EXPERIMENT #9 - PHYSICS 31

A.C. Impedance (Part I)

OBJECT: To study the effects of inductance, capacitance and resistance connected to an alternating current source.

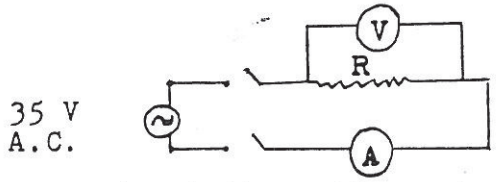
EQUIPMENT: inductor (860 mH)
resistor (100 watt light bulb)
capacitor (10μF and 4μF)
A.C. ammeter (0-1 A)
A.C. voltmeter (0-150 V)
A.C. source (35 volts, 60 Hz)
D.C. ammeter (0-1 A)
D.C. voltmeter (0-30 V)
D.C. source (25 V)

THEORY: Refer to lecture and chapter 39 of Halliday and Resnick.

GENERAL DIRECTIONS:

A. Light bulb resistance:

1. Connect the following A.C. circuit:



R = resistance of 100 watt light bulb

A = A.C. ammeter (0-1 A)

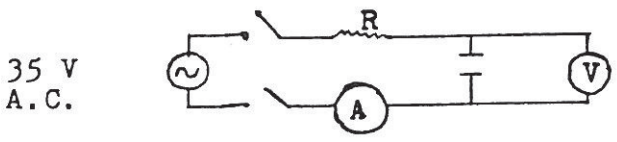
V = A.C. voltmeter (0-150 V)

Even though the voltage should be only 35 volts, there is still the possibility of accidentally receiving a serious electrical shock. Be careful when using any of the circuits in this experiment. Always completely disconnect your experimental circuit before physically changing any part of it or when you are not actually taking measurements. Also, be sure that the other people near you know when you are using a live circuit and always be sure your circuit is disconnected whenever you are not directly in control of your circuit. The electrical power plug may be used as the switch indicated in the diagrams. Also, be sure that you understand where you will obtain the 35 volts A.C. If you are in doubt, ask the instructor.

2. Using the readings from the ammeter and voltmeter find the resistance of the light bulb. The meters will give the effective or rms values of voltage or current. Why doesn't the light bulb glow more brightly?

B. Capacitive reactance:

1. Connect the following circuit and measure the effective (rms) voltage and current as indicated:



C = capacitor (10μF)

R = light bulb resistance

A = ammeter (0-1 A)

V = voltmeter (0-150 V)

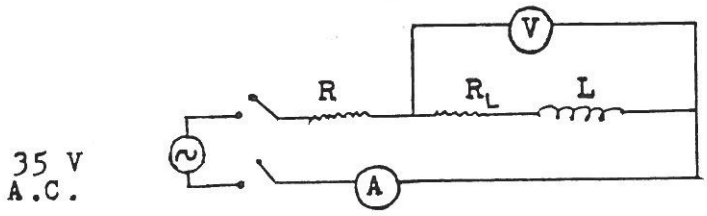
From this data calculate the capacitive reactance X_C of this capacitor. Draw an impedance diagram for this capacitor.

2. Calculate X_C by using the value of C and the frequency of the voltage source, and compare this to above value.

3. Replace the capacitor C with a $4\mu F$ capacitor and repeat parts 1 and 2 of this section. It may be necessary to use another A.C. ammeter with a suitable range.

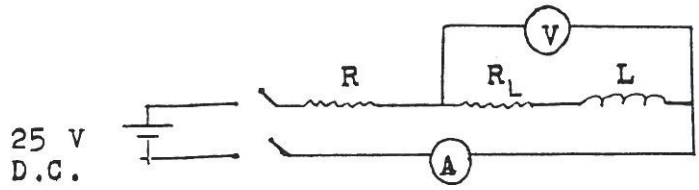
C. Inductive reactance and resistance:

1. Connect the following circuit and measure the effective (rms) voltage and current by using the A.C. meters:



A = A.C. ammeter (0-1 A)
L = inductor (860 mH)
R_L = D.C. resistance of inductor
R = light bulb resistance
V = A.C. voltmeter (0-150 V)

2. By using the following circuit find the resistance R_L of the inductor:



V = D.C. voltmeter (0-30 V)
A = D.C. ammeter (0-1 A)
R = light bulb resistance

3. Using the data in parts 1 and 2 of this section of the experiment calculate the inductive reactance X_L of the inductor and the phase angle between the meter's voltage and the current. Draw an impedance diagram for the inductor.

4. Calculate X_L by considering the values of L and the frequency of the voltage source and compare this value to the value of X_L calculated above.