

MEE210 ELECTRICAL MACHINES – Experiment #2

LABORATORY CONTENT: Building a simple electromagnet and measuring the generated magnetic field

EQUIPMENT REQUIRED: (students should bring electronic components)

Qty Description

- 1 Voltage supply (will be ready at lab.)
- 1 Oscilloscope (will be ready at lab.)
- 1 Iron cylinder/rod/ (ferromagnetic material)
- Isolated cable for winding electromagnet (not too thin)
- 1 Hall effect sensor (not having a large sensitivity value, the measurements mostly have 10-20 mT)
- Wiring equipments (jumper cables, crocodiles, etc.)
- Multimeter (check before coming to session if the current measurement function is properly working)

CAUTION:

This experiment includes health and security threats with careless actions. Be cautious about the isolation and the heating problem (doubling the current increases the heat four times, tripling increases nine times!).

PRELIMINARY QUESTIONS:

- 1) Wrap the cable around an iron bar (a nail, bolt or something similar should work). To make the magnetic field more powerful, you may wind the cable two or three times.
- 2) Build up a circuit for Hall-effect sensor. The output voltage should be read by using a voltmeter or oscilloscope. Briefly explain how a Hall-effect sensor works.
- 3) Briefly inspect the experiment system depending on Biot Sawart law.

EXERCISE STEPS:

- 1) Apply current to the electromagnet in three steps and measure the magnetic field values far from the electromagnet in a fixed distance (a few cm or mm) for each current. You can decide the current values depending on your electromagnet capacities (basically it might be 1x, 2x and 3x). Then record the values to Table 1.
- 2) Fix the current to a desired value, change the distance between the coil and the sensor and measure the magnetic field values. Record the values to Table 2.

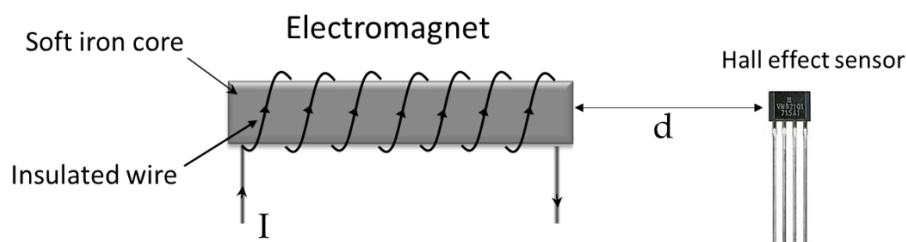


Table 1. The effect of the variable current to magnetic field strength

Distance [mm]	Current [A]			
	Sensor output voltage [V]			
	Magnetic field [mT]			

Table 2. The effect of the variable current to magnetic field strength

Current [A]	Distance [mm]					
	Sensor output voltage [V]					
	Magnetic field [mT]					

POSTLIMINARY QUESTIONS:

- 1) Plot graphs of current-magnetic field and distance-magnetic field and then find the relationships between them. Also, give the formulation that converts the magnetic field value from sensor output voltage.
- 2) What is hysteresis? Show the key points on the hysteresis plot and explain them. You can explain the effects referencing to your electromagnet.
- 3) Explain the magnetic material classes diamagnetism, paramagnetism, ferromagnetism. Also comment about the phenomenon superconductivity.
- 4) Briefly describe the working principle of microphones and cassette tapes as transducers.

IMPORTANT NOTE: For the next experiment, you need to build up some contents. So, the ones who are not prepared for the experiment will not be allowed to participate.