Mutual Induction Apparatus

Primary, Secondary & Iron Core

EM2220-001

Description:

The IEC Mutual Induction Apparatus is a high quality instrument designed to demonstrate the fundamentals of magnetic induction. The unit is complete with a Primary Coil containing few turns of large diameter copper wire and a Secondary Coil which fits over the primary coil. This contains many turns of small diameter copper wire and a Soft Iron Core passes through the centre of both coils.

Kit Contents:

- 1 pce. Primary coil with terminals. Approx. 420 turns.
- 1 pce. Secondary coil with terminals. Approx. 1200 turns.
- 1 pce. Soft Iron Core.

Operation:

Most experiments using this instrument are listed in your Physics text books.
The following information is a guide to the use of the Mutual Induction Apparatus.

Length: 290mm	Width: 130mm	Height: 115mm	Weight: 0.9kg

Experiment 1:

Induction From A Magnet.

PREPARATION: Remove the iron core and the small coil from the large coil. Connect a centre zero galvanometer (100-0-100 microamps) to the terminals of the large coil.

- Take a long bar magnet and, holding the magnet vertically, insert one end of the magnet into the mouth of the coil. Note the galvanometer reading whilst the magnet is moving. Note the reading whilst the magnet is not moving.
- Extract the magnet from the coil and note the galvanometer reading whilst the magnet is moving.
- Move the magnet more quickly, then more slowly and note the effect on the meter readings.
- Reverse the magnet so that the opposite end enters the coil. Move it up and down as before and note the galvanometer reading. Check the galvanometer direction of reading against whether you are raising or lowering the magnet. Reverse the magnet and check again.
- Insert the magnet and, whilst inserted, move the magnet from side to side but not up and down. Note the galvanometer reading.
- Support the magnet from a string so that the whole magnet is well inside the coil. Move the magnet up and down as before and note the galvanometer reading.

Experiment 2:

Induction From Another Coil.

PREPARATION: Remove the iron core and place the small coil inside the large coil. Connect a centre zero galvanometer (100-0-100 microamps) to the terminals of the large coil. Use a single cell battery or set a DC power supply to 2V.DC and connect two cables to the terminals of the power supply. Join only one cable to one terminal of the small coil and the second cable can be connected later when required.

- Touch the second cable to the other terminal of the small coil so that current passes through the coil. Note the reading on the galvanometer. Disconnect the cable and note the reading.
- Reverse the cables to the power source so that the current flows the opposite direction through the coil. Note the effect on the galvanometer direction of reading.
- Lift the small coil up so that only about half of its length is inside the large coil. Repeat experiment above and note the meter reading. Raise the small coil further and repeat the experiment. Note that as the 'coupling' between the coils reduces, there is less induction effect.
- With the small coil either fully or partly inserted into the large coil, insert the iron core into the small coil. Connect the power source and note any difference in the galvanometer reading. Try this with the iron core in and out.

Experiment 3:

Making a DC electromagnet.

Lay the small coil on the table and place the iron core into the small coil. Select 2V.DC and connect the terminals of the small coil to a DC power supply.

- Take a magnet or a magnetic compass and determine which end of the iron core is the north pole. Note the direction of current flow through the copper coil.
- Reverse the direction of current through the coil and note which end of the core is North.
- Place your left hand on the coil as if you were grasping it. Let the tips of your four fingers be pointing to the direction of current flow around wires in the coil, your thumb will now be pointing to the North end of the coil.
- Place the large coil over the small coil with the iron core and, with a second power source, pass current through the large coil and the small coil together. Check the strength of the magnetic field at the end of the iron core. Note that the magnetic fields add when the currents are flowing in the same direction and subtract when they are flowing in opposite direction.

Experiment 4:

AC Induction (Transformer Action).

Place the small coil inside the large coil and remove the iron core. Connect the terminals of the small coil to the AC terminals of a low voltage power supply set to 2V.AC. Connect the terminals of the large coil to an AC Voltmeter.

- Apply the AC current to the small coil with few turns (primary coil). Note the voltage generated by induction in the large coil with many turns (secondary coil) as seen on the AC Voltmeter.
- Repeat the experiment above with the iron core in place. Note the increased voltage due to the increase in magnetic field.
- Reverse the connections so that the power is applied to the large coil with many turns and the AC Voltmeter is connected to the small coil with few turns. Note the smaller voltage due to the ratio of turns between the two coils.

Experiment 5:

Making an AC electromagnet.

Repeat experiment 3) but use AC instead of DC current into the coils. Notice that the magnetic field in the iron core is reversing many times per second and, if a small iron object (a nail or similar) is placed near the tip of the iron core it vibrates.

Use the large coil and repeat the adding and subtracting magnetic field experiment as described in Experiment 3).

Experiment 6:

Magnetic 'Coupling' between coils.

Lay the large coil lengthwise on the table and connect it to the AC power source at say 2V.AC. Connect the small coil to the AC Voltmeter and hold the small coil horizontally and in line with the large coil but do not quite insert the small coil into the large coil. Note the small voltage reading from the small coil.

Place the iron core into the small coil so that it protrudes from one end and allow the protruding core to enter the mouth of the large coil. Note the higher voltage reading on the voltmeter because of better magnetic 'coupling' between the coils by the iron core.

Caution:

WHEN OPERATING, THE COILS SHOULD NOT BECOME HOT. THEY MAY BECOME WARM, BUT IF THEY BECOME TOO HOT TO EASILY HANDLE, TURN THE POWER OFF AND ALLOW THEM TO COOL DOWN. IF THE COILS BECOME TOO HOT, IT IS PROBABLY BECAUSE THEY ARE CONNECTED TO A POWER SOURCE WITH THE VOLTAGE SET TOO HIGH.

THESE COILS MUST NEVER BE CONNECTED TO MAINS POWER.

Designed and manufactured in Australia