Name: _____   **Date:** _____

Introduction

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

PreLab

1) Calculate the resonant frequency, f_S, the cutoff frequencies, f_1 and f_2, the bandwidth, **BW**, and the quality factor, Q_S, for the series-resonant circuit shown in Figure 7.1.

$f_S =$ _____ Hz $f_1 =$ _____ Hz $f_2 =$ _____ Hz

$BW =$ _____ Hz $Q_S =$ _____

2) Simulate the circuit shown in Figure 7.1 using PSpice. Perform an **AC Sweep**, with the parameters:

Start Freq. = 100Hz,   End Freq. = 100kHz,   1001 Pts/Decade

Plot the magnitude of V_{Load}, the phase angle of V_{Load}, and the magnitude of V_S/V_{Load} (in dB) on three separate graphs.

Note – to plot the phase angle of V_{Load}, place a **Vphase** probe at node B. The **Vphase** probe is accessed by selecting **Vphase** from the dropdown menu **Markers → Mark Advanced…**

Determine the resonant frequency, f_S, the cutoff frequencies, f_1 and f_2, the bandwidth, **BW**, for the series-resonant circuit from your Probe plots.

$f_S =$ _____ Hz $f_1 =$ _____ Hz $f_2 =$ _____ Hz

$BW =$ _____ Hz

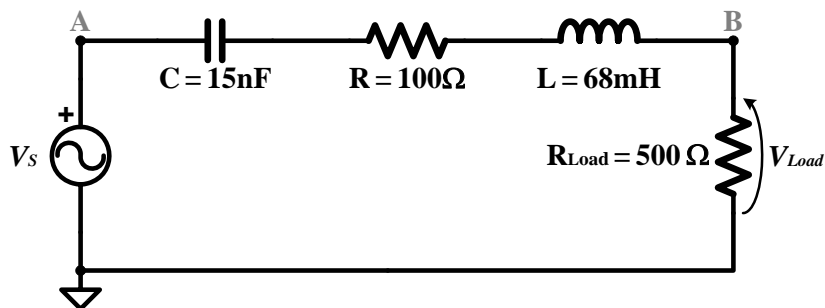**Have your instructor verify your prelab results.**   **Instructor Initials:** _____

Figure 7.1 – Series-Resonant Circuit

Procedure

1. Construct the circuit shown in Figure 7.1. Set the source voltage to $5V_{peak}$ and be sure to maintain this voltage throughout the experiment.

2. Experimentally find the series-resonant frequency, f_S, by adjusting the source frequency until a zero-degree phase shift is obtained between the source and load voltages. Record the result in Table 7.1.

3. Measure the peak value of the load voltage at the series-resonant frequency and divide the value of the peak voltage by $\sqrt{2}$. This should be the peak value of the load voltage at the cutoff frequencies.

   Note – be sure that you understand the significance of dividing by $\sqrt{2}$ in order to find the peak value of the load voltage at the cutoff frequencies.

4. Beginning at the series-resonant frequency, decrease the source frequency until the peak value of the load voltage equals the value that you calculated in Step 3. The frequency at which this occurs is the lower cutoff frequency, f_1. Record the value of the lower cutoff frequency in Table 7.1.

5. Beginning again back at the series-resonant frequency, increase the source frequency until the peak value of the load voltage equals the value that you calculated in Step 3. The frequency at which this occurs is the upper cutoff frequency, f_2. Record the value of the upper cutoff frequency in Table 7.1.

6. Determine the Bandwidth and the Quality Factor of the circuit from the measured values and record the results in Table 7.1.

PART B
7. Measure and record both the magnitude and the phase angle of the load voltage (with respect to the source voltage) at each of the frequencies specified in Table 7.2.

Report Guide

1) Compare the measured values obtained in procedure steps 2 through 6 with the theoretical values found in the Pre-Lab section. Explain any differences.

2) Calculate and record the theoretical load voltage magnitudes and phase angles (with respect to the source voltage) at each of the frequencies specified in Table 7.2.

3) On a single graph, plot both the measured and the calculated magnitudes recorded in Table 7.2. Use a logarithmic scale for the frequency (x) axis.

4) On a second graph, plot both the measured and the calculated phase angles recorded in Table 7.2. Use a logarithmic scale for the frequency (x) axis.

5) Compare the measured voltages with the theoretical voltages. Explain any differences.

6) Define and discuss the importance of resonance in AC circuits.

f_S (Hz)	f_1 (Hz)	f_2 (Hz)	BW (Hz)	Q_S

Table 7.1 – Circuit Parameters Determined from In-Lab Measurements

Frequency (Hz)	$|V_{Load}|_{Meas}$ (V)	$\angle V_{LoadMeas}$ (°)	$|V_{Load}|_{Calc}$ (V)	$\angle V_{LoadCalc}$ (°)
0.1 x f_S =				
0.5 x f_S =				
0.9 x f_S =				
f_S =				
1.1 x f_S =				
2 x f_S =				
10 x f_S =				

Table 7.2 –Measured and Calculated Frequency Response

Have your instructor verify your results: **Instructor's Initials: _____   Date: _____**