CALIFORNIA STATE UNIVERSITY
LONG BEACH

Control Systems Laboratory
EE 370L
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Lab #7

RLC Harmonic Oscillator

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1. RLC harmonic oscillator

Design an RLC harmonic oscillator circuit, shown in Figure 1, by choosing the R, L, and C component values to have the system adhere to the constraints of a natural frequency of 159.15 Hz and a damping ratio of 50.

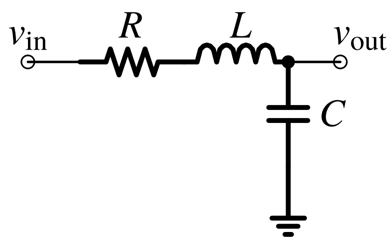

Figure 1. RLC harmonic oscillator circuit

This oscillator is described by the relationship,

$$H(s) = \frac{\omega^2}{s^2 + 2\zeta\omega s + \omega^2} = \frac{1}{LCs^2 + RCs + 1}.$$

Provide the equation for natural frequency in terms of C and L, and the equation for damping ratio in terms of R, L, and C. Visualize the step response on your oscilloscope and compare it with a MATLAB or Simulink model. Plot the frequency response using MATLAB or Simulink.

Sample report

1.1 Introduction

Harmonic oscillation is a common phenomenon observed in nature. In terms of control systems, these oscillators can be described by second order transfer functions. In this lab we design our own harmonic oscillator by choosing component values in an RLC circuit.

1.2 Setup

We wired our breadboard with the circuit shown in Figure 2.

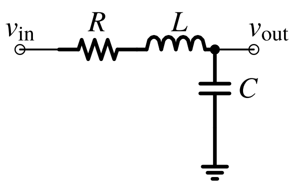

Figure 2. RLC harmonic oscillator circuit

The MATLAB code we used to generate our plots is shown below:

```
print("...")
```

1.3 Data

The equations for the damping ratio and natural frequency are shown in Equation 1 and Equation 2, respectively.

$$\zeta = \ldots \tag{1}$$

$$\omega = \ldots \tag{2}$$

Our calculated component values and oscillator parameters are shown in Table 1.

Table 1. Circuit component values

Component	Value
Resistance, R [Ω]	...
Inductance, L [H]	...
Capacitance, C [F]	...
Damping ratio, ζ	...
Natural frequency, ω [rad/s]	...

Our oscilloscope output is shown in Figure 3. Our MATLAB plots are shown in Figure 4 and Figure 5.

```
Figures 3 through 5 go here, all with
        descriptive captions.
                ...
                ...
                ...
```

1.4 Discussion

...

1.5 Conclusion

The harmonic oscillator is an important topic in control systems. We were able to apply our knowledge of the topic by successfully designing an RLC oscillator adhering to given system constraints by choosing component values of ....