NORTH SOUTH UNIVERSITY

The first private university in Bangladesh
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Department of Mathematics & Physics

Experimental Physics
PHY-108L

Laboratory Manual

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Experiment 1: Verification of Ohm's Law

1. Objectives:

- To confirm Ohm's law by studying the relationship of voltage, current and resistance.
- To make voltage and current measurements using a DMM in a resistive circuit to verify Ohm's law.

2. Backgrounds:

Ohm's Law: Ohm's law states that electrical current in a resistive circuit is *directly proportional to the applied voltage* and *inversely proportional to its resistance, provided all physical conditions and temperatures remain constant.*

$$I = \frac{V}{R} \qquad \text{in amperes (A)}$$

Where V is the applied voltage in volts (V).
R is the resistance in ohms (Ω).
I is the current in amperes (A).

The larger the applied voltage is, the larger the current becomes. The larger the resistance is, the smaller the current becomes.

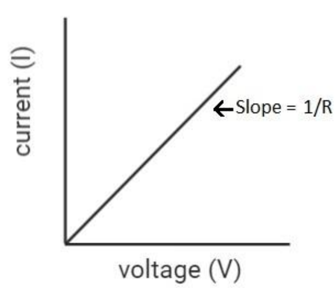
Conditions of Ohm's Law:

- A conducting device obeys Ohm's law when the resistance of the device is independent of the magnitude and polarity of the applied potential difference.
- Ohm's law is not applicable for unilateral electrical elements like diodes and transistors as they allow the current to flow through in one direction only.

Graphical Representation of Ohm's Law: Ohm's law can be represented as a straight line in x-y coordinates as the current and the voltage have a linear relationship.

$$I = \frac{V}{R} = \frac{1}{R} \cdot V$$

where, $\frac{1}{R}$ represents the slope of the line with I on the vertical axis and V on the horizontal axis.



Voltage- Current Characteristics- Ohm's Law Graph

3. Procedures and Observations:

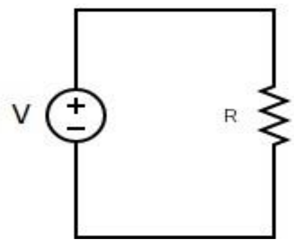


Figure 1

1. Pick 2.2$k\Omega$, 4.7 $k\Omega$, 10 $k\Omega$, from your laboratory kit as R_1, R_2 and R_3.
2. Measure the resistance using the DMM and record the measured value in Table 1.
3. Connect the circuit shown in Figure 1 using R to start. Set DMM to measure voltage and current simultaneously or separately.

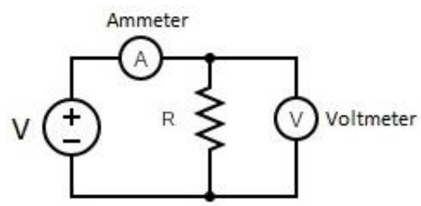


Figure 2

4. **Before turning on the DC power supply, have your circuit checked by the instructor.**
5. With the voltage control knob set to the minimum (fully CCW), turn the DC power supply on and set the voltage control to each voltage value shown in Table 1, beginning with 1 V.
6. For each voltage setting, measure and record the actual voltage and current values in Table 1(Page no. 4).
7. Turn the power supply off.
8. Calculate the theoretical current "$I_{calculated}$" values using the nominal resistance values and the nominal voltage values "$V_{Nominal}$".
9. Compare the calculated currents with the measured, and if satisfied, proceed to the next step.
10. Repeat the above procedures from step 2 through 9, using the other two resistors.

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Data Table:

	R_1			R_2			R_3		
	Nominal R: $2.2\ k\Omega$			Nominal R: $4.7\ k\Omega$			Nominal R: $10\ k\Omega$		
	Measured R:			Measured R:			Measured R:		
	Measured Values		$I_{Calculated}$	Measured Values		$I_{Calculated}$	Measured Values		$I_{Calculated}$
$V_{Nominal}$	$V_{Measured}$	$I_{Measured}$		$V_{Measured}$	$I_{Measured}$		$V_{Measured}$	$I_{Measured}$	
1 V									
2 V									
5 V									
10 V									
15 V									
20 V									
25V									

Table 1: Voltage and Current Measurement and Calculation

Tasks and Questions:

#1: Comment on the measured current compared to calculated currents.

#2: Use the data obtained in Table 1 to plot $I_{measured}$ vs. $V_{measured}$ graph.

#3: What does the inverse of the slope of your graphs represent? Illustrate with an example. [Hint: Find slopes from the graph].

#4: Using your graph, estimate the current that would flow through the resisters at *V* = 12 volts and compare it with the calculated value (12 V/ $R_{Nominal}$). Calculate the error.

For *E* = 12 V

Measured Resistance	**Estimated Current from Graph**	**Calculated Current** (12 V/ $R_{Nominal}$)	**% of Error**
R_1 =			
R_2 =			
R_3 =			

Table 2: Current Estimation and Calculation at V = 12V

Results:

Discussion:

Experiment 2: Visualization of charging and discharging characteristics of a capacitor

1. Objectives:

- To observe charging and discharging characteristics of a capacitor using an oscilloscope
- To verify the time constant in an RC circuit

2. Background:

A capacitor is a passive device that stores energy in it the form of an electric field. It can be charged and discharged through a resistor with the help of a power supply.

During charging, the voltage across the capacitor increases exponentially with time and is given by the following relation

$$V_c(t) = V_0(1 - e^{-\frac{t}{RC}}) \qquad \text{(Eqn. 1)}$$

Where V_0 is the input voltage and $V_c(t)$ is the voltage across the capacitor at a time t.

Similarly, a charged capacitor can be discharged through a resistor and the voltage across the capacitor at any instant can be found by the following relationship

$$V_c(t) = V_0 e^{-\frac{t}{RC}} \qquad \text{(Eqn. 2)}$$

Where V_0 is the initial voltage across the capacitor, the term RC is the above equations is called the time constant, τ, measured in terms of seconds.

Time constant is defined as the time required to charge the capacitor, through the resistor, to 63 percent of full charge; or to discharge it to 37 percent of its initial voltage.

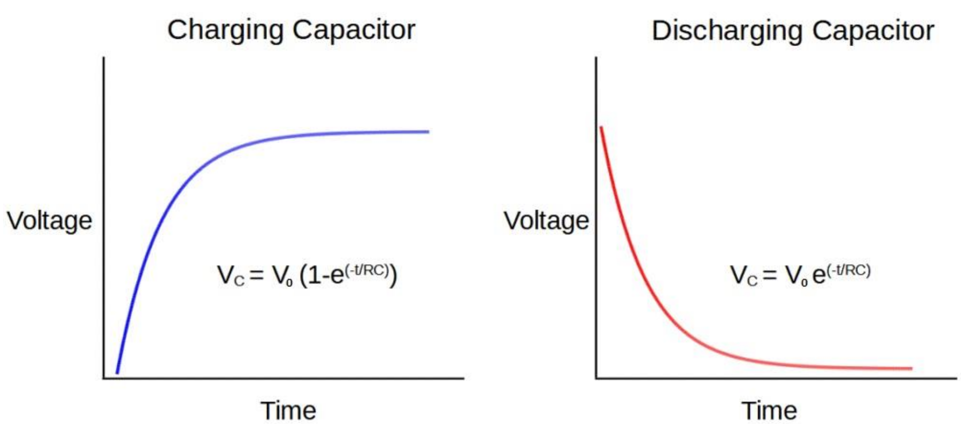


Figure 1: Charging and discharging curve of a capacitor in an RC circuit

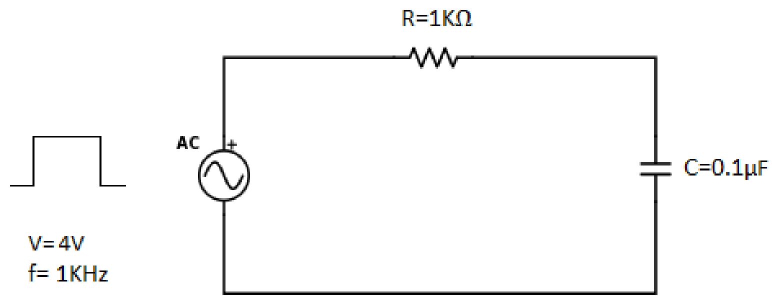


Figure 2: Circuit Diagram for charging and discharging

3. Procedures and Observations:

a. Assume that the capacitor is fully discharged. Measure the value of the resistor, $R_{measured} =$

b. Connect R and C in series with the AC signal generator. (For reference, please see the circuit given above in figure 2).

c. Connect the oscilloscope's channel 1 to the signal generator, choose square wave as an input signal and observe the signal on the oscilloscope.

d. Make sure that the channel is set to **DC coupling**.

e. Measure the amplitude and period of the input pulse and make sure that the amplitude is set to $4V_{p-p}$ and the time period to 1msec with 50% duty cycle.

f. Use the offset knob to raise the signal by 2 V so that the base of the signal is set at 0 V.

g. Connect the oscilloscope's channel 2 across the capacitor and observe the output.

h. Measure the voltage across the capacitor every 50 µsec (approximately) and record the data in the following table.

i. For calculation of capacitor voltage during discharging, measure the maximum capacitor voltage during charging and use it as V_0 in Eqn. 2.

j. Measure the capacitor voltage and record in the following table.

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Data Tables:

Table 1: Time dependent charging characteristic of a capacitor

Time (μsec)	Calculated V_C (Charging)	Measured V_C	Time (μsec)	Calculated V_C (Charging)	Measured V_C
0					

Table 2: Time dependent discharging characteristic of a capacitor

Time (μsec)	Calculated V_C (Discharging)	Measured V_C	Time (μsec)	Calculated V_C (Discharging)	Measured V_C
0					

Tasks and Questions:

#1: Use data obtained in Table 1 to **plot** capacitor voltage (V_c) vs time (t) graph. From the graph, calculate the time constant and compare it to the theoretical value. Also, label the axes properly.

Time constant (Theoretical): $\boldsymbol{R_{measured}} \times \boldsymbol{C} =$

Time constant (Measured from the graph) =

% of Error =

#2: Use the data obtained in **Table 2** to plot capacitor voltage (V_c) vs time (t) graph. From the above graph, determine the time constant and compare it to the theoretical value. Also, label the axes properly.

Time constant (Theoretical): $\boldsymbol{R_{measured}} \times \boldsymbol{C} =$

Time constant (Measured from the graph) =

% of Error =

#3: Did you notice any difference between theoretical and experimental values of time constants, as obtained from the charging and discharging of capacitors? If any, Explain.

#4: What will happen to the charging curve if the resistance is decreased to 100Ω.

Results:

Discussion:

Experiment 3: Visualization of the pattern of magnetic fields due to a bar magnet

1. Objectives:

To draw and analyze the magnetic field lines of a bar magnet.

2. Background:

The magnetic field near a bar magnet can be represented by magnetic field lines. These field lines pass through the magnet and form closed loops around the magnet. The closed field lines enter one end of a magnet and exit the other end. The end of the magnet from which magnetic field lines emerge is called the north pole and the other end, where the field lines enter, is called the south pole.

Earth has a magnetic field that is produced in its core by still unknown mechanisms. On Earth's surface, the magnetic field can be detected with a compass which is essentially a slender bar magnet on a low friction pivot. The bar magnet or the magnetic needle turns because its north-pole end is attracted toward the south pole of the Earth's magnet located near the Arctic region of the Earth. Thus, the south pole of the Earth's magnetic field is located near the Northern Hemisphere, which is known as the *geomagnetic north pole*. In the Southern Hemisphere, the magnetic field lines point out of Earth and away from the Antarctic – that is away from Earth's *geomagnetic south pole*.

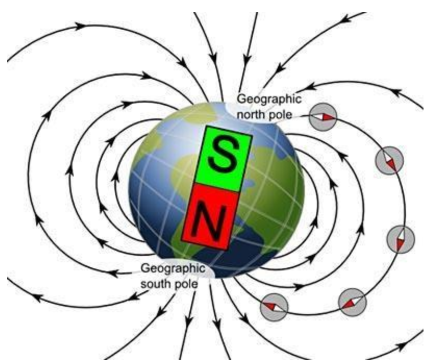


Figure 1: Magnetic field due to the Earth

3. Required Materials: Two bar magnets, One compass, A3 white paper

4. <u>Procedures and Observations:</u>

Part 1: Constructing Magnetic Field Lines of a Bar Magnet:

Use one of the compasses to determine the north pole and south pole of the magnet. The arrow on the compass is magnetic and will experience a torque so that the north pole of the compass will point towards the south pole of the bar magnet or away from the north pole. **Prior to starting the experiment, make sure that the compass poles are properly marked by placing it close to the north/south pole of a bar magnet**

Follow the following steps to complete each part of the experiment:

a. Collect an A3 white paper and tape it on the table.
b. Make sure there are no iron objects/magnets in the vicinity of the experimental area.
c. Place a bar magnet in the middle of the paper.
d. Draw an outline of the magnet on the paper and mark the poles as "N" for North and "S" for South.

Magnetic Field Line # 1:

(a) Place a compass in one end of the magnet. Put dot marks at both ends of the needle.
(b) Move the compass such that the end of the needle next to the magnet is directly over the second dot and make a new dot on the other end.
(c) Continue doing it until you reach the other end of the magnet or goes outside the paper.
(d) Draw a line through the dots and indicate an arrowhead to show the direction in which the North end of the needle pointed, as shown in Figure 2.

Figure 2: Construction of magnetic field lines around a bar magnet

Magnetic Field Line #2: Repeat the process described for Line #1, but start from about 1 cm (½ inch) inside from the same end of the magnet.

In a similar way, draw two more magnetic field lines on the other side of the magnet. *Are the field lines symmetrical with respect to the magnet?*

Magnetic Field Line #3: This time start from 4 – 5 cm (approximately 1.5 – 2 inches) away from the same end and repeat the steps used for Field Line #1. Note that the center of the compass must be on the line if the

outline of the magnet is extended to that direction. Repeat this same for other end of the N pole as well.

Repeat the procedure for the south side of the magnet.

Part #2: Constructing a Magnetic Field Diagram

Part 2 (I)

Get another piece of paper, if necessary, to do this part of the experiment, as shown in Figure 3. Arrange two magnets in such a way that three compasses can fit in between the magnets. Sketch the compass needles' directions as shown in the diagram below. Each position marked in the diagram is the starting point of a field line and mark the compass position a number of times for each starting point.

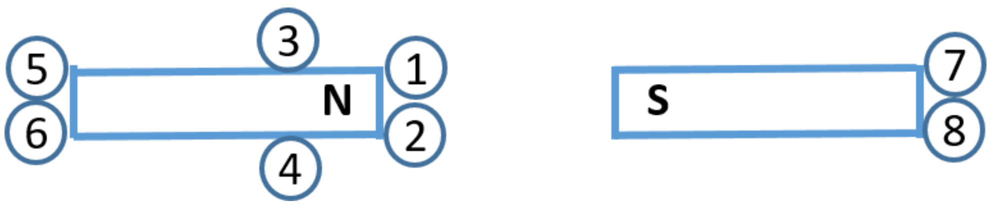


Figure 3: Two magnets with opposite poles facing each other

Part 2 (II)

Now reverse one magnet so that the two north poles face each other, as shown in figure 4. Follow the same procedure as above to draw some field lines from each starting point.

Figure 4: Two magnets with like poles facing each other

Part 3: Superposition of Magnetic Fields:

Place two bar magnets at right angles to each as illustrated in Figure 5. Let P be the point that lies along the centerlines of both magnets. Arrange the magnets so that their ends are equidistant from P (use ruler). Trace the outlines of the two magnets and label their poles.

Step 1: Place a compass on the dot, marked as **P**. Mark the needle position with two dots and draw an arrow indicating the needle's direction.

Step 2: Now remove the **Magnet #1** and indicate the compass needle's direction in the same manner as above. Then replace **Magnet #1** to its original position and remove **Magnet #2**. Again, indicate the needle's direction by drawing an arrow.

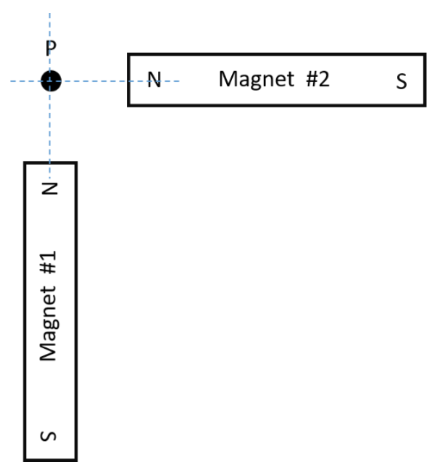


Figure 5: Two magnets at right angles to each other

Step 3: Now switch the position of the magnets (Magnet#1 replaced by Magnet#2 and Magnet #2 replaced by Magnet #1) and take note of the compass direction below. How does it differ from your observation in step 1.

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Tasks and Questions:

Note that all A3 papers used for drawing magnetic field lines must be attached with the report.

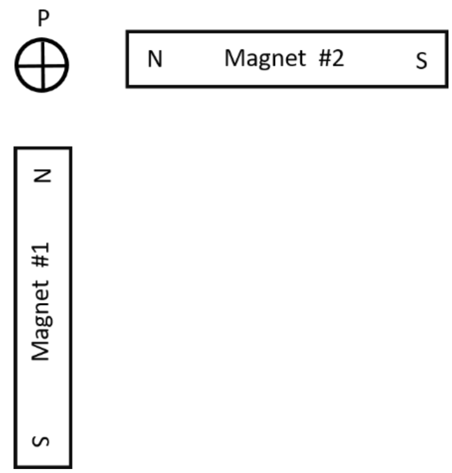
#1: Transfer the magnetic field from Part 1 of the experiment to your report.

#2: In Part 1 of the experiment, you have noticed that some of the magnetic field lines wander off and never come back to the bar magnet. Which part of your bar magnet do these lines come from? Why?

#3: Transfer the field lines you have drawn on the A3 paper from Part 2 (I)of this experiment to the figure below.

#4: Transfer the field lines you have drawn on the A3 paper from Part 2(II) of this experiment to the figure below. (Also attach the paper) Is there any place in the diagram where the magnitude of the magnetic field is equal to zero? Where?

#5: Two bar magnets are placed at right angles to one another. A compass is placed at point P in Figure 4. In what direction does the needle point? Why?



#6: Are both the magnets of the same strength? Use your experimental data to justify your answer.

Results:

Discussion:

Experiment 4: Understanding the induced EMF and working principal of a transformer

1. Objectives:

(a) To verify the concept of induced emf
(b) To calculate the turns-ratio of a transformer
(c) To verify the effect of frequency on a transformer

2. Background:

If two inductors are placed in the vicinity of each other, an induced emf appears in one coil if the current is changed in the other coil. It obeys Faraday's law of induction and is given by the formula

$$E_L = -L\frac{di}{dt}$$

It means that an induced emf (E_L) appears in the coil when there is a change in current. It is also called mutual induction.

A transformer is a widely used device that works on the principle of mutual induction. It consists of two coils with different number of turns wound around an iron core. The primary winding (called primary) of N_p turns is connected to an alternating current generator whose emf at any time t is given by

$$\mathcal{E} = \mathcal{E}_m sin\omega t$$

This sinusoidally changing primary current produces a sinusoidally changing magnetic flux in the iron core. The core acts to strengthen the flux and to bring it through the secondary winding (called secondary). As the flux varies, it induces an emf in each turn of the secondary. In fact, this emf per turn $\mathscr{E}_{turn}$ is the same in the primary and the secondary. Across the primary, the voltage V_p is the product of $\mathscr{E}_{turn}$ and the number of turns in the primary, N_p, i.e., $V_p = \mathcal{E}_{turn} * N_p$

Similarly, for the secondary side, $V_S = \mathcal{E}_{turn} * N_S$

Thus, we can write, $\varepsilon_{turn} = \frac{V_p}{N_p} = \frac{V_S}{N_S}$

If $N_S > N_p$, the device is called a step-up transformer because the secondary voltage is greater than the primary voltage.

If $N_p > N_S$, the device is called a step-down transformer because the secondary voltage is smaller than the primary voltage. However, for a transformer, the ratio of the voltages of across two terminals-called the turns ratio - is equal to the ratio of the number of turns of the corresponding terminals.

$$\frac{V_p}{V_s} = \frac{N_p}{N_s}$$

In this experiment, a step-down center-tapped transformer (12V – 0 – 12V) will be use

3. Procedures and Observations:

Part 1: Induced EMF:

1. Complete the circuit diagram, as shown in Figure 1.
2. Connect the primary of the transformer to a DC power supply. Set the voltage to 5V. Adjust the current knob, if necessary.
3. Connect the secondary of the transformer to one of the channels of an oscilloscope.
4. Make sure the channel is set to DC coupled with volt/div set at **0.2V**.
5. Measure the voltage. It will be zero volt.
6. Observe the voltage on the oscilloscope closely as you turn on and off the power supply. (**Be patient; wait for at least 30 seconds between turning on and off**)

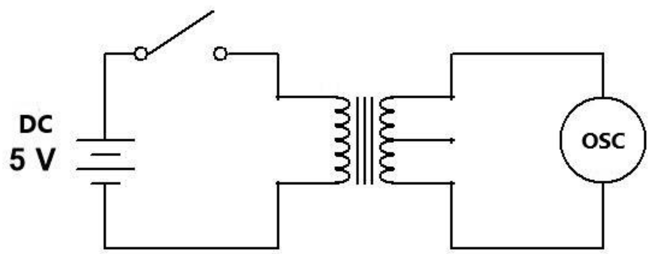


Figure 1

7. What did you notice? Note your observation below.

8. Using the oscilloscope, measure the amplitude of the induced voltage as you turn on and turn off the power supply. Use the STOP button to measure the amplitude of the voltage.

Turn on: Amplitude of the induced voltage ________________

Turn off: Amplitude of the induced voltage ________________

Part 2: Calculating the Turns Ratio

1. Complete the circuit diagram, as shown in Figure 2.
2. Connect the function generator to the primary and oscilloscope to both primary and secondary terminals of the transformer.
3. Set the function generator to produce **sinusoidal signal** with a frequency of 50Hz.
4. Use the function generator to set the input voltage and measure the peak-to-peak output voltage from the oscilloscope.
5. Calculate the turns-ratio of the transformer to complete Table 1.
6. Connect the equipment according to the circuit diagram in Figure 3 and repeat the steps above to fill out Table 2.

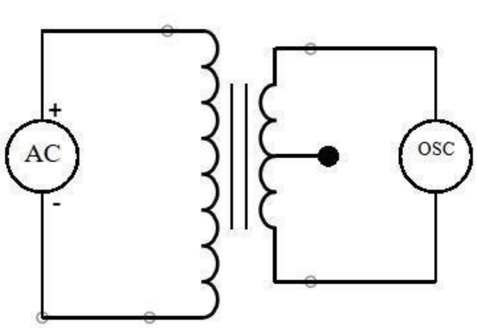


Figure 2

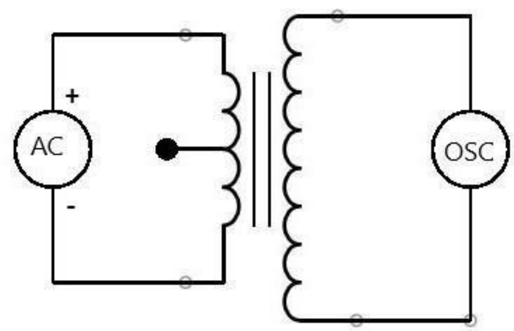


Figure 3

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Data Tables:

Table 1 (Use the set up shown in Figure 2)

Primary Voltage ($V_{P(p-p)}$)	Secondary Voltage ($V_{S(s-s)}$)	$\frac{V_{P(p-p)}}{V_{S(s-s)}}$
1		
2		
3		
4		
5		
6		
7		
8		

Table 2 (Use the set up shown in Figure 3)

Secondary Voltage ($V_{S(s-s)}$)	Primary Voltage ($V_{P(p-p)}$)	$\frac{V_{P(p-p)}}{V_{S(s-s)}}$
1		
2		
3		
4		
5		
6		
7		
8		

Tasks and Questions:

#1: Explain briefly your observation in *Part #1* of the experiment with reference to induced EMF.

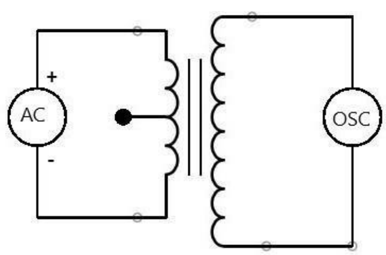
#2: What happens to the amplitude of the induced voltage if the number of turns in the primary coil (output terminal) of the transformer is reduced?

#3: Does a transformer work when a DC current flows through the primary? If not, why?

#4: Use the data in Table 1 to calculate the average turns-ratio of the transformer.

#5: If the transformer in this experiment has 400 turns in the primary, how many turns does it have in its secondary?

#6: If the frequency of the input signal is increased to 250 kHz, what happens to the output? You can build the following circuit to answer to this question. [Give input voltage 5V (peak-peak) and observe the output]



Results:

Discussion:

Experiment 5: Visualization of Current Behavior in an RL circuit

1. Objective:

1) To observe the rise and decay characteristic of an inductor using an oscilloscope.
2) To verify the time constant of an RL circuit.

2. Background:

An inductor is a passive electronic component that stores energy in the form of a magnetic field. In its simplest form, an inductor consists of a wire loop or coil. If a source emf is introduced in a circuit containing an inductor and a resistor, an induced emf ($\mathcal{E}_L$) will be observed across the inductor while there is a change in the current (like switch 'on' or 'off'), written below:

$$\mathcal{E}_L = -L\frac{di}{dt} \tag{1}$$

It follows the **Faraday's law of induction**. The "minus" sign in the equation 1 indicates that $\mathcal{E}_L$ is opposes the change in current, explained by the **Lenz's Law**.

In this experiment we will observe the decay (positive to zero and negative to zero) of voltage across the inductor in an exponential fashion, like we observed in the *RC* circuit experiment. However, there is no such terms as "charging" and "discharging" in an inductor.

If a constant emf V_O is introduced in a circuit containing R and L, when the current rises exponentially to $\frac{V_O}{R}$, and because of this change the voltage across the inductor will decay exponentially (positive to zero) (see equation 1), written as,

$$V_L(t) = V_O e^{-t/\tau}. \tag{2}$$

Where τ_L is the inductive time constant of the inductor measured in terms of second, given by

$$\tau = L/R. \tag{3}$$

Similarly, if the constant emf V_O is withdrawn, current decays exponentially and the voltage across the inductor also decay exponentially (negative to zero), written as,

$$V_L(t) = -V_O e^{-t/\tau}. \tag{4}$$

In figure 2 both current and voltage waveforms are given schematically with respect to time.

Here the inductive time constant, τ is the time required to decay the inductor, through the resistor, 37% of its initial voltage.

For this experiment we will use the circuit in figure 1.

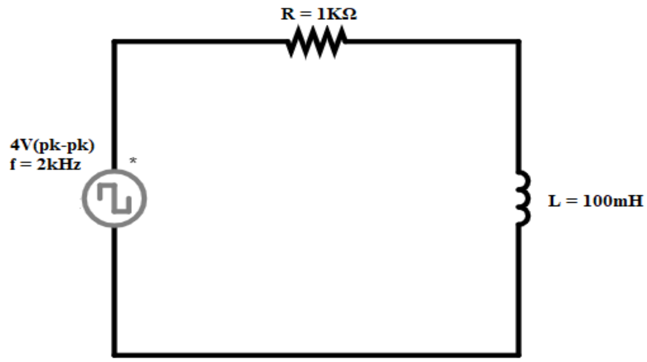


Figure 1: RL Series Circuit

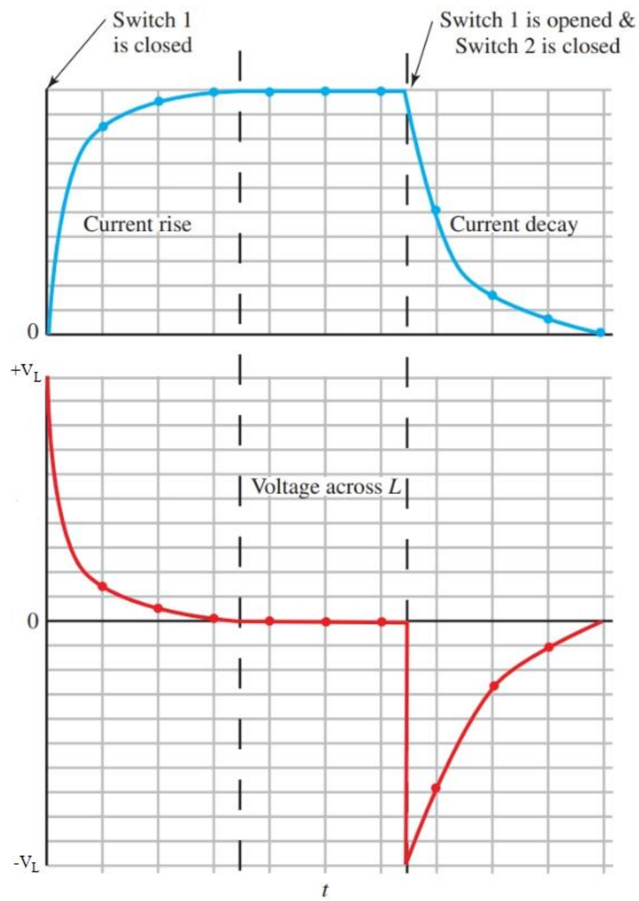


Figure 2: Current and voltage waveform with respect to time

3. Procedures and Observations:

a) Measure the value of the resistor, $R_{measured}$=

b) Connect R and L in series with the AC signal generator. (For reference, please see the circuit given above in figure 1).

c) Connect the oscilloscope's channel 1 to the signal generator, choose **square wave** as an input signal and observe the signal on the oscilloscope.

d) Make sure that the channel is set to **DC coupling**.

e) Measure the amplitude and period of the input signal and make sure that the amplitude is set to $4V_{p\text{-}p}$ and the frequency to 2 kHz with 50% duty cycle.

f) Use the offset knob to raise the signal by 2V so that the base of the signal is set at 0 V.

g) Connect the oscilloscope's channel 2 across the inductor and observe the output.

h) Measure the voltage across the inductor at 20 μs (approximately) interval and record the data in the following table.

i) For calculation of inductor voltage during decay, measure the maximum inductor voltage during charging and use it as V_o in Eqn. 1.

j) Measure the inductor voltage and record in the following table.

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Data Tables:

Table 1: Time dependent for the voltage decay **(positive to zero)** of an inductor

Time (μs)	**Calculated V_L (positive to zero)**	**Measured V_L**	**Time (μs)**	**Calculated V_L (positive to zero)**	**Measured V_L**
0					

Table 2: Time dependent for the voltage decay **(negative to zero)** of an inductor

Time (μs)	**Calculated V_L (negative to zero)**	**Measured V_L**	**Time (μs)**	**Calculated V_L (negative to zero)**	**Measured V_L**
0					

Tasks and Questions:

#1: Use data obtained in Table 1 to plot inductor voltage (V_L) vs time (t) graph. Calculate the time constant and compare with the theoretical value. Label the axes properly.

Time constant (theoretical) =

Time constant (measured from the graph) =

% of error =

#2: Use data obtained in Table 2 to plot inductor voltage (V_L) vs time (t) graph. Calculate the time constant and compare with the theoretical value. Label the axes properly.

Time constant (theoretical) =

Time constant (measured from the graph) =

% of error =

Results:

Discussion:

Experiment 6: Observation electrical resonance in RLC circuit

1. Objectives:

1) To understand the concept of resonance in simple RLC circuit.
2) To determine the resonance frequency in a parallel RLC circuit and compare this to the expected resonance value.
3) To understand concepts related to resonance such as bandwidth and Q- factor.

2. Background:

Resonance is the tendency of a system to oscillate at maximum amplitude when excited at its natural frequency. Electrical resonance occurs when the impedance of part of the circuit reaches a maximum or a minimum at a particular frequency. This is called resonant frequency and its value depends on the circuit elements involved.

The reactance of a capacitor is measured in ohms, is given by $X_C= \frac{1}{2\pi f C}$ and the reactance of an inductor is measured in ohms, given by $X_L=2\pi f L$.

At low frequencies, the inductor caries most of the current because its impedance $Z_L = j\omega L$ is small. At high frequencies, the capacitor carries most of the current because its impedance $Z_C=\frac{1}{j\omega C}$, is small.

At some point between, when $|Z_L| =|Z_C|$, you might expect that the inductor and the capacitor would each carry half the current. However, this is not the case because we are now dealing with vector quantities. For this condition there is in fact a resonance.

The condition $|Z_L| =|Z_C|$ can be written as

$$\omega L = \frac{1}{\omega C} \text{ or } \omega = \frac{1}{\sqrt{LC}} \text{ and f}= \frac{1}{2\pi\sqrt{LC}} \qquad (1)$$

So the expected resonance frequency is given by equation 1.

$$f_r=\frac{1}{2\pi\sqrt{LC}}$$

Quality Factor

In RLC Circuit, the ratio of resonance frequency to the difference of its neighboring frequencies so that their corresponding signal is 1/√2 times of the peak value, is called Q-factor of the circuit.

$$\Delta f = f2 - f1$$

$$Q = \frac{fr}{\Delta f}$$

Where f_r is the resonant frequency, and Δf the bandwidth, is the width of the range of frequencies for which the energy is at least $1/\sqrt{2}$ its peak value and Q in known as Quality Factor.

Q is measured as the "sharpness" of the resonance. For instance, when Q is large, the peak of the graph is sharp and the bandwidth is small.

For a parallel RLC circuit, assuming L and C are ideal, the Q factor is given theoretically by the equation.

$$Q = R\sqrt{\frac{C}{L}}$$

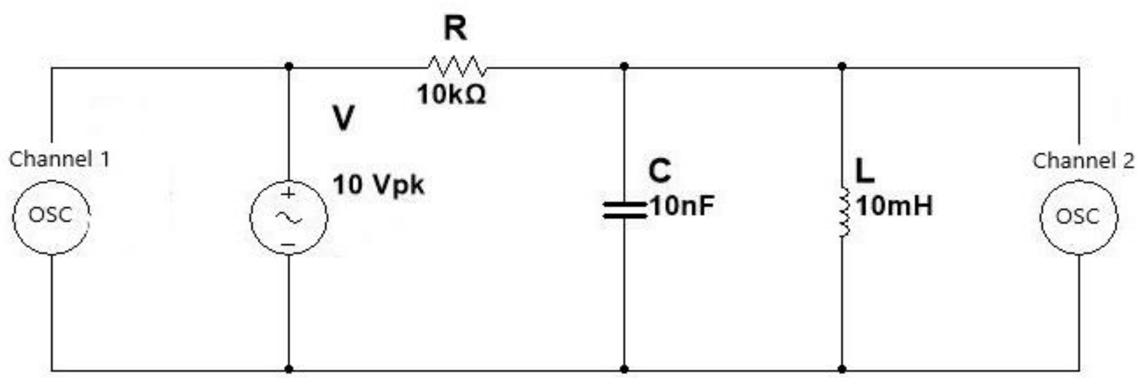


Figure 1: RLC circuit

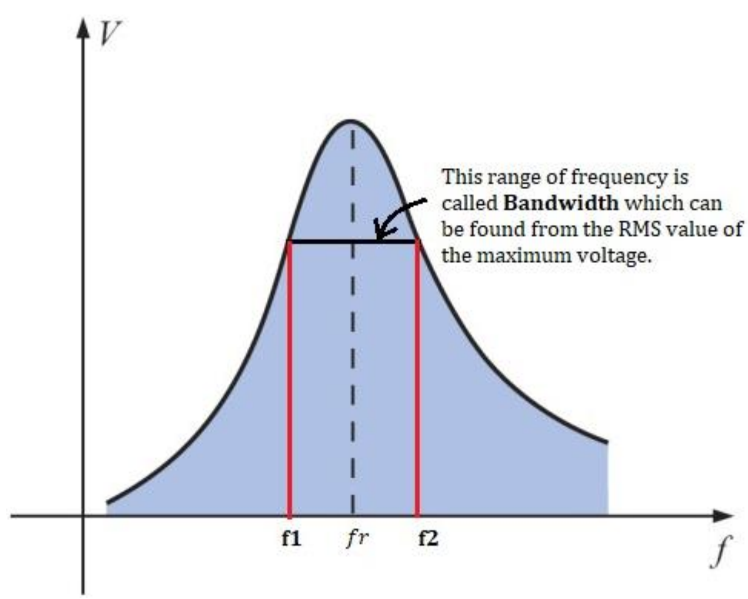


Figure 2: A Graphical representation of resonance in RLC circuit

3. Procedures and Observations:

a. Before you connect, the circuit to the function generator set the frequency to 1 kHz. Then, using the voltmeter set the function generator's output to 10 volts.

b. Connect L and C in parallel with the function generator.

c. Connect the oscilloscope's channel 1 to the signal generator, choose sine wave as an input signal, connect the oscilloscope's channel 2 to the capacitor and inductor, and observe the output signal on the oscilloscope.

d. Record the values of R, L, and C for this circuit in the space provided in the data section. Use equation 1 to compute the expected resonance frequency and record your result in data table 2.

e. Record the peak-to-peak voltage from the oscilloscope in data table 1. Now change the function generator frequency to 2 kHz and record the voltage. Then again adjust the frequency to 3 kHz and record the voltage. Continue adjusting the input frequency to each value below the expected resonance frequency computed in step 'd'. Record the voltage for each of these values.

f. Determine an experimental value for resonance frequency by finding the frequency that produces the largest voltage on the oscilloscope. Record this frequency and voltage.

Lab Report:

Date:	
Name of the Students and IDs	(1)
	(2)
	(3)

Data Tables:

Circuit Parameters:

R=______________________

C=______________________

L=______________________

Table 1

Frequency (KHz)	Output Voltage (V) (pk-pk)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Frequency (KHz)	Output Voltage (V) (pk-pk)
16	
17	
18	
19	
20	
21	
22	
23	
24	
25	
26	
27	
28	
29	
30	

Resonant Frequency=

Maximum voltage=

Frequency at maximum voltage, f_0=

Table 2

Calculated Resonant Frequency	
Experimental Resonant Frequency	
% of error	

Tasks and Questions:

#1: Use data obtained in Table 1 to plot output voltage vs frequency graph. Also, label the axes properly.

#2: Find the frequencies f_1 and f_2 and calculate the bandwidth.

#3: Quality Factor (measured from graph) =

#4: Quality Factor (theoretical) =

#5: Compare the theoretical value of Q factor with the experimental value. Find the % error.

Results:

Discussion: