NILE UNIVERSITY OF NIGERIA

HONORIS UNITED UNIVERSITIES

Faculty of Natural and Applied Sciences
Department of Physics

PHY 108
Electricity and Magnetism Lab
Experiment 5: Magnetic Induction

Student Name:

Student ID:

Department:

Date of Experiment:

Group:

EXPERIMENT 5: Magnetic Induction

Purpose: To Measure the induction voltage as a function of the current in the field coil at a constant frequency

Apparatus:

- Field coil, 750 mm, 485 turns/m
- Induction coil, 300 turns, d = 41 mm
- Induction coil, 200 turns, d = 41 mm
- Induction coil, 100 turns, d = 41 mm
- Digital function generator
- Multi-range meter
- Connecting cords

Theory:

A magnetic field of variable frequency and varying strength is produced in a long coil. The voltages induced across thin coils which are pushed into the long coil are measured depending on the frequency of the current in the field coil and the strength of its magnetic field as well as the number of turns and the diameter of the induction coil.

To understand the fundamentals of this experiment, two cases must be considered. First, we treat the temporal variation of the magnetic flux through an area which induces a voltage in a conductor. In this experiment, this voltage will be measured. Second the temporal variation of a current in a conductor, which induces a magnetic field, will be regarded whereby the current is the second measurand. The temporal variation of the magnetic flux leads to Faraday's law of induction. The magnetic flux ϕ through an area is obtained by integrating the magnetic flux density over this area:

$$\emptyset = \int_A \vec{B}\, d\vec{A}$$

After the law of induction, the temporal variation of the flux ϕ induces the voltage V_{ind} . Considering the flux ϕ through A which is enclosed by a conductor loop, the induced voltage is the integral of the electric field E in the conductor loop over the area's boundary C

$$V_{ind} = -\frac{\partial \emptyset}{\partial t} = \oint_c \vec{E}\, d\vec{S}$$

This relationship for one conductor loop is the second of Maxwell's equations.

SETUP AND PROCEDURE

The experimental set-up is as shown in Fig. 1. One multi-range meter is set up in series connection to the field coil and the digital function generator in order to measure the current in the field coil. The second multi-range meter is connected to the induction coil to measure the induced voltage.

Tasks

Measure the induction voltage as a function of the current in the field coil at a constant frequency.

Tune the current in the field coil by turning up the amplitude of the sinus signal of the digital function generator. Start with an amplitude of 0.5 V and increase to a maximum of 5 V in steps of 0.5 V. (Note: Set the frequency constant at 1 kHz).

Repeat the experiment for coils with 100, 200 and 300 turns.

Plot a graph of V (v) against I (A) for each of the induction coils.

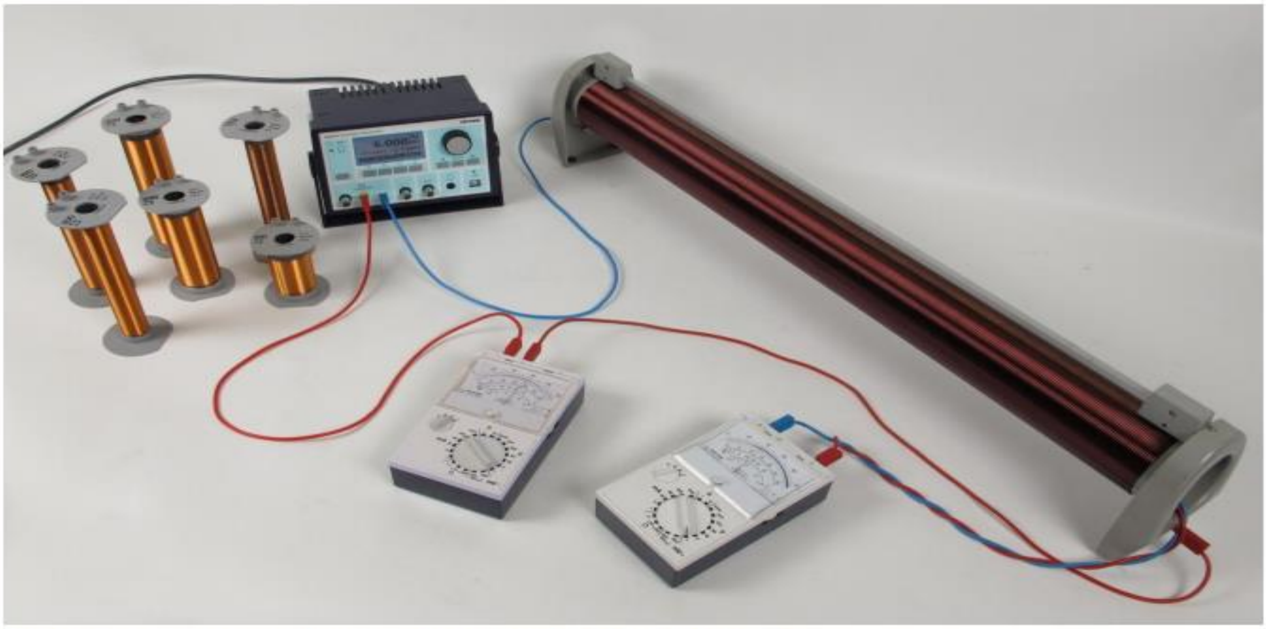

Fig. 1: Experimental set-up with one induction coil slid into the field coil.

DATA

- Tabulate your readings as shown below
  a) For the solenoid coil of 100 turns.

		For 100 turns Solenoid Coil		For 200 turns Solenoid Coil		For 300 turns Solenoid Coil	
S/N	Signal Amplitude (V)	I (A)	V (V)	I (A)	V (V)	I (A)	V (V)
1	0.5						
2	1.0						
3	1.5						
4	2.0						
5	2.5						
6	3.0						
7	3.5						
8	4.0						
9	4.5						
10	5.0						

Instructor Signature and Date____

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DISCUSSIONOF RESULTS/OBSERVATION

PRECAUTIONS