**Southern Polytechnic State University** **ECET 2111 Laboratory Exercise No. 8**
**Electrical & Computer Engineering Technology** **Parallel Resonance**

**Name: _____** **Date: _____** **Section: _____**

# Introduction

In this exercise you will determine the resonant characteristics of a parallel RLC network.

# Pre-Lab Calculations

1. Calculate the resonant and cutoff frequencies for the circuit shown in Figure 1, along with the bandwidth and the quality factor.

   fp = _____ Hz, f1 = _____ Hz, f2 = _____ Hz

   BW = _____ Hz, $Q_{ckt}$ = _____

2. Simulate the circuit shown in Figure 1 with PSpice using the AC Sweep analysis. Choose a start frequency of 100 Hz and an ending frequency of 100k Hz. Print the plot of $V_{OUT}$ / $V_{IN}$ magnitude (in dB). Also print the plot of the phase voltage of $V_{OUT}$ by inserting a vphase marker at the point $V_{OUT}$ in the circuit.

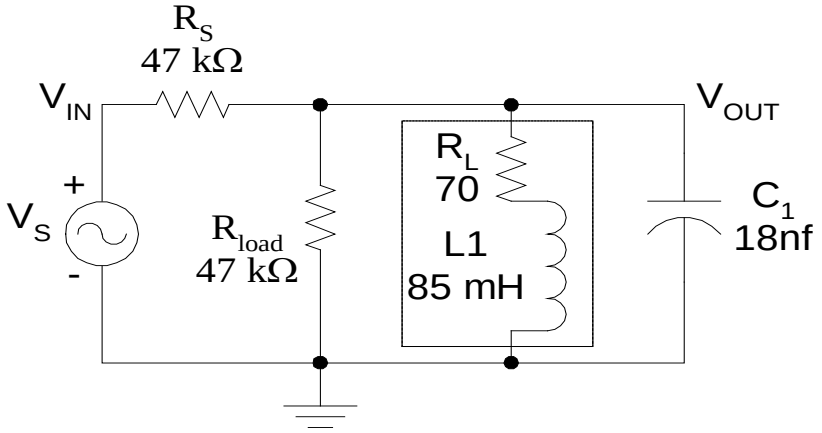


**Figure 1**

# Procedure

1. Connect the circuit shown in Figure 1 with the exception of $R_L$. Do **NOT** include the resistor $R_L$, it is part of the inductor. Set $V_S$ to 5 volts peak and be sure to maintain this voltage throughout the experiment.
   Experimentally find $f_P$ by adjusting the frequency until zero degree's phase shift is obtained between the load voltage ($V_{OUT}$) and the source voltage ($V_{IN}$). Record this frequency in the table below.
   ***What is the importance of zero degree's phase shift at resonance?***

2. Measure the peak load voltage at the resonant frequency. Divide the voltage just found by $\sqrt{2}$. Adjust the frequency slightly below $f_P$ until you obtain the voltage just calculated. This will be the first half-power frequency $f_1$. Record this value the table below.

3. Now adjust the frequency slightly above the resonant frequency until you reach the same calculated voltage from step two. This will be the second half-power frequency $f_2$. Record this value in the table below.

   ***What is the importance of dividing by the $\sqrt{2}$ in order to find the voltage at $f_1$ and $f_2$?***

**Measured Values:**

| $f_P$ ( Hz ) | $f_1$ ( Hz ) | $f_2$ ( Hz ) |
|---|---|---|
| | | |

4. Determine the Bandwidth and circuit Q from the measured values in the table above.

| BW ( Hz ) | $Q_{ckt}$ |
|---|---|
| | |

## Section B

**If the CAT system is unavailable, then skip to Section C.**

5. Using the CAT system take 200 data points starting at 100 Hz and ending at 100 KHz. Use a source voltage of 5 Volts peak. Plot the magnitude vs. frequency and print. ***The data file will be used in the Report Guide section. Be sure and save your data file!***

## Section C ( do this section only if the CAT system is unavailable at lab time)

5. Measure and record each of the load voltage magnitudes and phase angles specified in the table below.

6. Calculate the theoretical load voltage magnitude and phase angle (with respect to the source voltage) for each specified frequency. Record your results in table below. ( $R_{Load}$ = "Load" ) *Using Mathcad for these calculations will help simplify this step.*

| Frequency (Hz) | $\|V_L\|_{(Meas)}$ (V) | $\angle V_{L(Meas)}$ (°) | $\|V_L\|_{(Calc)}$ (V) | $\angle V_{L(Calc)}$ (°) |
|---|---|---|---|---|
| 0.1* $f_P$ | | | | |
| 0.5* $f_P$ | | | | |
| 0.9* $f_p$ | | | | |
| $f_P$ | | | | |
| 1.1* $f_p$ | | | | |
| 2.0* $f_P$ | | | | |
| 10 * $f_P$ | | | | |

# Report Guide

***If CAT system was used:***

1. Using the CAT system measured data file, plot the magnitude data as a function of frequency. Use a logarithmic scale for the (frequency) x-axis.

2. Compare the measured values obtained in procedure steps 1 thru 3 with the theoretical values found in the Pre-Lab section. Explain any differences.

3. Compare and contrast the operating characteristics of series and parallel resonant circuits.

***If the CAT system was not used:***

1. Compare the measured values obtained in procedure steps 1 thru 3 with the theoretical values found in the Pre-Lab section. Explain any differences.

2. On a single graph, plot both the measured and theoretical voltage magnitudes found in Section C as a function of frequency. Use a logarithmic scale for the (frequency) x-axis.

3. On a second graph, plot both the measured and theoretical voltage angles found in Section C as a function of frequency. Use a logarithmic scale for the (frequency) x-axis.

4. Compare the measured voltages with the theoretical voltages. Explain any differences.

5. Compare and contrast the operating characteristics of series and parallel resonant circuits.

Approved by (Instructor): _____ Date: _____