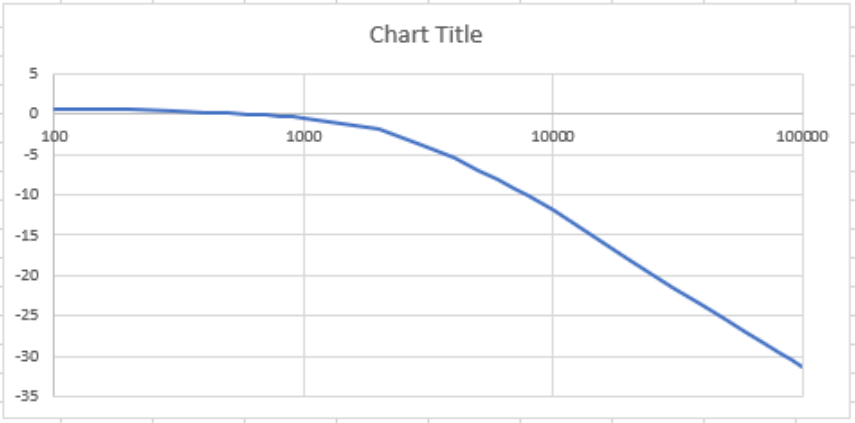
We set up the RC circuit onto the breadboard using the resistor of 10kΩ and capacitor of 10nF. We power the circuit using a function generator. We send a sinusoidal pulse as input. We then find the Vpp voltage and Δx values across

capacitor by attaching channel 1 of the oscilloscope probe to one of the legs of the capacitor and channel 2 of the oscilloscope probe to the input probe of the function generator. We record the value of Vpp got on the oscilloscope and vary the frequency. We also use cursors in the oscilloscope to find out the Δx values also and record the same on a piece of paper. We repeat the same for 20-25 values of frequency so that we can plot the same on the semi log paper.

Measurements

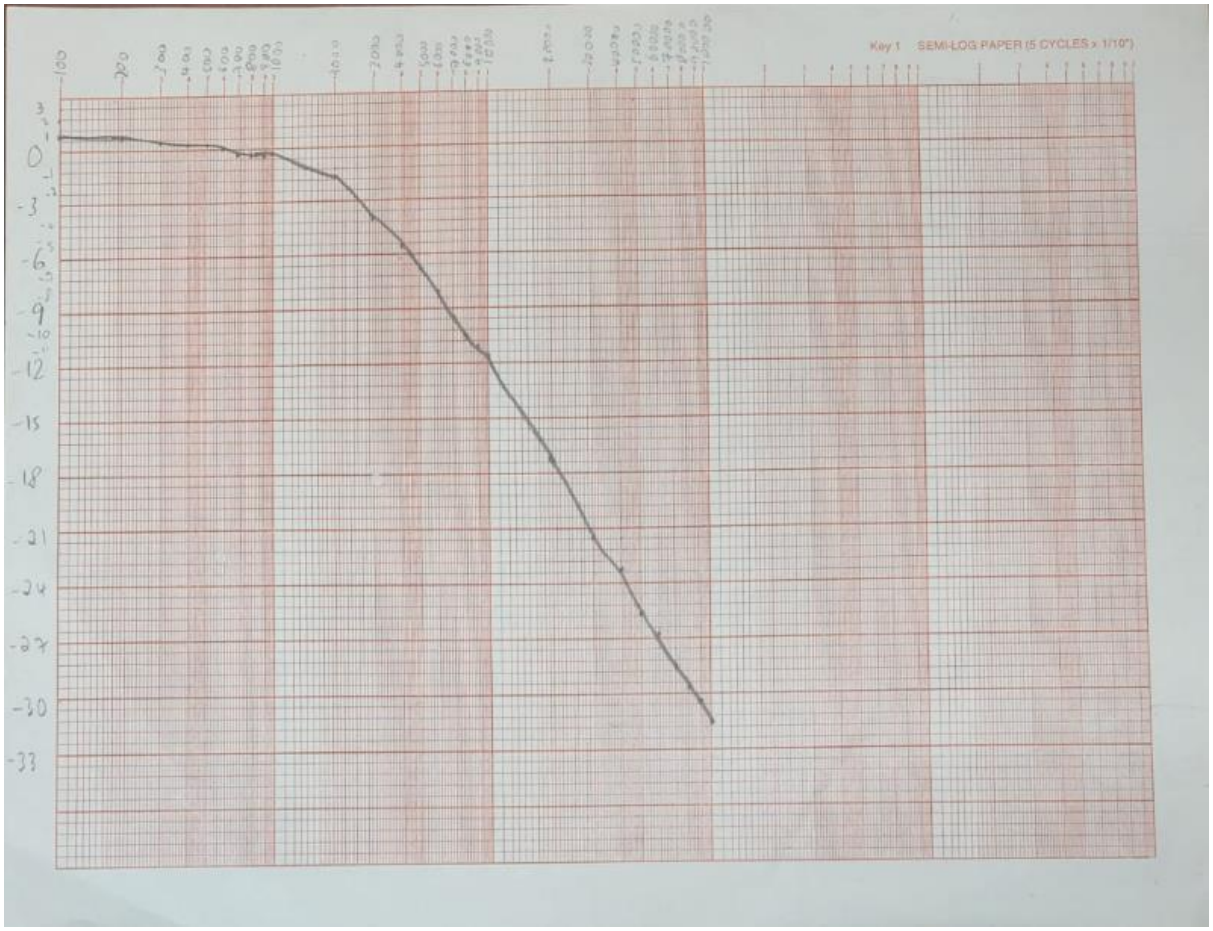
100	0.66848
200	0.50612
300	0.34067
400	0.172
500	0.08643
600	0
700	-0.0873
800	-0.26457
900	-0.35458
1000	-0.53744
2000	-1.9382
3000	-3.8764
4000	-5.4167
5000	-6.97444
6000	-8.13428
7000	-9.26883
8000	-10.1169
9000	-11.0568
10000	-11.8352
20000	-17.8558
30000	-21.5144
40000	-23.7417
50000	-25.5473
60000	-26.9744
70000	-28.3134
80000	-29.5772
90000	-30.4576
100000	-31.3086

H represents frequency
I represents 20log(Vout/Vin)



The above sheet refers to the magnitude bode plot.

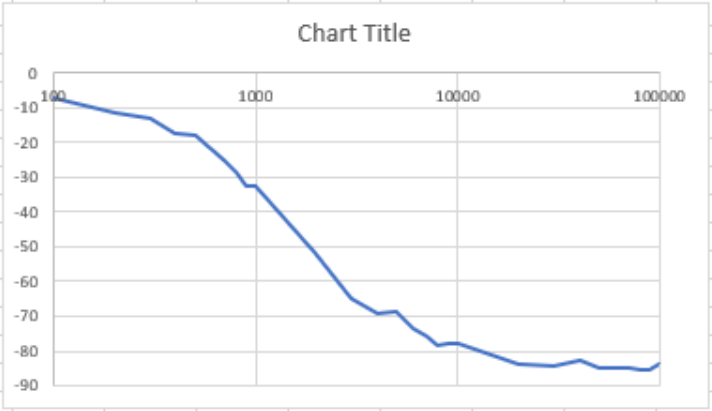
The Y-axis represents 20log(Vout/Vin) and the X-axis represents frequency.



The above sheet refers to the magnitude bode plot plotted on the semi log paper.

The Y-axis represents 20log(Vout/Vin) and the X-axis represents frequency.

100	-7.2		
200	-11.52		
300	-12.96	G represents frequency	
400	-17.28	H represents phase measured in angle	
500	-18		
600	-21.6		
700	-25.2		
800	-28.8		
900	-32.4		
1000	-32.4		
2000	-51.84		
3000	-64.8		
4000	-69.12		
5000	-68.4		
6000	-73.44		
7000	-75.6		
8000	-78.336		
9000	-77.76		
10000	-77.76		
20000	-83.52		
30000	-84.24		
40000	-82.944		
50000	-84.96		
60000	-84.672		
70000	-84.672		
80000	-85.248		
90000	-85.536		
100000	-83.52		



The above sheet represents the phase bode plot. The Y axis represents phase in degrees and the X-axis represents frequency.

The above sheet represents the phase bode plot plotted on the semi log paper. The Y axis represents phase in degrees and the X-axis represents frequency.