Lab 6: Faraday's Law of Induction Student Handout

The Project: Faraday's Law of Induction

Company X needs to understand the effect of varying magnetic fields on electric circuits. Changes in magnetic flux, due to time varying magnetic field, area, and orientation are known to induce currents in nearby circuits and wires. Company X needs to understand the strength of currents which may be induced in circuits due to any time dependent change in the magnetic flux.

You and your team have been hired to find a relationship between a time varying magnetic field and the induced current on a provided solenoid

You should consult your instructor for additional safety instructions before starting on ***ANY*** lab. *You should cap the current output of your power supply at* ***.1 A (100 mA).***

Equipment:

- CNC
- Power Supply
- PASCO Solenoid
- Neodymium magnet
- Flexible solenoid
- Mount for permanent magnet to CNC
- Stand for permanent magnet

Possible Needed Techniques:

- Moving the CNC using Python controls
- Measuring Voltage with a DAQ

Pre-Lab Organizational Questions:

1. The Data Acquisition Software is only equipped to measure the potential difference (voltage) between two points. What experiment can you design that will allow you to convert voltage measurements into information about the current through the wire loop?
2. What is the total resistance of the wire loop provided for you?
3. Given only a strong magnet with a magnetic field that is constant in time, how can you produce a changing magnetic field (flux) through the provided wire loop? What tools are available to you such that you can vary the magnetic field in a ***controlled*** way?
4. How does the orientation of the magnet impact the current induced in the wire loop?

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The Requirements:

Please provide Company X with the following information:

1. The resistance of your wire loop (with appropriate error bars).
2. The current induced in the wire loop as a function of your changing magnetic field (or parameter used to change the magnetic field) for at least two different orientations of your wire loop.

Presentation of the solution:

Your team must prepare a presentation that will be given to Company X on the approach that your team is using to complete the project. The presentation may be given by the whole team as a group or by a single member of the team chosen by a member of Company X. The presentation must include:

- A description of the basic physics principles used in your project, including the definition of magnetic flux, its relation to Kirchhoff's voltage loop of the solenoid, and a description justifying the direction of the induced current.
- A description of the technique used to measure the resistance of your solenoid. You will need to provide the total resistance of your loop with justifiable error bars.
- A description of the technique used to produce a changing magnetic field through the wire loop. Explain what quantifiable parameter you were able to use to control the change consistently.
- Plot the current through your wire loop as a function of your quantifiable parameter for at least two different configurations of the wire loop. You will need to provide schematics of the experimental configuration that you used.
- Explain the process you used to convert the data recorded by the DAQ (the DAQ readout) to the current through the wire loop.
- Provide an example of the readout for a single voltage measurement produced by a changing magnetic field.