# Experiment No. 5: Faraday's Law and Lenz's Law

## 1. Objective

The objective of this experiment is to verify Faraday's law and Lenz's law.

## 2. Apparatus

- Magnetic Bar
- IT-100 and IT-100B Trainer
- 2mm Patch Cords

## 3. Theory

Faraday's law of electromagnetic induction (referred to as Faraday's law) is a basic law of electromagnetism predicting how a magnetic field will interact with an electric circuit to produce an electromotive force (EMF). This phenomenon is known as electromagnetic induction.

Michael Faraday formulated two laws on the basis of experiments. These laws are called Faraday's laws of electromagnetic induction. Faraday's First Law states that any change in the magnetic field of a coil of wire will cause an e.m.f to be induced in the coil. This e.m.f induced is called induced e.m.f and if the conductor circuit is closed, the current will also circulate through the circuit and this current is called induced current. Methods to change the magnetic field are,

- By moving a magnet towards or away from the coil
- By moving the coil into or out of the magnetic field
- By changing the area of a coil placed in the magnetic field
- By rotating the coil relative to the magnet

Faraday's Second Law states that the magnitude of e.m.f induced in the coil is equal to the rate of change of flux that linkages with the coil. The flux linkage of the coil is the product of the number of turns in the coil and flux associated with the coil.

Lenz's law of electromagnetic induction states that the direction of this induced current will be such that the magnetic field created by the induced current opposes the initial changing magnetic field which produced it. The direction of this current flow can be determined using Fleming's right-hand rule.

Faraday's law of induction explains the working principle of transformers, motors, generators, and inductors. The law is named after Michael Faraday, who performed an experiment with a magnet and a coil. During Faraday's experiment, he discovered how EMF is induced in a coil when the flux passing through the coil changes.

According to Faraday's law of electromagnetic induction, the rate of change of flux linkage is equal to induced e.m.f as given in Equation 5.1.

$$E = -N\frac{d\phi_B}{dt} \quad 5.1$$

Considering Lenz's Law,

Where,

Flux $\phi_B$ in Wb = B.A

B = magnetic field strength

A = area of the coil

We can demonstrate these phenomena by considering the relative motion between a movable magnet and a stationary coil as shown in Figure 5.1. When the magnet is put in the coil, the coil produces a magnetic field with the same pole as the end pole of magnet on the left and trying to prevent the magnet in and the induced current causes the pointer of Galvanometer to deflect to one side. If the magnet is putting, out the coil, the coil will produce a magnetic field with the opposite pole to the pole of magnet on the left end trying to prevent the magnet out and the induced the pointer of Galvanometer to deflect to the other side illustrated Figure 5.2.

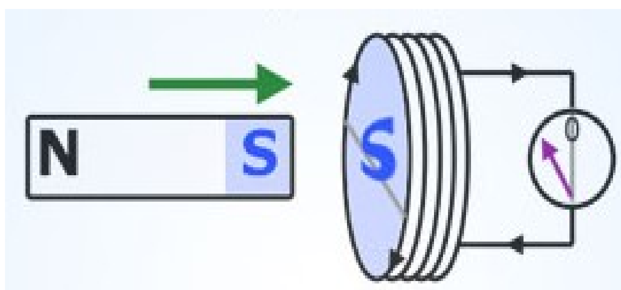


**Figure 5.1: Movement against Repulsion**

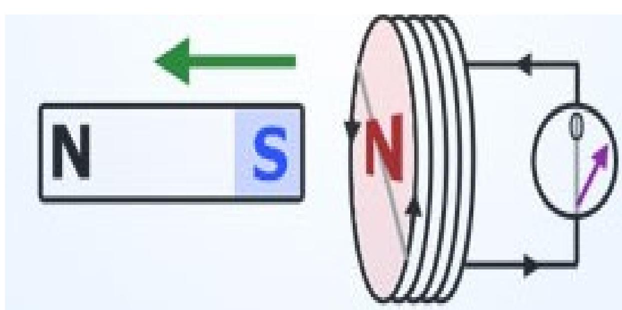


**Figure 5.2: Movement against Attraction**

## 4. Procedure

1. Locate the Lenz's block on IT-100B trainer.
2. Connect the both ends of coil to the Galvanometer located on IT-100 trainer.
3. Bring the magnet close to the coil and observe the deflection in galvanometer.
4. Move in and out the magnet in the coil and observe the current indication on Galvanometer.
5. Change the moving speed of the magnet and observe the indication to the Galvanometer.
6. Record your observations in the Table 5.1.

**Table 5.1**

| S. No. | Position of Magnet | Deflection in Galvanometer |
|---|---|---|
| 1 | Magnet at rest | |
| 2 | Magnet moves towards the coil | |
| 3 | Magnet is held stationary at same position (near the coil) | |
| 4 | Magnet moves away from the coil | |
| 5 | Magnet is held stationary at the same position (away from the coil) | |

## 5. Questions:

1. How the induced e.m.f in a coil can be increased?

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2. What is the relationship between induced e.m.f and moving speed of magnet?

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## 6. Conclusions