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PHY366 Lab Report
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Aim

To design and analyse a series LCR circuit.

Methods

We simulated a series LCR circuit on the online platform MultiSim[1], employing a 20Ω resistor, a 200 μH inductor and a 2.0μF capacitor.

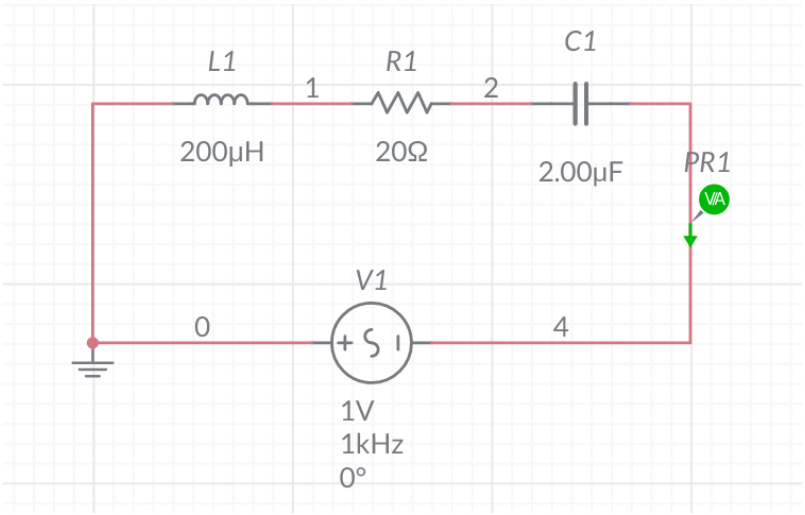

Figure 1: The series LCR circuit employed here.

We predict resonance at

$$\omega = \frac{1}{\sqrt{LC}} = \frac{1}{200 \times 2 \times 10^{-6} \times 10^{-6}}$$

which is $\omega = 50,000$ or $f_0 = 7.96$ kHz.

We applied a 1V AC supply and expected to get a $i_0 = 1/20 = 50$mA peak current at resonance. The circuit we used is shown in Figure 1.

From the data obtained from the simulator, we also calculated the bandwidth and the corresponding quality factor of the LCR circuit. We summarize our results in the succeeding section.

[1]Constructed circuit is available at https://www.multisim.com/content/XudVnEW8m4cFpayszBtMSX/lcr-series-prac-1/open/

Results

We obtain a resonance peak at a frequency of ~ 7.94 kHz and a peak current of 50mA, consistent with theoretical estimates (see Figure 2). A summary of the data produced by the simulator is available in the `LCR series data.csv` file included with this report.

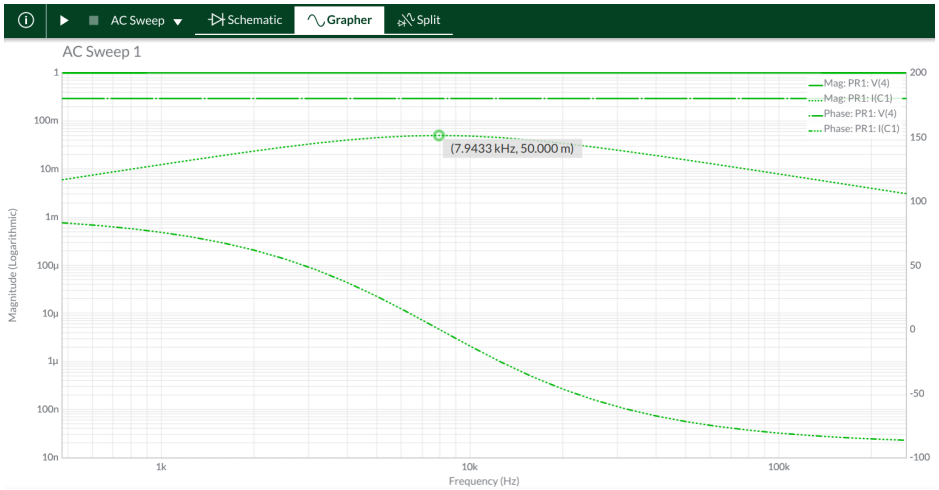

Figure 2: The resonance peak is obtained at ~ 7.94kHz, consistent with the theoretical expectations.

The current drops to around $0.707 i_0$ at $f_1 = 3.16$ kHz and $f_2 = 19.95$ kHz respectively. From this we calculate the bandwidth to be

$$\text{BW} = \Delta f = 19.95 - 3.16$$

or BW $= 16.79$ kHz.

The quality factor Q of the circuit is defined as

$$Q = \frac{f_0}{\text{BW}}$$

where f_0 is the resonance frequency (here, 7.94kHz).

This gives a Q-value of $Q \sim 0.47$.