Department of Computer and Electronics Engineering Technology

CEET 1140

Lab 12

Title: Series Resonant Circuits.

Objective: The student will be able to construct and a series resonant circuit and be able to find the resonant frequency, the quality factor (Q) the cutoff frequencies and the bandwidth.

Equipment: Function Generator
Oscilloscope
Proto Board

Parts: 1 470Ω Resistor, ¼ watt
1 10Ω Resistor, ¼ watt
1 1mH Inductor
1 0.01uF Capacitor

Preparation: Write the title and a short description of this lab in your lab book. Make sure the page is numbered and make an entry in the table of contents for this lab.

Measure the DC resistance of your 1mH inductor. You can think of this resistance as being in series with your inductor. Record this measurement in your lab book as R_L.

Consider the series resonant circuit shown below.

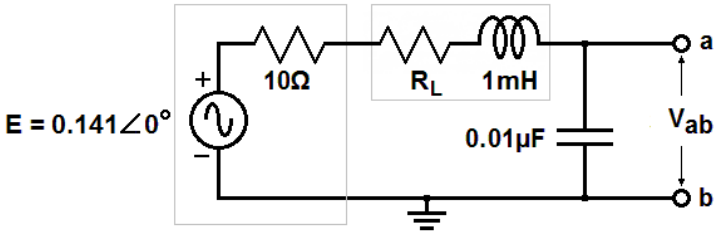

Figure 1. Series Resonant Circuit

For the purposes of analysis, combine $R = R_L+10\Omega$. Calculate the resonant frequency (f_s) and the Quality Factor (Q_s). Compute the bandwidth, BW, and cutoff frequencies, f_1 and f_2. (If Q>10, you may use the approximation in the text) Record these values in your lab book and bring it, along with the parts, above, to your lab period.

Set up: Construct the circuit in Figure 1 on your proto-board. Use a voltage divider of 470Ω and 10Ω in conjunction with the function generator (Figure 2) to create a voltage source with only 10Ω impedance. Do not connect it to your circuit yet.

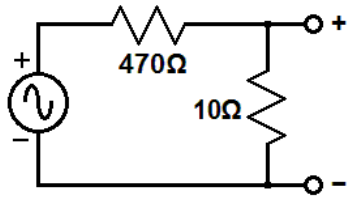

Figure 2. Equivalent voltage source with $R_{TH} \approx 10\Omega$.

Turn on the function generator and configure it to produce a sine wave across the 10Ω resistor with a peak amplitude of 200mV and a frequency approximately equal to f_s.

Connect your voltage source circuit to your series resonant circuit.

Procedure: Attach the oscilloscope across points (a) and (b) in your circuit. Adjust the frequency so that the V_{ab} is maximized. Record this (resonant) frequency in your lab book. Use the cursors on the scope to measure the amplitude of V_{ab} and record it too. From that (and the fact that the amplitude of E_{TH} = 0.2V) compute Q.

To find the cutoff frequencies, compute the amplitude of V_{ab} at the half power point (which is 0.7071 times the amplitude of V_{ab} you recorded earlier). Adjust the cursors of the scope to this amplitude, then adjust the frequency of the function generator (both upward and downward) until the amplitude of V_{ab} matches the cursors. Record these two frequencies in your lab book as f_1 and f_2. Subtract the two to compute the bandwidth and record that as well.

Cleanup: Turn off the power to the scope and function generator.

Conclusions: In the conclusion section, write a short summary of what you did and what you learned. Make sure your conclusion answers the following questions:

Did your measurements agree with your calculations?

What could you do to double both the resonant frequency and Q?

What could you do to double Q but cut the resonant frequency in half?