**Experiment 8:**

Resonance

**Ben Giftakis**

TA: Mario Rojas

Physics 181

8/18/20

**Purpose**: The purpose of this experiment is to experiment with the concepts of self inductance and resonance.

**Data**: inco

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **For Single Capacitor** | | **For Series Capacitor** | | **For Parallel Capacitor** | |
| f | VR | f | VR | f | VR |
| 500 | 1.27E+00 | 500 | 6.11E-01 | 500 | 2.56E+00 |
| 600 | 1.56E+00 | 600 | 7.43E-01 | 600 | 3.17E+00 |
| 700 | 1.87E+00 | 700 | 8.79E-01 | 700 | 3.84E+00 |
| 800 | 2.21E+00 | 800 | 1.02E+00 | 800 | 4.55E+00 |
| 900 | 2.57E+00 | 900 | 1.17E+00 | 900 | 5.30E+00 |
| 1000 | 2.98E+00 | 1000 | 1.34E+00 | 1000 | 6.07E+00 |
| 1100 | 3.43E+00 | 1100 | 1.51E+00 | 1100 | 6.79E+00 |
| 1200 | 3.93E+00 | 1200 | 1.69E+00 | 1200 | 7.39E+00 |
| 1300 | 4.48E+00 | 1300 | 1.89E+00 | 1300 | 7.81E+00 |
| 1400 | 5.09E+00 | 1400 | 2.11E+00 | 1400 | 7.99E+00 |
| 1500 | 5.74E+00 | 1500 | 2.35E+00 | 1500 | 7.95E+00 |
| 1600 | 6.39E+00 | 1600 | 2.62E+00 | 1600 | 7.73E+00 |
| 1700 | 7.02E+00 | 1700 | 2.91E+00 | 1700 | 7.40E+00 |
| 1800 | 7.54E+00 | 1800 | 3.24E+00 | 1800 | 7.01E+00 |
| 1900 | 7.88E+00 | 1900 | 3.61E+00 | 1900 | 6.61E+00 |
| 2000 | 8.00E+00 | 2000 | 4.03E+00 | 2000 | 6.22E+00 |
| 2100 | 7.91E+00 | 2100 | 4.49E+00 | 2100 | 5.85E+00 |
| 2200 | 7.64E+00 | 2200 | 5.01E+00 | 2200 | 5.52E+00 |
| 2300 | 7.28E+00 | 2300 | 5.58E+00 | 2300 | 5.21E+00 |
| 2400 | 6.86E+00 | 2400 | 6.17E+00 | 2400 | 4.93E+00 |
| 2500 | 6.44E+00 | 2500 | 6.77E+00 | 2500 | 4.67E+00 |
| 2600 | 6.03E+00 | 2600 | 7.31E+00 | 2600 | 4.44E+00 |
| 2700 | 5.65E+00 | 2700 | 7.73E+00 | 2700 | 4.23E+00 |
| 2800 | 5.31E+00 | 2800 | 7.97E+00 | 2800 | 4.04E+00 |
| 2900 | 5.00E+00 | 2900 | 7.98E+00 | 2900 | 3.86E+00 |
| 3000 | 4.71E+00 | 3000 | 7.79E+00 | 3000 | 3.70E+00 |
| 3100 | 4.46E+00 | 3100 | 7.46E+00 | 3100 | 3.55E+00 |
| 3200 | 4.23E+00 | 3200 | 7.05E+00 | 3200 | 3.42E+00 |
| 3300 | 4.02E+00 | 3300 | 6.60E+00 | 3300 | 3.29E+00 |
| 3400 | 3.83E+00 | 3400 | 6.17E+00 | 3400 | 3.18E+00 |
| 3500 | 3.66E+00 | 3500 | 5.75E+00 | 3500 | 3.07E+00 |
| 3600 | 3.51E+00 | 3600 | 5.38E+00 | 3600 | 2.97E+00 |
| 3700 | 3.36E+00 | 3700 | 5.03E+00 | 3700 | 2.87E+00 |
| 3800 | 3.23E+00 | 3800 | 4.73E+00 | 3800 | 2.78E+00 |
| 3900 | 3.11E+00 | 3900 | 4.45E+00 | 3900 | 2.70E+00 |
| 4000 | 3.00E+00 | 4000 | 4.20E+00 | 4000 | 2.62E+00 |
| 4100 | 2.89E+00 | 4100 | 3.98E+00 | 4100 | 2.55E+00 |

Table : frequency data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Capacitance (F) | C-1/2 (F-1/2) | *f*0 (Hz) | **N** |
| Single Capacitor | 1.001E-07 | 3160.70 | 2000 | 3 |
| Series Capacitor | 4.930E-08 | 4503.77 | 2900 | **slope** |
| Parallel Capacitor | 1.970E-07 | 2253.03 | 1400 | **(units)** |
|  |  |  |  | 0.666724 |
| |  | | --- | |  | |  |  |  | **intercept** |
|  |  |  |  | **(units)** |
|  |  |  |  | -104.0796 |
|  |  |  |  | **R2** |
|  |  |  |  | 0.999986 |
|  |  |  |  | **Sy** |
|  |  |  |  | **(units)** |
|  |  |  |  | 3.985927 |
|  |  |  |  | **Sslope** |
|  |  |  |  | **(units)** |
|  |  |  |  | 0.002489 |
|  |  |  |  | **Sintercept** |
|  |  |  |  | **(units)** |
|  |  |  |  | 8.543997 |

Table : capacitance and frequency with 2d stats

|  |  |
| --- | --- |
| Lexp (H) | %diff |
| 0.056983312 | 9.5502983 |
| Lexp (mH) |  |
| 56.98331207 |  |

Table :experimental induction values

**Calculations**:

= H

**Discussion**:

In the experiment the frequencies and voltages were given and measured for 3 circuits. From these data points, we find the peak voltage, unfortunately as the data is only so granular, there is some estimation in finding the correct frequency to use in calculations. The frequencies I used in the single, series, and parallel circuits were, 2000 Hz, 2900 Hz, 1400 Hz, respectively. Using the calculated capacitance of the circuit I was able to run 2d stats to obtain the slope. Then with that I used the inductance formula to calculate the inductance 56.98331207 mH which when compared the accepted value for this data set is 9.55% different. This is a significant difference, there is like some non-negligible error in this experiment. I would collect a lot more datapoints for this experiment to be viable in a simulated online setting. Since difference from the accepted value was quite large there is some error. The largest source of error was likely the guesswork that comes from estimating where the top of the curve was for the peak voltage, the datapoints were not granular enough to get a precise frequency.

**Conclusion & results**:

Cap,single = 1.001E-07 F, inverse square = 3160.70

Cap,series = 4.930E-08 F, inverse square = 4503.77

Cap,parallel = 1.970E-07 F, inverse square = 2253.03

F0,single = 2000 Hz

F0,series = 2900 Hz

F0,parallel = 1400 Hz

Slope = 0.666724

Lexp = 56.98331207 mH, 9.5502983% diff

**Questions**:

1. when accounting for the resistance the graph would be wider and flatter

2. single -> 794.9797 Ω

Series -> 1113.2052 Ω

Parallel -> 577.0665 Ω

3. single -> 716.0734183 Ω

Series -> 1038.306457 Ω

Parallel -> 501.2513928 Ω