#ret #inclass

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1 | Lab Report

1.1 | Experiment 1

First, the yellow wire is connected to positive side of the current sensor. Next, a magnet is dropped through the coil. The current graph "goes down then up." The current flips direction as the magnets passes the coils midpoint.

Due to the wiring of the circuit, clockwise current means measured positive current.

The induced current is initially negative, meaning that a counterclockwise current was induced in the coil. Next, a positive current is measured, meaning a clockwise current was induced in the coil. Given this information, we can deduce that the magnet's north side was facing the ground.

The measured current raises exponentially, flips over the x axis, then decreases exponentially. This behavior makes sense, as when the magnet is closest to the coil is there the most changing magnetic flux, thus inducing the most current.

$$|EMF| = |\frac{d\phi}{dt}|$$

As the magnet passes the coils midpoint, the direction of the induced current would be expected to flip yet still be at its strongest point. This expected behavior is also what is measured.

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first experiment

clockwise current is positive

counterclockwise induced current

yello wwirte goes to positive current drop magnet through coil induces current whose direction flips

1.2 | Experiment 2

Experiment 2, titled Experiment 4, contains a coiled tube of wire roughly 5cm long with a magnetic field sensor roughly halfway inside of it. Positive current is being run through the wire at roughly 0.45A. The loose coil, or solenoid, consists of 14 loops.

When a current is run through the wire, a magnetic field is induced inside of the coil. This magnetic field is expected to follow the equation

$$B = \mu n I$$

where

$$B$$

is our magnetic field inside our coil,

$$\mu$$

is roughly equal to

$$4\pi \cdot 10^{-7} Tm/A$$

,

$$n$$

is the number of wraps per unit unit length, and

$$I$$

is our current. This equation can also be represented as

$$B = \mu \frac{nI}{l}$$

where

$$l$$

is the length of our solenoid.

Thus, our expected magnetic field output would be

$$B = \frac{4\pi \cdot 10^{-7} \cdot 0.45 \cdot 14}{0.05} = 0.158 \text{ mT (milliteslas)}$$

Our baseline magnetic field value measured by our sensor is 0.035mT, while our measured magnetic field value is -0.10mT. Thus, the difference in measured magnetic field is 0.135mT.

Calculating the percent error between our two values with

$$\delta = \left| \frac{v_A - v_E}{v_E} \right| \cdot 100\%$$

yields 14.55% error. Given potential sources of error within our experiment, 14.55% error is entirely reasonable to verify our theoretical equation. Some of these potential sources of error include the sensors being off, external magnetic fields changing, human precision limit in reading the values measured, and a slightly misplaced magnetic field sensor.