EE380: EC Lab Experiment 1

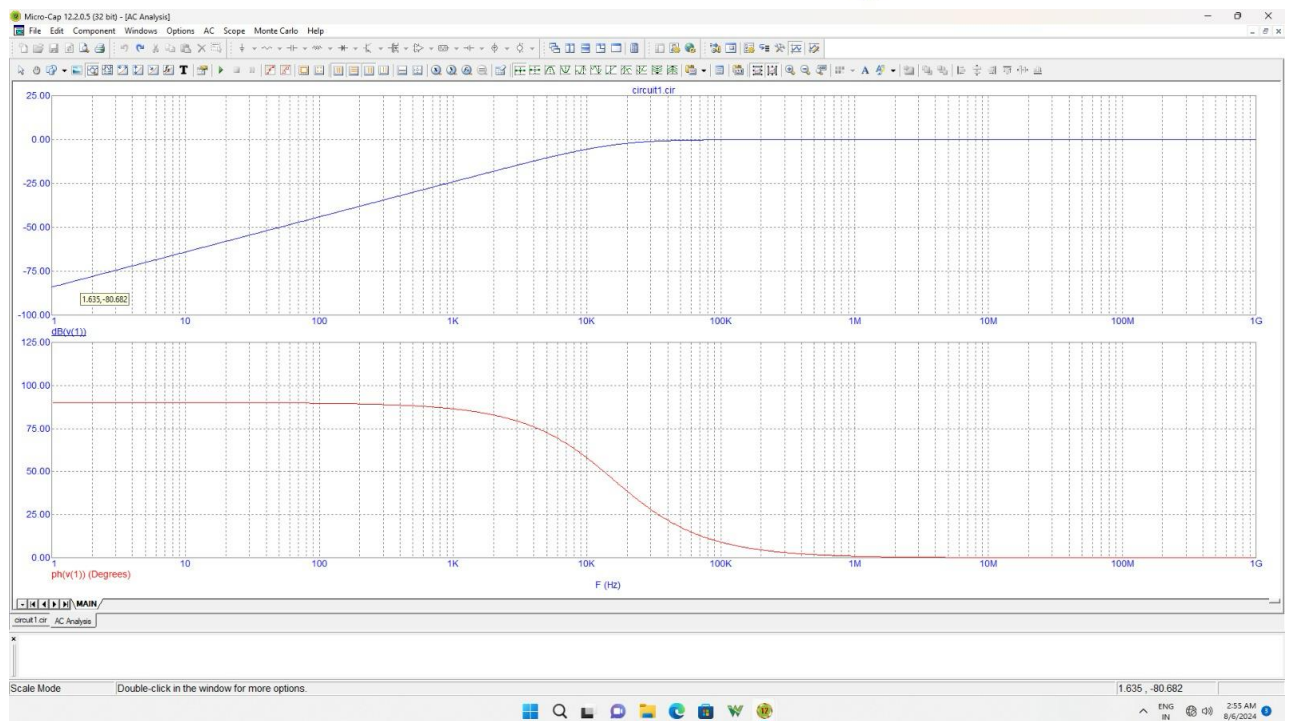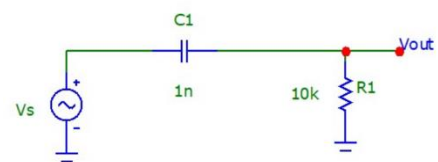# Design, Simulation and Prototyping of Analog Circuits

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Objective

Design, Simulation and Prototyping of Analog Circuits

Pre-Lab Write-Up

1. Measure the frequency response of the given RC circuit and make an Amplitude and Phase Bode plot: Upon simulation in Micro-Cap, the following plot was generated (Top: Amplitude, Bottom: Phase):

2. Determine the transient response of the given RC circuit with a square-wave input of 5V amplitude for the circuit in part 1. Upon simulation in Micro-Cap, the following plot was generated:
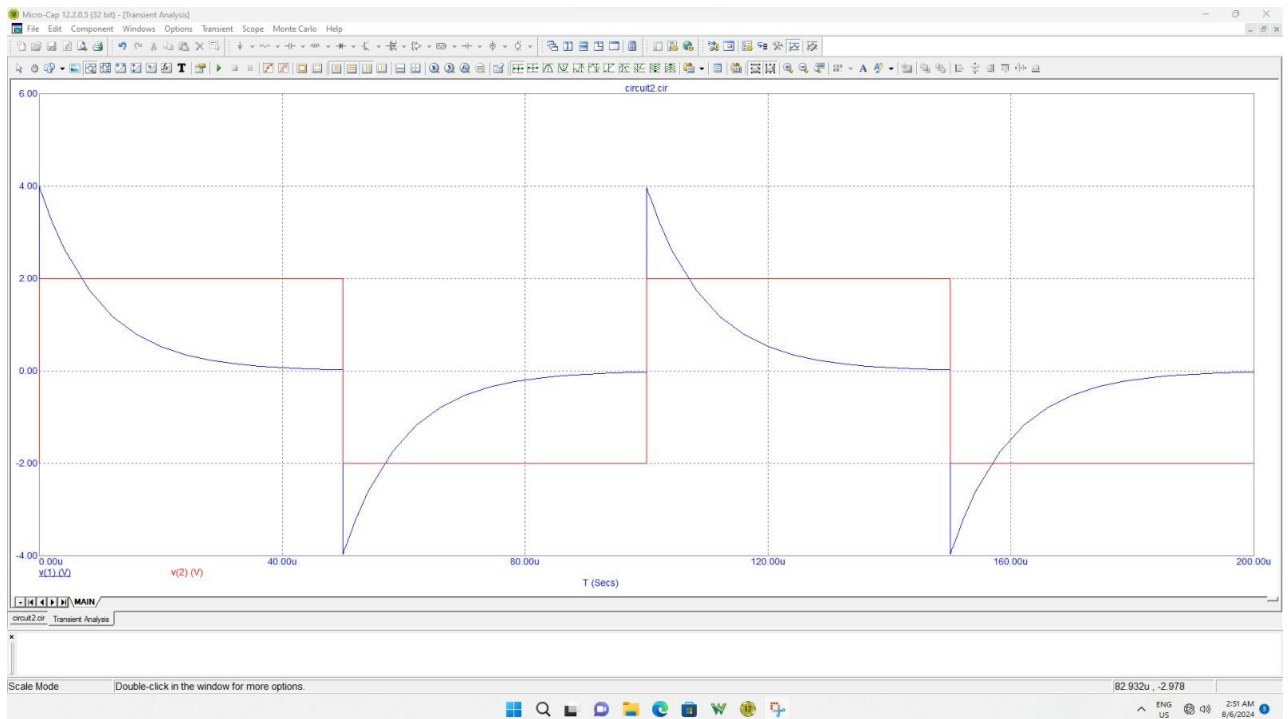

3. Experimentally determine the frequency at which the gain is -80dB:

We found the frequency at which the gain is -80dB is **1.635 Hz.**

4. Find from both simulation and experiment the frequency at which phase difference between input and output is not 180° but 90°. What is the voltage gain at this frequency?
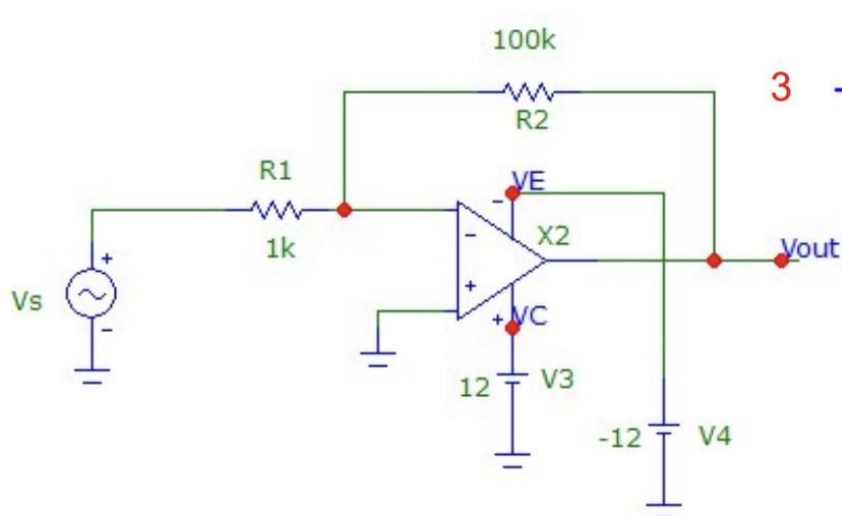
We got the following plot in Micro-Cap: The top magnitude plot is of the voltage gain (Output Voltage/ Input Voltage) and the bottom phase plot is of phase difference (Output Voltage - Input Voltage).
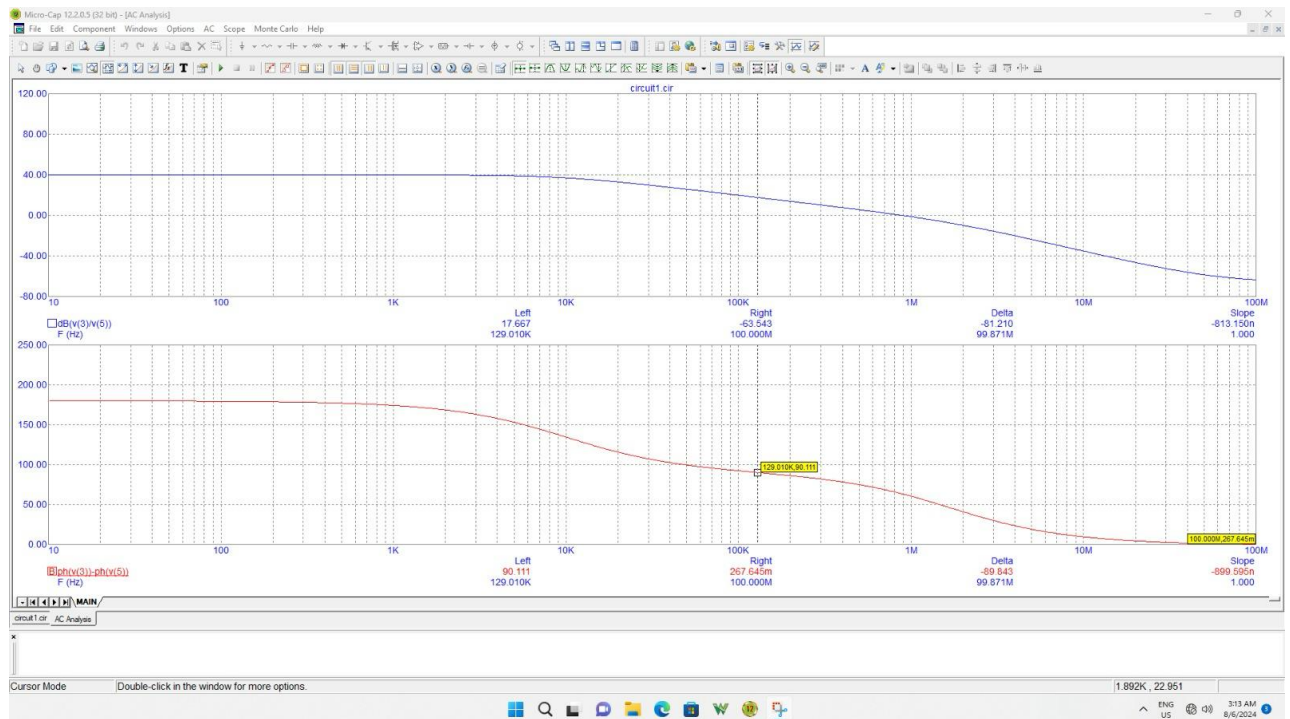

We found the frequency at which the phase difference between input and output is not 180° but 90° to be **129 KHz**. Also, the voltage gain at this frequency was found to be **17.5 dB.**
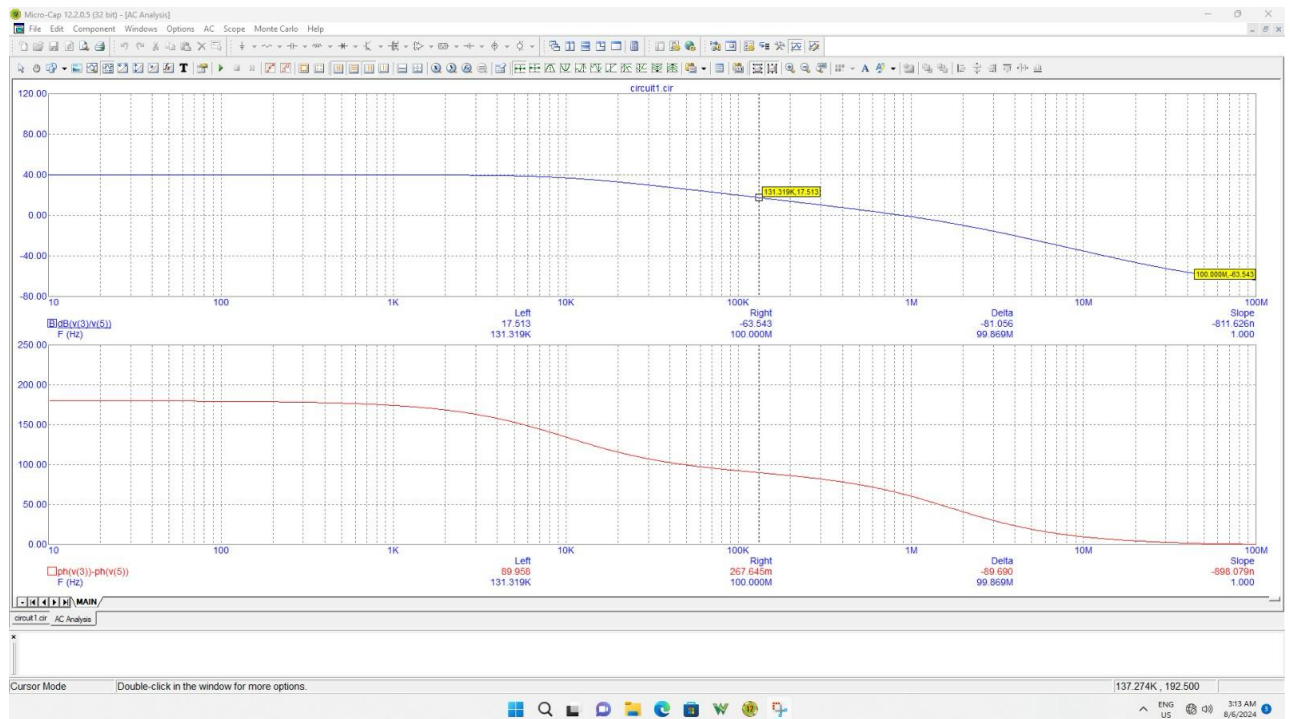
5. Design a circuit that has the following frequency response. Verify using simulation and measurements in the lab.
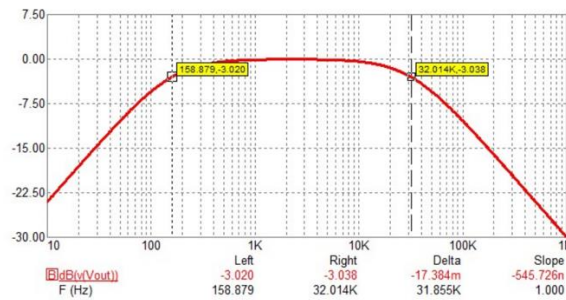
We designed the following band pass circuit using two resistors and capacitors each, and obtained the following frequency response for V_{out}:
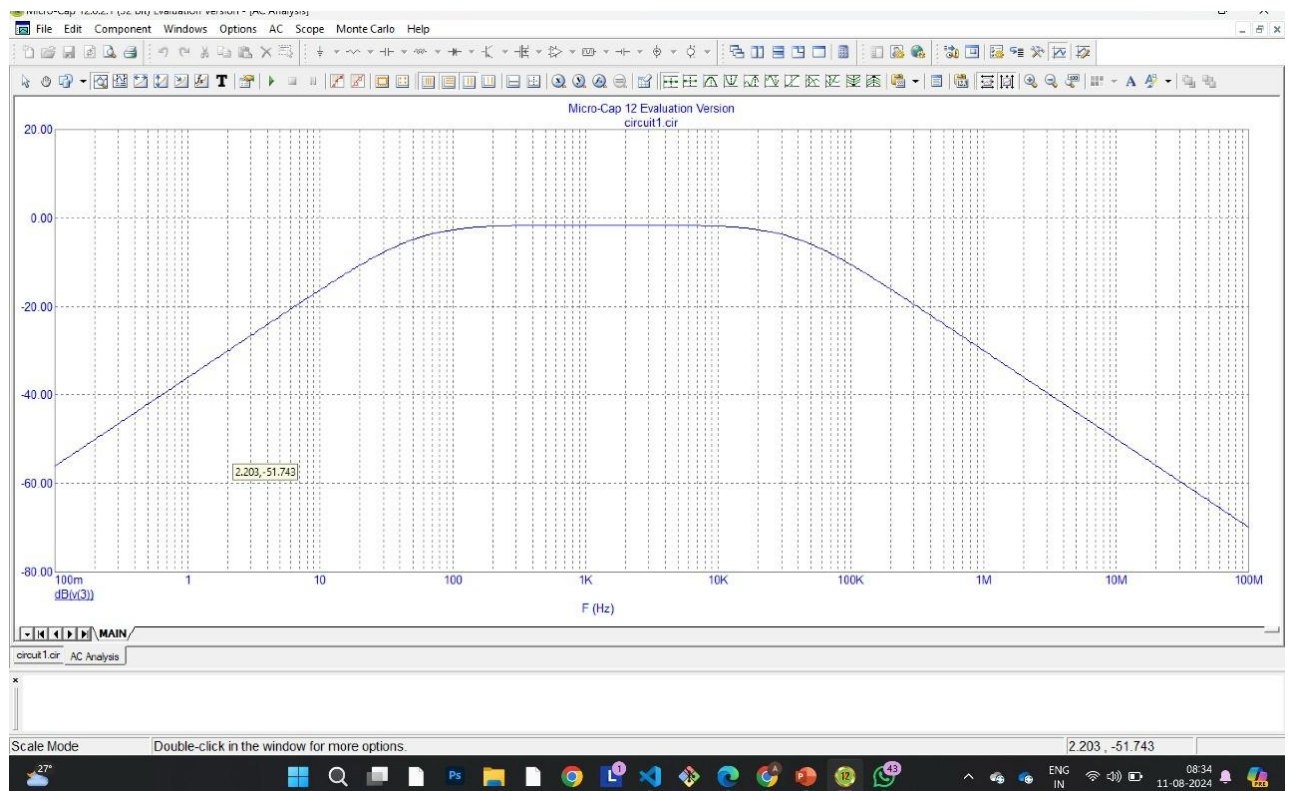
In-Lab Write Up

1. The circuit was connected on a breadboard, and a plot similar to the one in the pre-lab write-up was detected, and the same was confirmed with the Tutor/TA.
2. The circuit was connected on a breadboard, and a plot similar to the one in the pre-lab write-up was detected for square wave input as well, and the same was confirmed with the Tutor/TA.
3. Due to some problems with the breadboard and other equipment, the noise level for this part was high. However, the value of **1.6 Hz** was successfully ascertained, which aligns with the predictions.
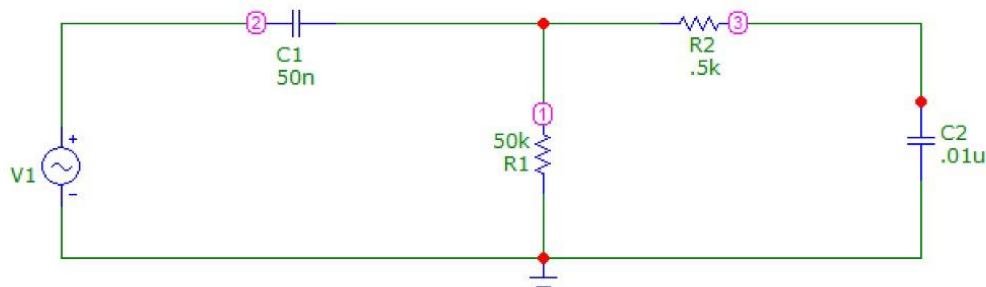4. The circuit as given was connected in the lab using an LM741 Op-Amp, and values similar to the simulation were obtained. We found the frequency at which the phase difference between input and output is not 180° but 90° to be **131 KHz**. Also, the voltage gain at this frequency was **17 dB.**
5. We implemented the circuit we designed with the values of the capacitors shown, got a plot similar to the one predicted in Micro-Cap, and confirmed the plot from the Analog Discovery kit with the TA.

Post-Lab Write Up

In conclusion, the simulation and experimental results were close to each other.

The main outcomes of this lab for us were learning how to use the Micro-Cap software to simulate electrical circuits, and then Analog Discovery Kit for seamlessly connecting circuits experimentally.