ELECTRICITE ET MAGNETISME

SYSTEME ELECTROSTATIQUE DE BASE

(Basic Electrostatics System)

Thèmes des expériences :

- **Production de charge égale et opposée**
- **Charge par induction**
- **Principe de cage de Faraday**
- **Transfert de charge**
- **Distribution de charge dans un champ électrique**
- **Capacité and the Q=CV relationship**

Basic Electrostatics System:

Quantitative Electrostatics
Comprehensive Experiment Manual Included
Individual or Demonstration Use.

CUVE ELECTROLYTIQUE

(Les courbes équipotentielles)

Cuve électrolytique :

Jeu d'appareils permettant d'enregistrer les courbes équipotentielles de champs électriques. Des électrodes de formes différentes permettent de mesurer les courbes équipotentielles d'un condensateur à plaques, d'un dipôle, d'une charge réfléchie et d'un becher de Faraday.
Dimensions de cuve: 160x105x65 mm³

L'ensemble comprend:

1 cuve en plastique

1 support avec électrode mesure

2 électrodes en baguette

2 électrodes en disque rondes

1 électrode annulaire

20 feuilles de papier millimétrique.

CHAMP ELECTRIQUE DANS UN CONDENSATEUR A PLAQUE

Thèmes :

• Mesure du champ électrique dans un condensateur à plaques en fonction de la distance entre les plaques.
• Mesure du champ électrique dans un condensateur à plaques en fonction de la tension appliquée.

Objectif :

Mesure du champ électrique dans un condensateur à plaques à l'aide du mesureur du champ électrique.

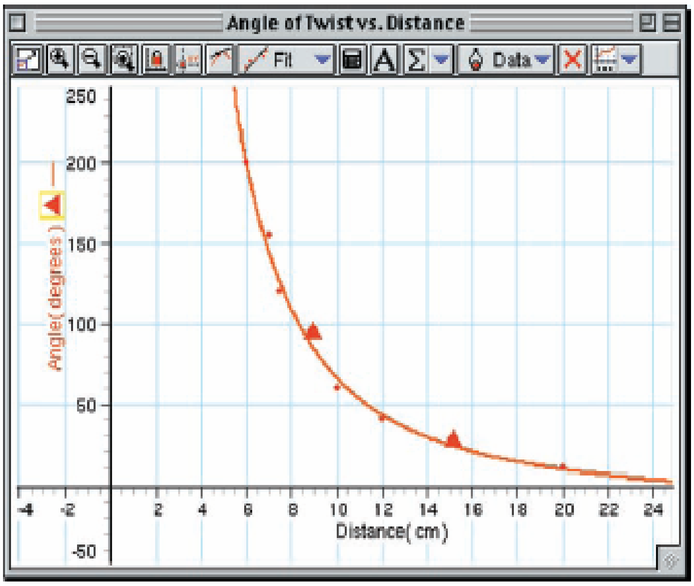
Résumé :

Le dispositif de mesure du champ électrique permet de mesurer le champ électrique dans un condensateur à plaques. Un disque à ailettes tournant interrompt le flux électrique sur une plaque électrostatique formant une partie d'une plaque de condensateur. Les impulsions de tension ainsi produites sont amplifiées et redressées en une tension de sortie qui est proportionnelle au champ électrique *E* agissant sur la plaque électrostatique.

LOI DE COULOMB *(Coulomb's Law)*

- **Verify the Inverse Square Law: F~1/R^2**
- **Verify the Force/Charge Relationship**
- **Determine Coulomb's Constant**

- **Vérifié La Loi Du Carré Inverse : F~1/R^2**
- **Vérifié La Relation Force/ Charge**
- **Déterminé La Constante De Coulomb**



Introductory physics students can determine the Inverse Square Law in a simple experiment, while advanced students can perform investigations into all the variables involved in electrostatic repulsion.

Advantage: PASCO's Coulomb's Law Experiment features a calibrated track designed to minimize mirror charges, which can significantly affect experimental results. In addition, the conducting sphere connected to the torsion wire is magnetically damped. This allows force measurements to be made quickly, reducing the traditional difficulties with leakage currents.

Experiment Includes:

Coulomb's Law Apparatus ES-9070
Kilovolt Power Supply SF-9586
Basic Electrometer ES-9078
Faraday Ice Pail ES-9042A
Charge Producers and Proof Plane ES-9057B
Coulomb's Law Experiment Manual
DataStudio Lite Software

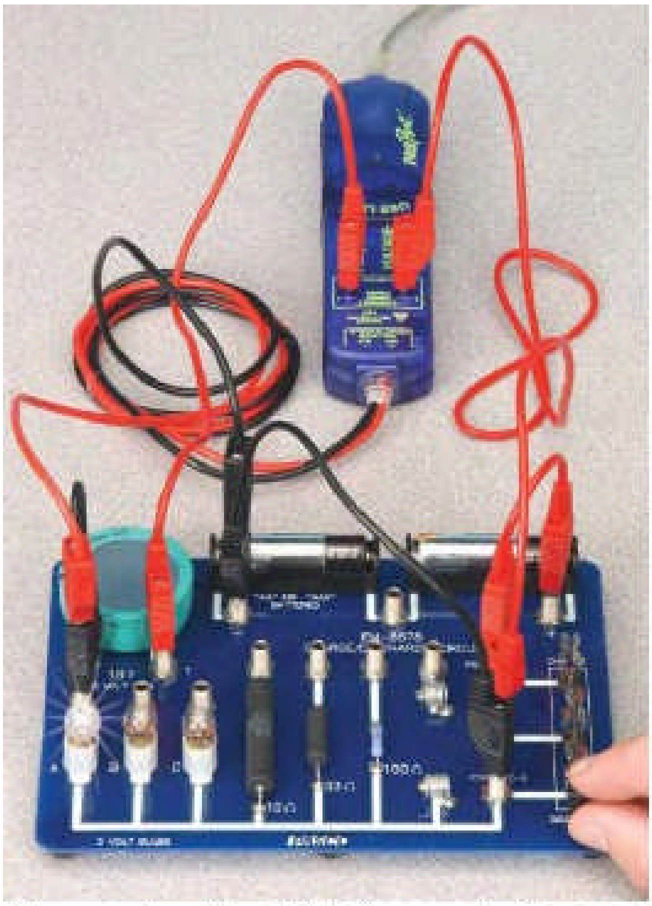
LA LOIS D'OHM

Thèmes :

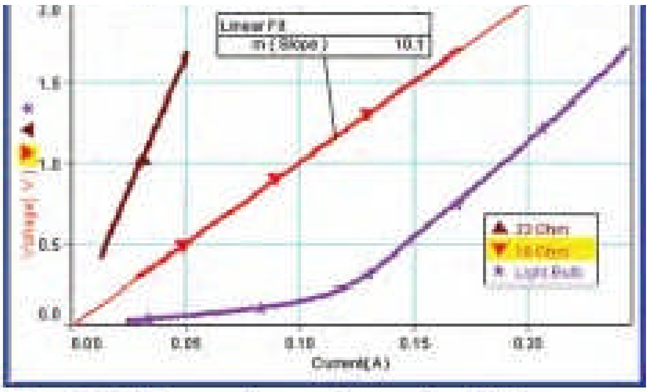
Relation entre le courant et la tension
Charge / décharge d'un condensateur

Method:

In this experiment, students simultaneously measure both current and voltage for a simple DC circuit. The relationship between current and voltage is explored for a 10 Ω resistor, 33 Ω resistors and a light bulb.
Prior to performing the Ohm's Law experiment, students study the characteristics of a capacitor by recording current and voltage measurements during both the charging and discharging cycles. Once the function of a capacitor is better understood, the capacitor is used as a variable voltage source during the Ohm's Law experiment. The relationship between current and voltage is studied for each resistor and the light bulb to determine their similarities and differences.



Voltage across and current through the light bulb are measured real-time as the capacitor discharges.



The relationship between voltage and current varies for different electrical components. The resistance of the light bulb filament increases with temperature.

PASCO Advantage:

Using a capacitor as a variable voltage source allows the experiment to be easily repeated for several loads. Students can view the voltage vs. current graph real-time which allows them to see the relationship unfold before their eyes. Furthermore, the tangent tool on the Data Studio graph enables students to easily determine Resistance of the light bulb at any instant.

Experiment Includes:

Charge/Discharge Circuit
Voltage-Current Sensor
AA Batteries
Short Patch Cords
Ohm's Law Experiment Manual
DataStudio Files for Ohm's Law Experiment
DataStudio Lite Software

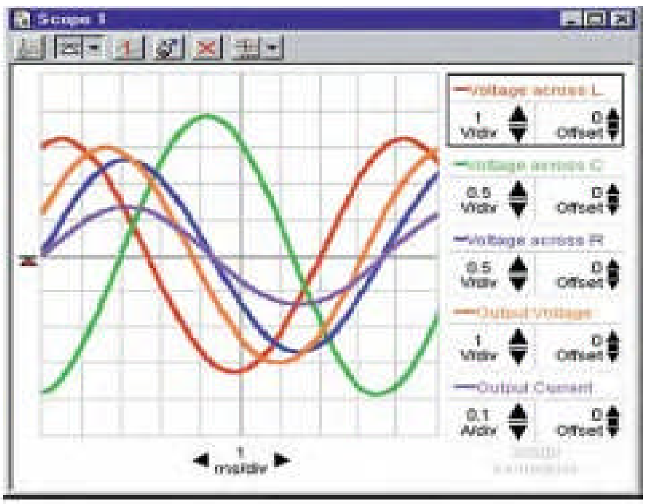
CIRCUIT LRC

The 750 Interface supplies AC voltage to an LRC series circuit.

Thèmes :

- **Oscillations LC**
- **Circuits AC Inductive, Capacitive et Résistive**
- **Fréquence de Resonance LRC**

The response of a series LRC circuit is examined at driving frequencies above, below and at the resonant frequency.
First, a square wave voltage is applied to an LC circuit and the period of oscillation of the voltage across the capacitor is measured and compared to the theoretical value. Then three AC circuits are examined: A sinusoidal voltage is applied individually to a resistor, a capacitor and an inductor. The amplitude of the current and the phase difference between the applied voltage and the current are measured in each of the three circuits to see the effect each component has on the current. Finally, a sinusoidal voltage is applied to an inductor, resistor and capacitor in series. The amplitude of the current and the phase difference between the applied voltage and the current are measured and compared to theory.



The oscilloscope display in DataStudio is used to simultaneously display the voltages across the inductor, capacitor and resistor, as well as the source voltage and current.

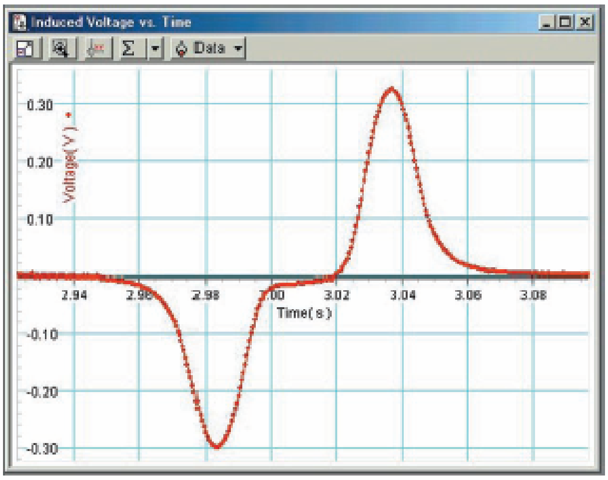
Experiment Includes:

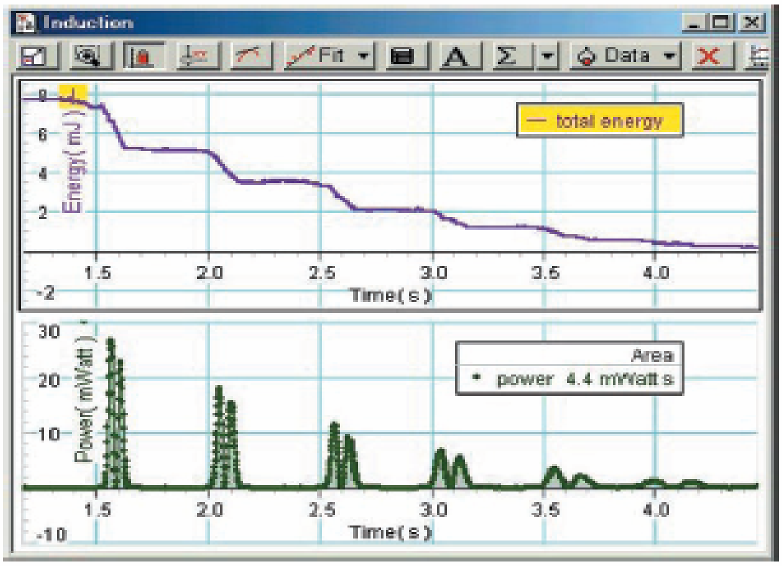
AC/DC Electronics Laboratory EM-8656
Voltage Sensors (3) CI-6503
Banana Plug Cord (30 cm, Set of 8) SE-7123
LRC Circuit Experiment Manual
DataStudio File for LRC Circuit Experiment.
DataStudio Lite Software.

LA LOI D'INDUCTION DE FARADAY *(Faraday Law Induction)*

- **Magnetic Flux**
- **Faraday's Law of Induction**
- **Lenz's Law**
- **Conservation of Energy**
- **Electrical Power**

- **Flux Magnétique.**
- **Loi D'induction De Faraday.**
- **Loi De Lenz.**
- **Conservation D'énergie.**





A voltage is induced in a coil swinging through a magnetic field. Faraday's Law and Lenz's Law are examined and the energy dissipated in a load resistor is compared to the loss of energy of the coil pendulum.

A rigid pendulum with a coil at its end swings through a horseshoe magnet. A resistive load is connected across the coil and the induced voltage is recorded using a Voltage Sensor. The angle is measured with a Rotary Motion Sensor, which also acts as a pivot for the pendulum. The induced voltage is plotted versus time and angle. The power dissipated in the resistor is calculated from the voltage and the energy converted to thermal energy is determined by finding the area under the power versus time curve. This energy is compared to the loss of energy determined from the amplitude and speed of the pendulum.
Faraday's Law is used to estimate the magnetic field of the magnet from the maximum induced voltage. Also, the direction of the induced voltage as the coil enters and leaves the magnetic field is examined and analyzed using Lenz' Law.

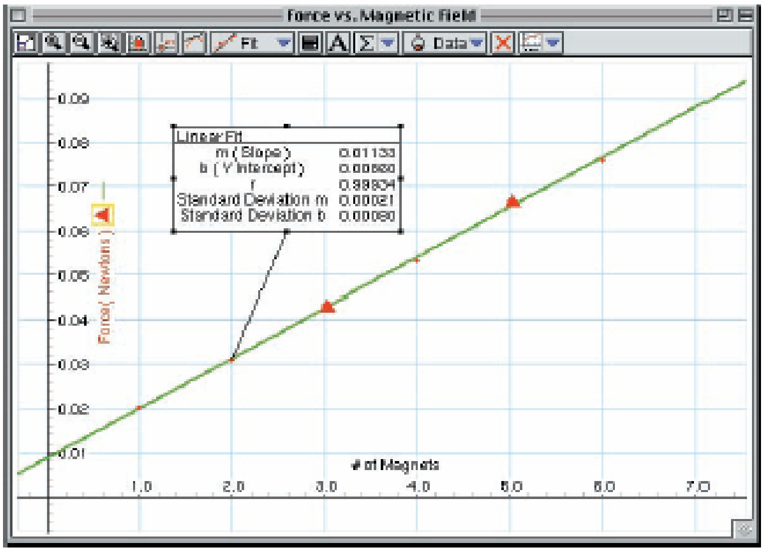
Advantage:

The DataStudio calculator calculates energy and power using the voltage and angle data. The induced voltage and the calculations are plotted in real-time as the coil swings through the magnet.

LA FORCE MAGNETIQUE DANS LES FILS

(Magnetic Forces on Wires)

- **Relationship between Force and Current**
- **Relationship between Force and Length of Wire**
- **Relationship between Force and Magnetic Field Strength**
- **Relationship between Force and Angle**



- **La Relation Entre Le Courant Et La Force**.
- **La Relation Entre La force Et La Longueur Du Fil**.
- **La Relation Entre La Force Et Le Champ Magnétique.**
- **La Relation Entre La Force Et l'Angle.**

Magnets are mounted on an iron yoke and placed on a balance (resolution of at least 0.01 g)One of the conducting paths is suspended between the magnets. The balance is used to measure the mass of the magnets and yoke prior to any current passing through the conducting path. Current is then passed through the conducting path, producing a force. The change in reading on the balance can be converted to find the magnetic force between the conductor and magnetic field.Conductors of different length are included to measure the effect of length on magnetic force. Magnetic field can be varied by changing the number of magnets in the yoke. The power source is used to change the current supplied to the conductor. The Current Balance Accessory includes all the components needed to test the effect of angle on magnetic force.

Advantage: PASCO's Magnetic Force in Wires Experiment allows students to study the key variables (conductor length, current, magnetic field strength and angle) that affect magnetic force.

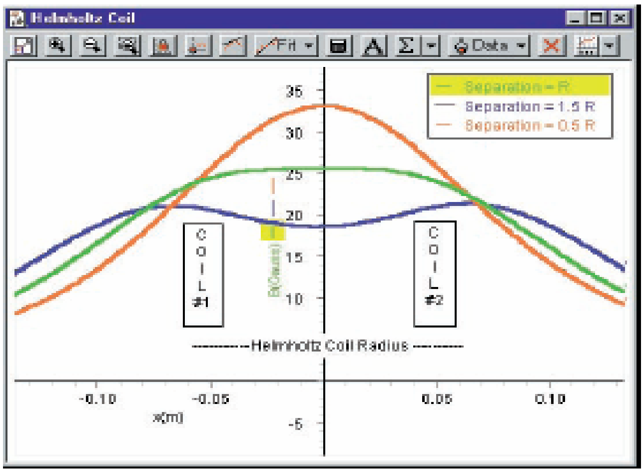
Experiment Includes:

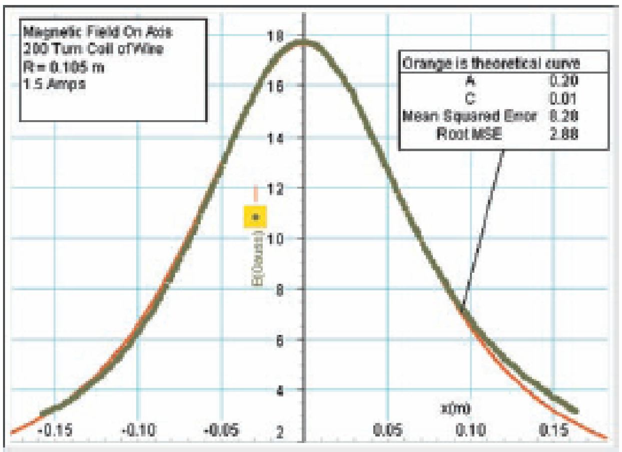
Basic Current Balance
Current Balance Accessory
Ohaus Cent-o-gram Balance
Low Voltage AC/DC Power Supply
Large Base and Support Rod
Banana Plug Cord-Red (5 pack)
Banana Plug Cord-Black (5 pack)
Magnetic Forces on Wires Experiment Manual

CHAMP MAGNETIQUE DANS UNE BOBINE
(Magnetic Fields of Coils)

- **Magnetic Field of a Single Coil**
- **Magnetic Field of Helmholtz Coils**
- **Magnetic Field Inside a Solenoid**

- **Champ Magnétique D'une Bobine.**
- **Champ Magnétique De La Bobine De Helmholtz.**
- **Champ Magnétique Dans Une Solénoïde**





The dependence of the magnetic field strength of current-carrying coils on the distance from the coil along the perpendicular axis is determined and compared to the theoretical curve. In addition, the effect of varying the coil separation on the shape of the magnetic field between the Helmholtz coils is examined.
The magnetic fields of various coils are plotted versus position as the Magnetic Field Sensor is passed through the coils, guided by a track. The position is recorded by a string attached to the Magnetic Field Sensor that passes over the Rotary Motion Sensor pulley to a hanging mass.
It is particularly interesting to compare the field from Helmholtz coils at the proper separation of the coil radius to the field from coils separated at less than or more than the coil radius.
The magnetic field inside a solenoid can be examined in both the radial and axial directions.

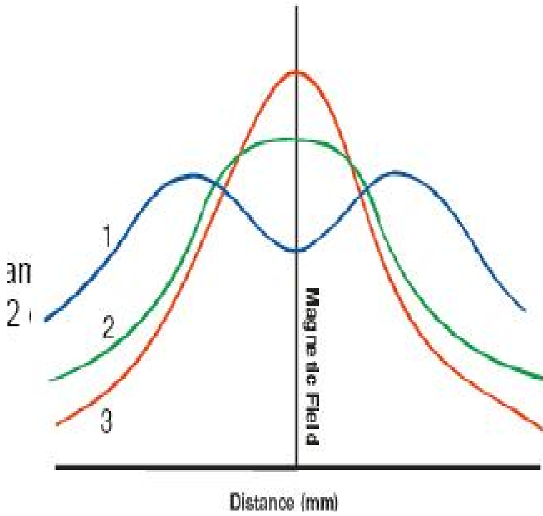
Advantage:
Using DataStudio's curve fit, the theoretical equation for the magnetic field can be plotted on the same graph.

Experiment Includes:
Helmholtz Coil Base
Field Coil (200 Turn) (2)
Primary and Secondary Coils
Banana Plug Cord-Red (5 pack)
Banana Plug Cord-Black (5 pack)
60 cm Optics Bench
Dynamics Track Mount
Hooked Mass Set
Small Base and Support Rod (2)
Optics Bench Rod Clamps (2)
DC Power Supply
Digital Multimeter
AMagnetic Field Sensor
Rotary Motion Sensor
Magnetic Field of Coils Experiment Manual

Scientific workshop 500 interface :
Ports: 2 Digital, 3 Analog
Connection: Serial (also USB compatible with USB/Serial Converter)
Data logging: Collect up to 17,000 Analog (force, voltage, etc.) data points or 7,000 Motion Sensor data points
Portable: Built-in battery compartment

MAGNETIC FIELD MEASUREMENT APPARATUS

The experiment consists of two coils, Constant Current Power Supply and Gaussmeter. The Gaussmeter probe is mounted on a rail with a scale. It can move smoothly and precisely for measurement of magnetic field along the centre of the coils.



The following studies can be carried out with the set-up:

1. Study of magnetic field due to one coil and calculation of its diameter.
2. Study of Principal of super-imposition of magnetic field due to 2 coils by keeping the distance between the coils at a, >a and <a, where a is the radius of the coil.

Legend:

Line 1 - Magnetic Profile when the distance between the coils is >a
Line 2 - Magnetic Profile when the distance between coils is =a
Line 3 - Magnetic Profile when the distance between coils is <a –
Superimposition overlaps completely Apparatus consists of the following:-

1. Digital Gaussmeter:

- Range: 0-200
- Resolution: 0.1G
- Accuracy: ± 0.5%
- Display: 3½ digit 7 segment LED with autopolarity.

2. Two Coil:

- Diameter: 200mm
- Number of turn: 1000

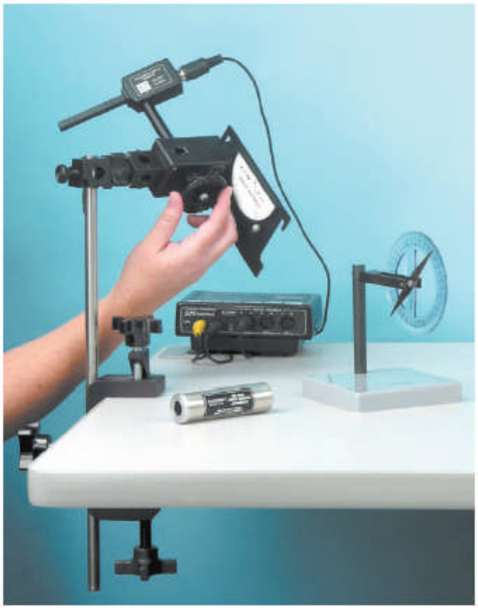
3. Constant Current Power Supply:

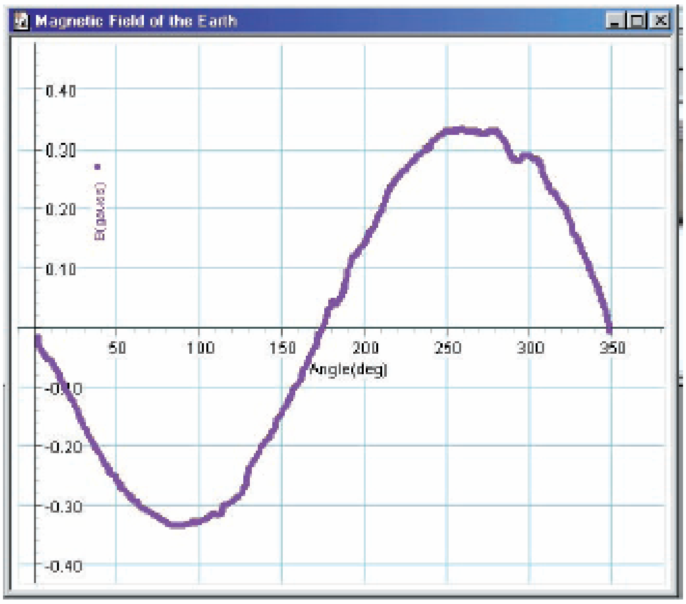
- Current: 0-0.5A Smoothly adjustable
- Line Regulator: ± 0.2%for 10% mains variation.
- Load Regulator: ± 0.2 % for 0 to full load
- Display: 3½ digit 7 Segment LED Display

Protection:

Against overload/ short current.
The 2 coils are mounted on platform one coil is fixed and other coil move smoothly on a rail along with the axis of the coils.

CHAMP MAGNETIQUE DE LA TERRE
(Earth's Magnetic Field)





- **Magnitude of the Earth's Magnetic Field**
- **Direction of Earth's Magnetic Field**
- **Dip Angle**

- **Magnitude Du Champ Magnétique De La Terre.**
- **Direction Du Champ Magnétique.**
- **Dip Angle.**

The magnitude and direction of the Earth's magnetic field are measured using a Magnetic Field Sensor mounted on a Rotary Motion Sensor. The Magnetic Field Sensor is rotated through 360 degrees by rotating the Rotary Motion Sensor pulley by hand. The Magnetic Field Sensor is zeroed using the Zero Gauss Chamber, the walls of which are made of a highly permeable material which redirects the magnetic field around the chamber.

Advantage:

The sensitive Magnetic Field Sensor combined with the Rotary Motion Sensor enables the measurement of the magnetic field strength as a function of angle from North. It is essentially a computerized compass that can measure both the direction and the magnitude of the field.

Experiment Includes:

Magnetic Field Sensor CI-6520A
Zero Gauss Chamber EM-8652
Rotary Motion Sensor CI-6538
Dip Needle SF-8619
Large Table Clamp ME-9472
45 cm Stainless (non-magnetic) Steel Rod ME-8736
Adjustable Angle Clamp ME-8744
Angle Indicator ME-9495
Earth's Magnetic Field Experiment Manual
Data Studio File for Earth's Magnetic Field Experiment

Scientific workshop 500 interface :
Ports: 2 Digital, 3 Analog
Connection: Serial (also USB compatible with USB/Serial Converter)
Data logging: Collect up to 17,000 Analog (force, voltage, etc.) data points or 7,000 Motion Sensor data points
Portable: Built-in battery compartment

OSCILLOSCOPE DADACTIQUE

Exercices :

- **Etude de la déviation d'un faisceau d'électrons dans un champ électrique.**
- **Etude de la déviation d'un faisceau d'électrons dans un champ magnétique.**
- **Démonstration de la représentation oscilloscopique à l'exemple Des signaux périodiques d'un générateur de fonctions.**
- **Calibrage de l'actionneur de fréquence du générateur de dents de scie.**

Objectif :

Etude des principes physiques fondamentaux pour la représentation oscilloscopique à résolution dans le temps des signaux électriques.

Résumé :

L'oscilloscope didactique permet d'étudier les principes physiques fondamentaux de la représentation à résolution dans le temps de signaux électriques sur un écran fluorescent. Dans un tube de Braun, un faisceau focalisé d'électrons sera généré et son point d'impact sur l'écran pourra être observé sous la forme d'une tâche lumineuse verte. Dévié par une tension en dents de scie sur une paire de plaques, le faisceau d'électrons se déplace à vitesse constante de gauche à droite pour revenir d'un saut à son point d'origine. Ce processus se répète de manière périodique avec une fréquence réglable. La tension dépendante de la durée devant être représentée alimente une bobine à l'extérieur du tube et provoque une déviation verticale du faisceau dans le champ magnétique de la bobine. Sa dépendance au temps est déclenchée par le déplacement horizontal simultané du faisceau d'électrons et rendue visible sur l'écran fluorescent.

CHARACTERISTICS OF SEMICONDUCTORS DIODES

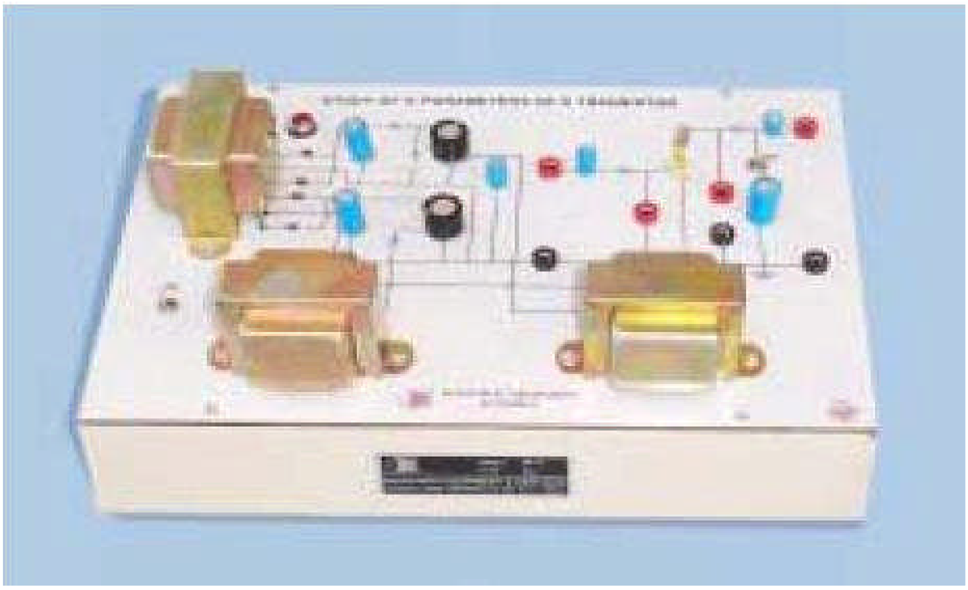
Features:

- Forward and reverse characteristics of Ge, Si diodes and LED's
- Study of Zener diode characteristics
- The set-up is provided with a booklet which contains its theory of operation, description, suggestions and discussion of the experiments that may be performed with it.

The experimental set-up consists of the following:

- Diodes: Rectifier-4007 (Si), Signal diode-1N34 (Ge), Zener 5.1V and LED.
- 3½ digit DPM which can measure voltage (0-20V).
- Suitable precision resistances are provided for the measurement of forward current.
- Reverse current, in the range of 10nA to 200mA.
- IC regulated variable power supply (0-12V).

THE STUDY OF HYBRID PARAMETERS OF A TRANSISTOR



Features:

- Study of h11 parameter (input impedance parameter)
- Study of h22 parameter (output admittance parameter)
- Study of h21 parameter (forward current transfer ratio)
- Study of h12 parameter (reverse voltage feedback ratio)

Introduction:

A transistor has low input impedance and high output impedance and hence the use of Z and Y parameters becomes awkward specially at high frequencies. As a result the hybrid of 'h' parameters.
are found to be most useful for transistor circuit analysis, because the hybrid parameters form a combination of impedance and admittance parameters and are selected to ideally suit the low input and high impedance of the transistor. Another advantage is that the parameters h11, h21 and h22 almost correspond to the actual operating conditions.
The experimental set-up have been laid down on a decorated bakelite board with an aim of providing an easy understanding to the students. All components are well spread out for clarity and easy repairs and replacement. The set-up is provided with a booklet, which contains its detailed theory of operation, description, specifications, suggestions and discussions on the various experiments that may be performed with it.

Measuring/ testing instruments required:

- True R.M.S A.C. Millivoltmeter, Model ACM-103 or
- True R.M.S A.C. Millivoltmeter, Model ACM-102 & Oscillator.