GOAL - The goals of this lab are to:

a. determine the self inductance of a solenoid through its design.

b. determine the self inductance of a solenoid by measuring the resonant frequency.

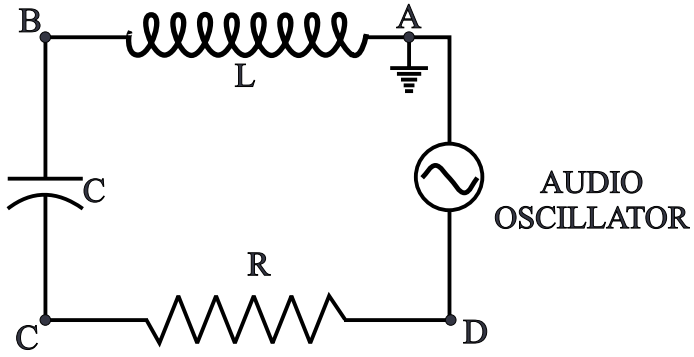
c. show that the EMF across a solenoid is 90^{o} out of phase with the EMF across the source.

d. show that the voltage drops across the individual circuit elements in a series RCL circuit add up geometrically to give the EMF across the source.

e. measure the impedance of an RCL circuit.

PROCEDURE -

1. Determine the self inductance [L] of a solenoid as a function of its design.
2. Measure the length [l] of the solenoid.
3. Determine the number of turns [N] contained in this coil. [A fairly difficult process! Use your previous experience with circuits to help you determine N.]
4. Measure the cross section of the solenoid.
5. Calculate the self inductance of your solenoid.
6. Determine the self inductance of a known inductor through the determination of the resonant frequency.
7. Connect up the circuit as shown to the right where R = 5000 Ω. and the capacitor is approximately C = 100 μF.
8. Attach an oscilloscope [or an AC Voltmeter] between points A and C.
9. Systematically, vary the frequency of the AC oscillator until the potential difference across the oscilloscope [or AC Voltmeter reaches a minimum. [Note! It may be useful to calculate the resonant frequency]
10. From this resonant frequency verify the rated self inductance of your inductor.
11. Repeat the above procedure on your unknown inductor and then compare this value to the inductance predicted in step 5.
12. Demonstrate the phase relationship between the EMF across the power supply and the voltage across the induction coil.



13. Adjust the oscillator to 2000 Hz and the resistance to 500 Ω .
14. Connect the vertical input of the oscilloscope between points A and D.
15. Simultaneously connect the horizontal input of the oscilloscope between points A and B.
16. Turn the input selector of the oscilloscope to Horizontal input.
17. Adjust the resistance and the gains of the oscilloscope until a circle appears on the screen.
18. Demonstrate the mathematical relationship among the EMF of the power supply, the Voltage across the inductor, the voltage across the capacitor and the voltage drop across the resistor.
19. Adjust the oscillator to some frequency significantly different from the resonant frequency.
20. Using the AC voltmeter capability of the multimeter, measure the voltage across each element of this circuit.
21. Using the theoretical relationship developed in class, show that the voltages across the inductor, capacitor and the resistor add up geometrically to the EMF of the oscillator.
22. Measure the total impedance of this circuit from the EMF of the oscillator and the AC current flowing in the circuit. Compare this value to the impedance of the circuit based on the values for resistance, inductance and capacitance.