**Lab Report: 209L – 01 Ngyuen**

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**Experiment 4**

**Transfer Functions**

**Objectives:** To calculate and measure the frequency response of RLC circuits

**Equipment’s Used:**

* Oscilloscope
* AC Voltage Generator
* Multimeter
* Capacitor-Inductor Meter
* Clip leads
* BNC Cables
* Resistor (1kΩ and 10kΩ)
* Capacitor (two 33.8µF)

**Prelab:**

Attached at end of the report.

**Lab:**

**Part 1**:

Measure your resistor and capacitor values:

Measured resistor value 1 = 380.0Ω

Nominal resistor value 1 = 390.0Ω

%difference =

Measured capacitor value 1 = 32.6nF

Nominal capacitor value 1 = 33.8nF

%difference =

Measured capacitor value 2 = 34.6nF

Nominal capacitor value = 33.8nF

%difference =

Capacitor combination in serial = 16.8nF

Nominal value = 16.4nF

%difference =

Nominal value Inductor = 10mH

Table 1: Measurement of tools

|  |  |  |  |
| --- | --- | --- | --- |
|  | Measured | Nominal | %difference |
| Resistor | 380.0Ω | 390.0Ω | -2.564% |
| Capacitor | 16.8nF | 16.4nF | -4.85% |
| Inductor | - | 10 mH |  |

**Part 2:**

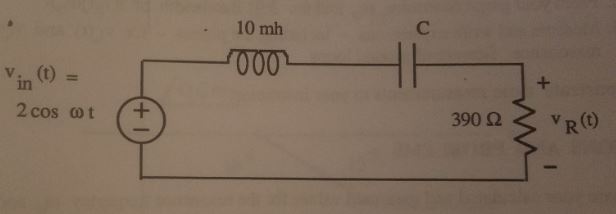


Figure 1: Circuit 1

Step 1) Finding the Resonance Frequency and Capacitor value

The Resonance Frequency =

The maximum is simply that frequency where

The minimum, is where

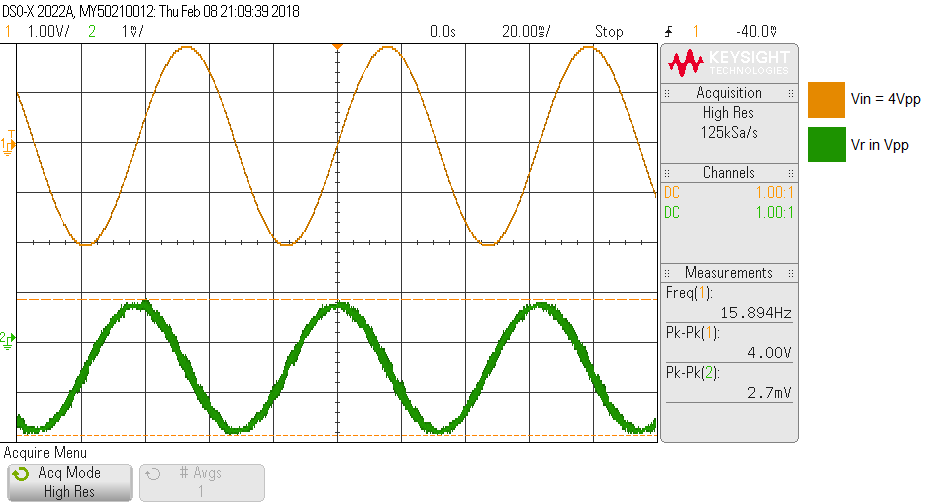
Which implies

From page 12 – 12:

Since,

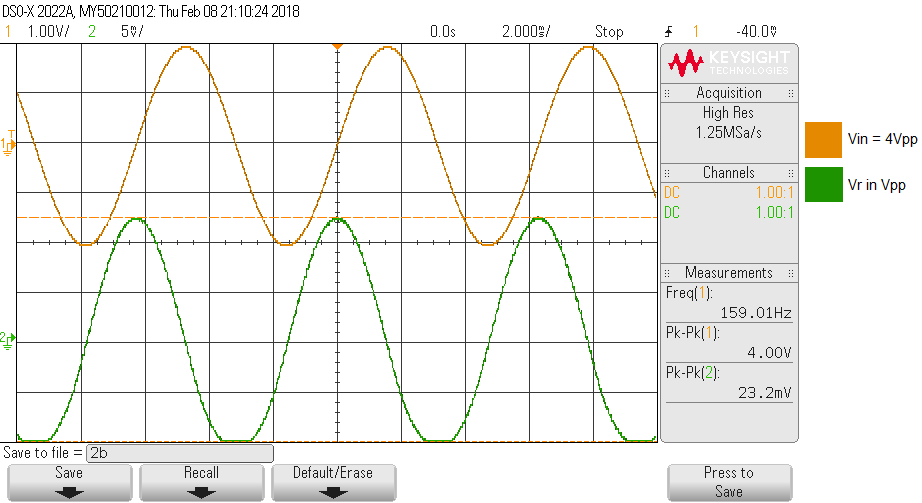
Finally,

Step 2: Measure for Gain



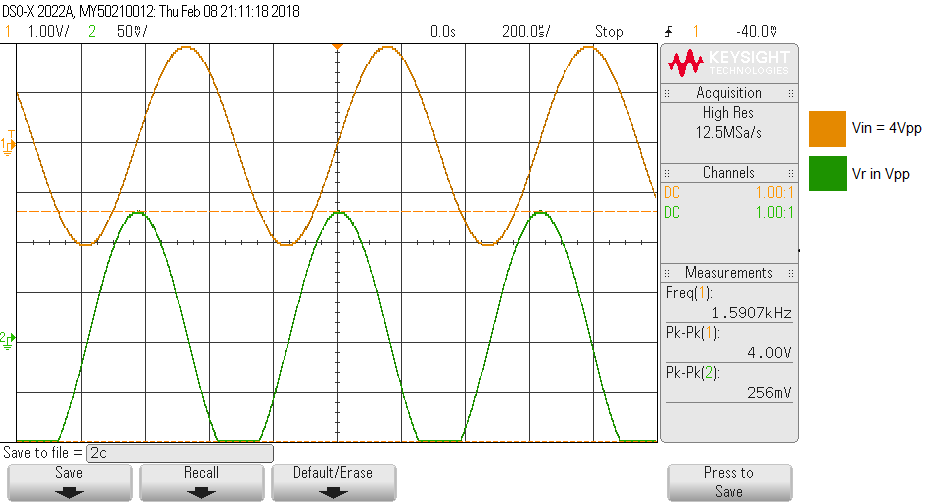
Graph 1: Measurements of Vin(t) and Vr(t) at F = 15.9Hz

Vin(t) = 4.0Vpp, Vr(t) = 0.0027Vpp, Gain = 0.000675



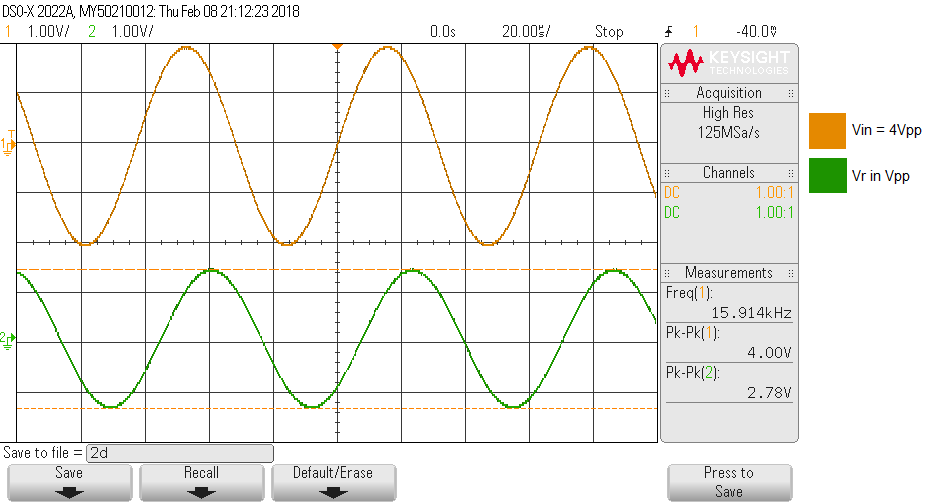
Graph 2: Measurements of Vin(t) and Vr(t) at F = 159Hz

Vin(t) = 4.0Vpp, Vr(t) = 0.0232Vpp, Gain = 0.0058



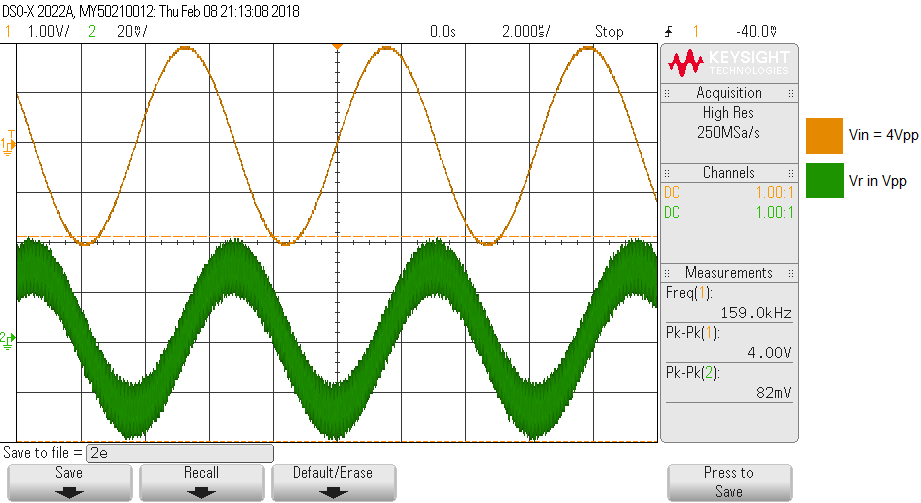
Graph 3: Measurements of Vin(t) and Vr(t) at F = 1590Hz

Vin(t) = 4.0Vpp, Vr(t) = 0.256Vpp, Gain = 0.064



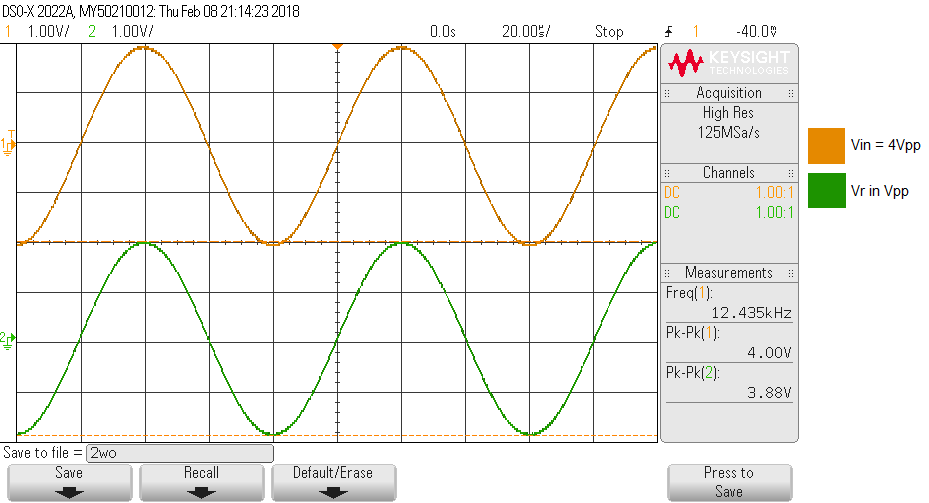
Graph 4: Measurements of Vin(t) and Vr(t) at F = 15.9 kHz

Vin(t) = 4.0Vpp, Vr(t) = 2.78Vpp, Gain = 0.695



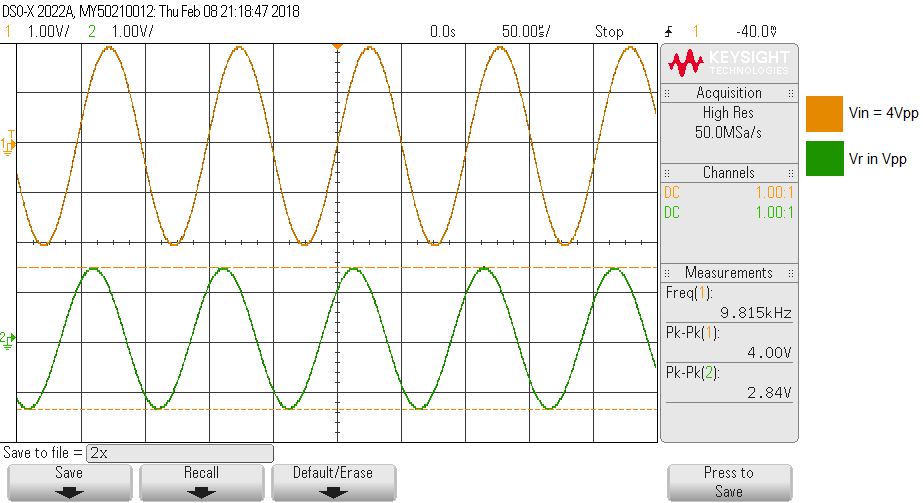
Graph 5: Measurements of Vin(t) and Vr(t) at F = 159 kHz

Vin(t) = 4.0Vpp, Vr(t) = 0.0082Vpp, Gain = 0.00205



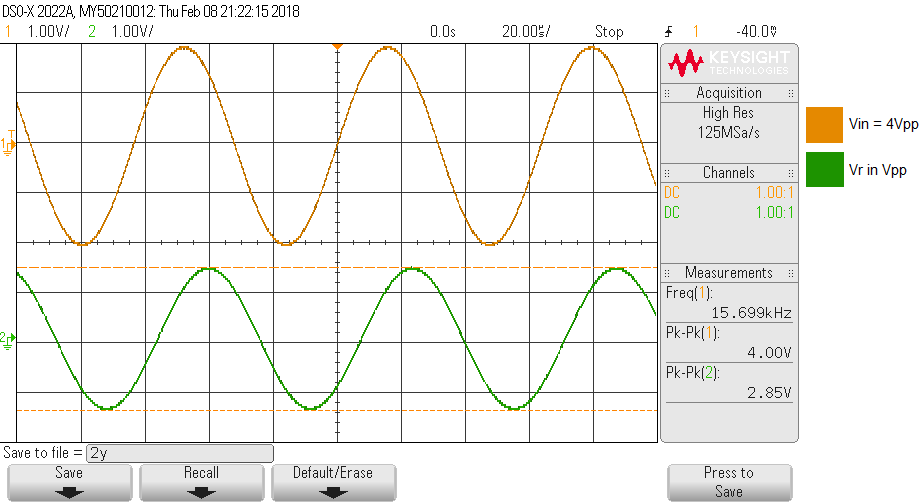
Graph 6: Measurements of Vin(t) and Vr(t) at F = 12.435 kHz (resonance frequency)

Vin(t) = 4.0Vpp, Vr(t) = 3.88Vpp, Gain = 0.97



Graph 7: Measurements of Vin(t) and Vr(t) at F = 9.815 kHz (lower dB)

Vin(t) = 4.0Vpp, Vr(t) = 2.84Vpp, Gain = 0.71



Graph 7: Measurements of Vin(t) and Vr(t) at F = 15.699 kHz (higher dB)

Vin(t) = 4.0Vpp, Vr(t) = 2.85Vpp, Gain = 0.71

Table 1: Summary of Circuit 1

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency | Vin | Vr | Gain |
| 15.9 Hz | 4 Vpp | 0.0027 Vpp | 0.000675 |
| 159 Hz | 4 Vpp | 0.0232 Vpp | 0.0058 |
| 1590 Hz | 4 Vpp | 0.256 Vpp | 0.064 |
| 15.9 kHz | 4 Vpp | 2.78 Vpp | 0.695 |
| 159 kHz | 4 Vpp | 0.0082 Vpp | 0.00205 |
| Wo = 12.427 kHz | 4 Vpp | 3.88 Vpp | 0.97 |
| 3db1 = 9.82 kHz | 4 Vpp | 2.84 Vpp | 0.71 |
| 3db2 = 15.7 kHz | 4 Vpp | 2.85 Vpp | 0.71 |

Graph 8: Plot of the measurements

**Part 3**

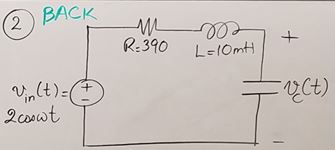
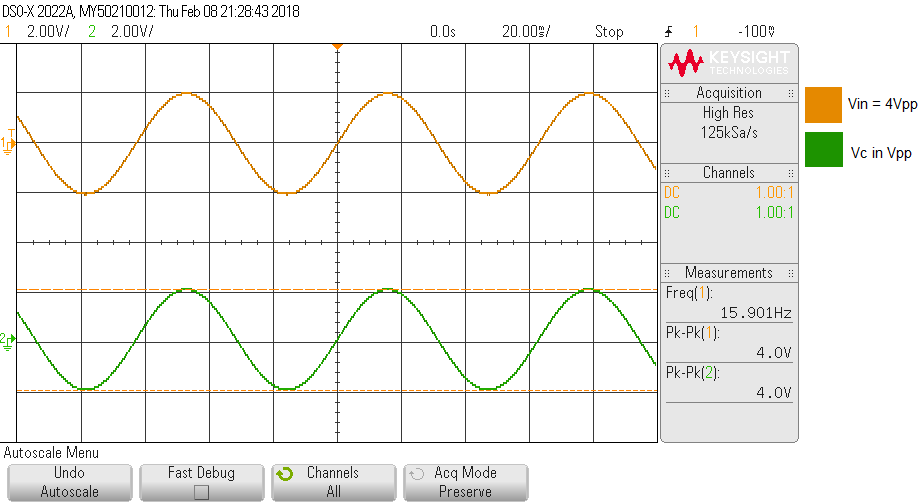
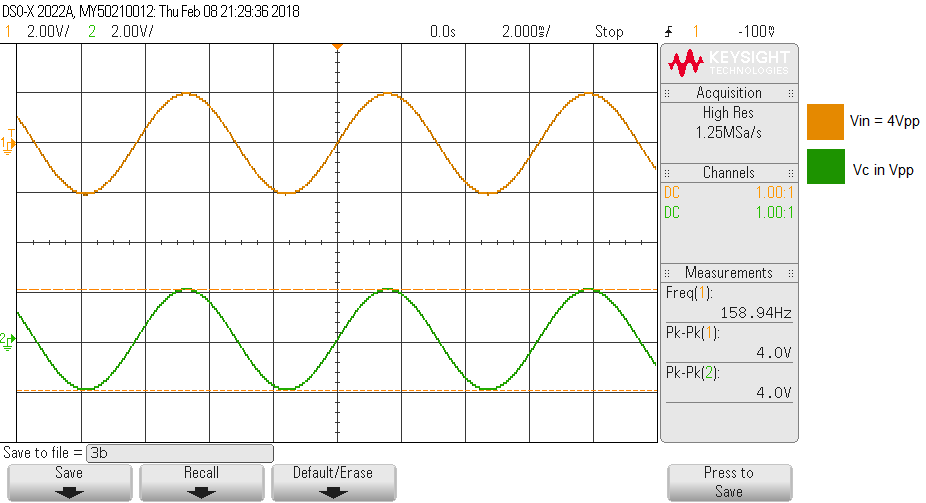


Figure 2: Circuit 2



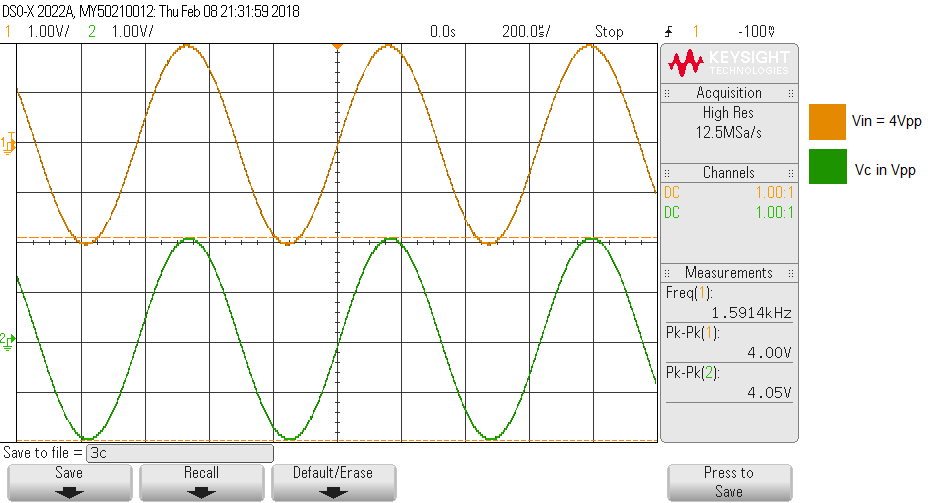
Graph 9: Measurements of Vin(t) and Vc(t) at F = 15.9 Hz

Vin(t) = 4.0Vpp, Vr(t) = 4.0Vpp, Gain = 1.0



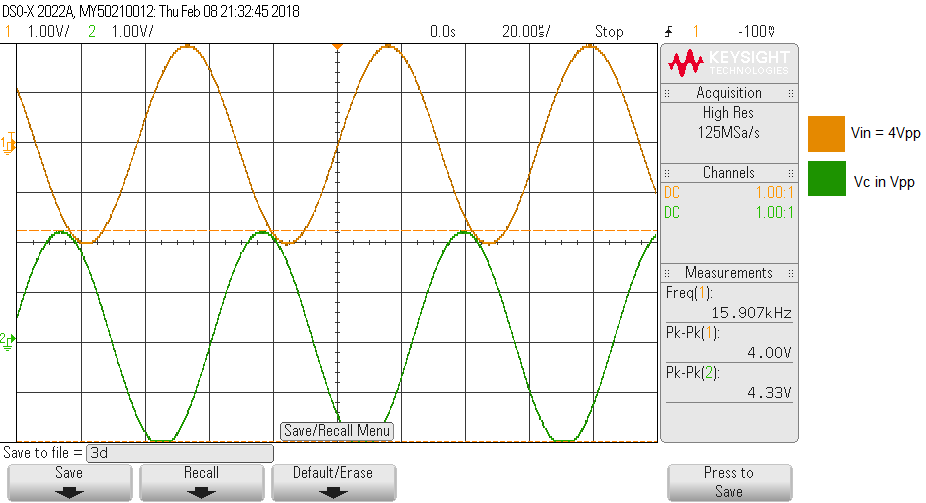
Graph 10: Measurements of Vin(t) and Vc(t) at F = 159 Hz

Vin(t) = 4.0Vpp, Vr(t) = 4.0Vpp, Gain = 1.0



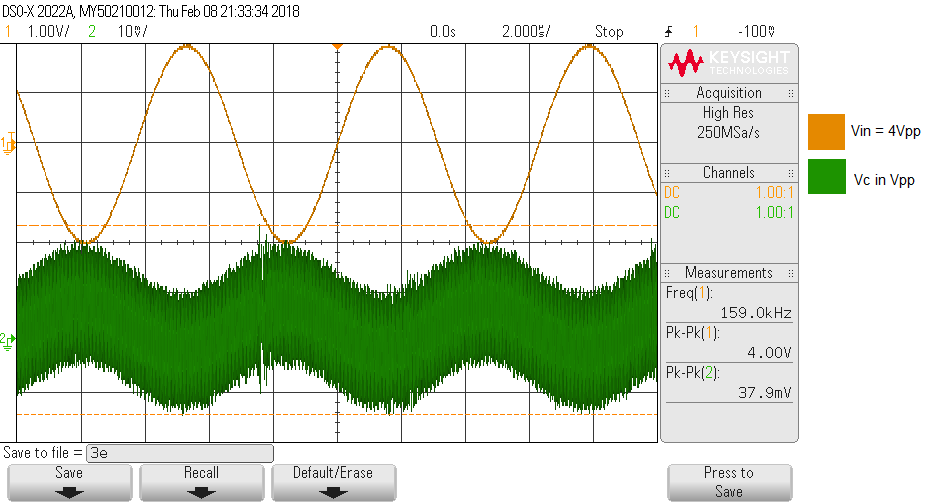
Graph 11: Measurements of Vin(t) and Vc(t) at F = 1590 Hz

Vin(t) = 4.0Vpp, Vr(t) = 4.05Vpp, Gain = 1.0125



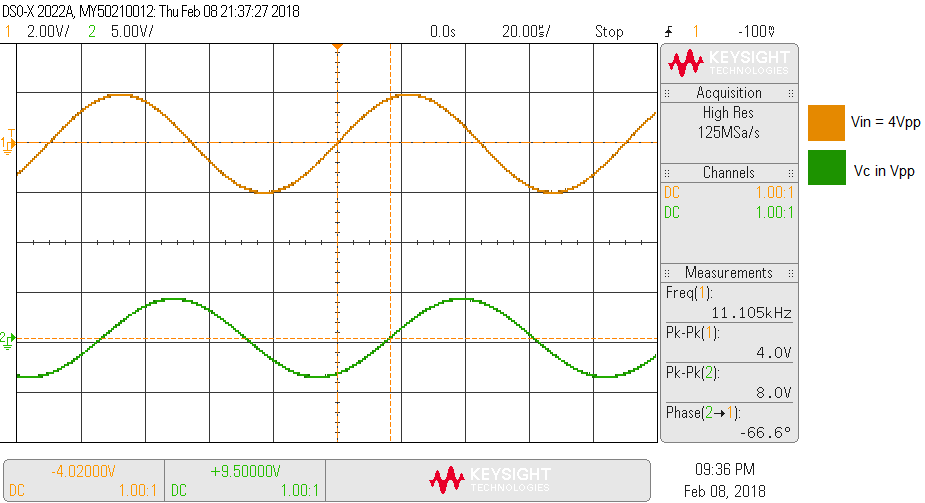
Graph 12: Measurements of Vin(t) and Vc(t) at F = 15.9 kHz

Vin(t) = 4.0Vpp, Vr(t) = 4.33Vpp, Gain = 1.0825



Graph 13: Measurements of Vin(t) and Vc(t) at F = 159 kHz

Vin(t) = 4.0Vpp, Vr(t) = 0.0037 Vpp, Gain = 0.000925



Graph 14: Measurements of Vin(t) and Vc(t) at F = 11.105 kHz (Resonance)

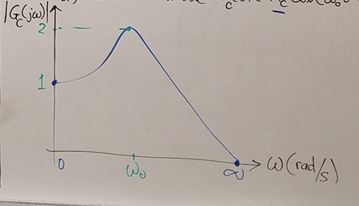
Vin(t) = 4.0Vpp, Vr(t) = 8.0 Vpp, Gain = 2.0

Phase at resonance = -66.6°

Table 2: Summary of Circuit 2

|  |  |  |  |
| --- | --- | --- | --- |
| Frequency | Vin | Vc | Gain |
| 15.9 Hz | 4 Vpp | 4.0 Vpp | 1.0 |
| 159 Hz | 4 Vpp | 4.0 Vpp | 1.0 |
| 1590 Hz | 4 Vpp | 4.05 Vpp | 1.0125 |
| 15.9 kHz | 4 Vpp | 4.33 Vpp | 1.0825 |
| 159 kHz | 4 Vpp | 0.0037 Vpp | 0.000925 |
| Wo = 11.105 kHz | 4 Vpp | 8.0 Vpp | 2.0 |

Figure 3: Expected Gain graph of circuit 2



Graph 15: Actual Gain graph of circuit 2

**Post Lab:** Attached at the end of lab.