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NORTH SOUTH UNIVERSITY

Department of Mathematics & Physics

Experimental Physics

PHY-108L

Name of the Experiment: Induced EMF and Mutual Inductance

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Group Number: E

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Experiment Name: Induced EMF and Mutual Inductance.

Objective:

- To verify the concept of induced EMF.
- To calculate the turns-ratio of a transformer
- To verify the effect of frequency on a transformer.

Apparatus:

- Transformer
- Function Generator
- Oscilloscope
- Wires

Theory:

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

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

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 of N_p turns is connected to an alternating current generator whose EMF at any time t is given by

$$E = E_m \sin \omega t$$

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. As the flux varies, it induces an EMF in each turn of the secondary. In fact, this EMF per turn E_{turn} is the same in the primary and the secondary.

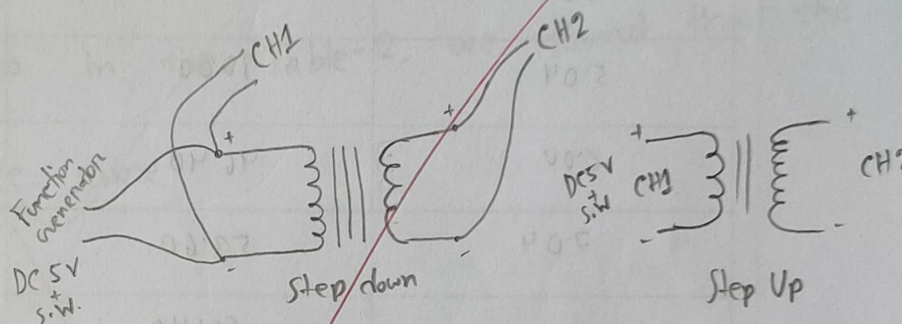
Across the primary, the voltage V_p is the product of E_{turn} and the number of turns in the primary, N_p.

$$V_p = E_{turn} \cdot N_p$$

Similarly, for the secondary side, $V_s = E_{turn} \cdot N_s$

Thus, we can write, $E_{turn} = \frac{V_P}{N_P} = \frac{V_s}{N_s}$

Circuit Diagram:



Data Table:

Table-1:

Primary Voltage $V_P(p-p)$ (V)	Secondary Voltage $V_s(p-p)$ (mV)	$\frac{V_P(p-p)}{V_s(p-p)}$
1.04	128	8.125
2.08	248	8.387
3.04	368	8.261
4.08	488	8.361
5.04	600	8.400
6.00	728	8.242
7.04	848	8.302
8.0	968	8.264

Table-2:

Secondary Voltage V_s (p-p) (V)	Primary Voltage V_p (p-p) (V)	$\frac{V_p\ (p\text{-}p)}{V_s\ (s\text{-}s)}$
1.02	8.00	7.843
2.0	17.60	8.800
3.04	23.60	7.763
4.00	30.40	7.600
5.04	38.00	7.540
6.00	46.40	7.733
7.04	53.60	7.614
8.00	60.40	7.550

Graph: N/A

Results: After completing this experiment, we construct two table. From Table-1, we found that, for each primary voltage the ratio of V_P and V_S are the same. Also in the Table-2, we found that the ratio are same.

Questions & Answers:

01.

In part 1, we connect a transformer's primary side with a DC power suply, and the secondary part connected with the Oscillscope. As DC power ~~supply~~ is constant we don't found any Induced EMF. But when we turn the switch ~~turn~~ on and off we found a little peak of EMF. That means we need changing current for EMF. When we use the Sineocidal wave, then we found the EMF. For input voltage of 1.04 V we found 128 mV. ~~And~~ That means ~~we~~ the transformer

~~Q2.~~ is ~~now in~~ step down transformer. As the ration is on average 8.

02.

In the number of turns in the primary side of the transformer is reduced, the amplitude of the induced voltage in the secondary side will increase. Because the number of turns the primary coil will be lower than the number of turns in the secondary coil.

In primary coil, if we reduce the turn then the voltage of each turn will be increase. That's why we ~~found~~ will found more EMF from the secondary coil.

03.

If a DC current flows through the primary coil, transformer will not work. Because, the DC current is constant. As we know, $\varepsilon = -L\frac{di}{dt}$.

Since, current is constant, $\frac{di}{dt} = 0$

So, $\mathcal{E} = 0V.$

4.

Average turns ratio

$$= \frac{8.125 + 8.387 + 8.261 + 8.361 + 8.400 + 8.242 + 8.382 + 8.264}{8}$$

$$= 8.293$$

05.

We know,

$$\frac{V_P}{V_S} = \frac{N_P}{N_S}$$

Given,

$$\frac{V_P}{V_S} = 8.293$$

$$N_P = 400$$

$$\therefore \cancel{N_S = \frac{N_P V_S}{V_P}} \quad N_S = \frac{400}{8.293} = 48.233 \text{ turns}$$

6.

If we inerease the frequency such as 250kHz, the output will be reduced. The iron core used in the transformer is manufactured for low frequency. If we provide high frequency, iron core will ~~be~~ produce heat. For we found some voltage lose due to heat. That's why the output will be reduced.

Discussion:

From this experiment, we learn about the concept of Induced EMF. We learn how to calculate the turns ratio. And verify the effect of frequency on a transformer. In this experiment we don't face any techincal problem. But at first we can't handle the Oscillscope. With the help of Instructor, finall we complete the experiment with in time. Briefly, we learn about the step up and step down transformer.

Group- E

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Data Tables:

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

Primary Voltage $(V_{P(p-p)})$ (V)	Secondary Voltage $(V_{S(s-s)})$ mV	$\frac{V_{P(p-p)}}{V_{S(s-s)}}$
1 1.04	128	8.125
2 2.08	248	8.387
3 3.04	368	8.261
4 4.08	488	8.361
5 5.04	600	8.40
6 6.00	728	8.242
7 7.04	848	8.302
8 8.0	968	8.264

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 1.02	8.0	7.843
2 2.0	17.60	8.800
3 3.04	23.60	7.763
4 4.00	30.40	7.600
5 5.04	38.00	7.540
6 6.00	46.40	7.733
7 7.04	53.60	7.614
8 8.00	60.40	7.550

Parik