Department of Computer and Electronics Engineering Technology

CEET 1140

Lab 8

Title: Reactance.

Objective: The student will be able to measure the reactance of capacitors and inductors and from that compute the capacitance or inductance.

Equipment: Function Generator
Oscilloscope (with 2 probes)
Proto Board

Parts: 1 10Ω resistor, ¼ watt
1 3300pF capacitor
1 1000μH inductor

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.

Calculate the reactance X_C of the 3300pF capacitor when the frequency, f = 100kHz.

Calculate the reactance X_L of the 1000μH inductor at the same frequency.

Measure the actual resistance of the 10Ω resistor.

Record these calculations and measurements in your lab book and bring it, along with the parts, above, to your lab period.

Set up: In order to measure the reactance of an element (capacitor or inductor), we need to see waveforms for both its voltage and its current simultaneously. Sadly, oscilloscopes only display voltage waveforms, not current waveforms. To see the current waveform, we must employ a little subterfuge. We will add a small resistor in series to the reactive element and display the voltage across that. Since I=V/R, it is easy to compute the current waveform.

Construct the circuit in Figure 1, using the function generator in place of the voltage source. Connect one scope probe to point (a) and the other to point (b). Connect the scope ground clamps the circuit ground.

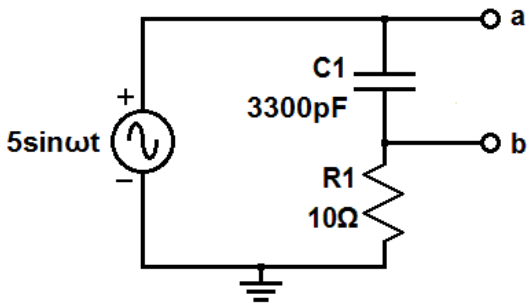

Figure 1. Circuit to Measure Capacitor Reactance.

Turn on the function generator, and configure it to produce a sine wave with a frequency of approximately 100kHz. Adjust the amplitude to at least ±5V.

Procedure: Using the cursors on the scope, measure the peak amplitude of each waveform. (Be careful to use different scales for each measurement.) The peak amplitude measured at point (a) is the peak voltage, V_m. (The voltage drop across the 10Ω resistor is negligible.) The peak amplitude measured at point (b) divided by the measured resistance of the 10Ω resistor is the peak current, I_m.

Calculate the reactance, $X_C = V_m/I_m$. From that, calculate the capacitance, C, from the equation $X_C = 1/(\omega C)$. Note: find ω using the actual frequency on the function generator.

From the waveforms, determine if the current leads or lags the voltage and by about how many degrees.

Replace the 3300pF capacitor in your circuit with a 1000μH inductor and repeat the measurements of V_m and A_m.

Calculate the reactance, $X_L = V_m/A_m$. From that, calculate the inductance, L, from the equation $X_L = \omega L$. Once again, determine if the current leads or lags the voltage and by how many degrees.

Cleanup: Turn off the power and return the second scope probe.

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:

Why might the X_C and X_L you computed initially differ from the X_C and X_L you computed from measurements?

How close (in percent) were the C and L you computed to 3300pF and 1000μH, respectively? Why might there be a difference?