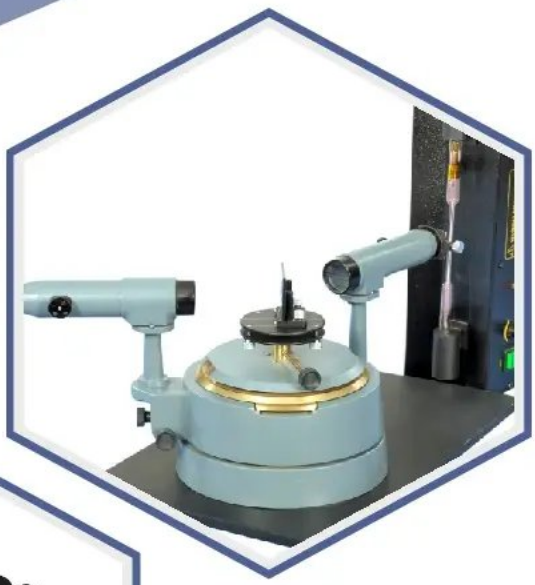
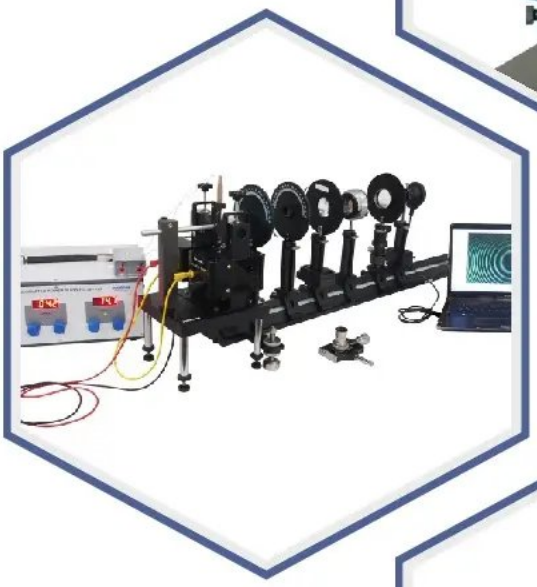
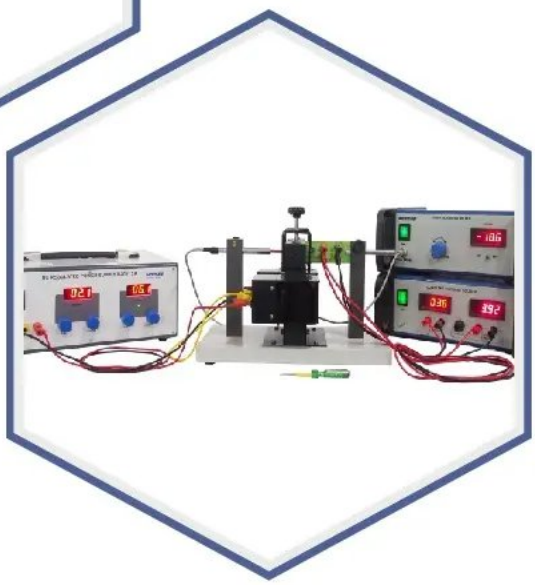
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COMMITTED TO EXCELLENCE

Physics Experiments







- Light & Optics
- Electricity & Magnetism
- Mechanics
- Waves & Sound
- Heat
- Electronics
- Atomic & Nuclear Physics
- Solid State Physics

OUR BEGINING



Nand Lal
The Group Founder
- Started Manufacturing in 1919.



Ajay Sagar (M.D.)
- B.E. Production, PEC Chd.
- 31 Years Experience



Manisha Sagar (Jt.M.D.)
- P.G. in Science
- 15 Years Experience

INFRASTRUCTURE

Head Office and Factory
Location : Ambala
Established : 1993
Total Area : 300,000 sq.feet
Covered Area: 40000 sq.feet.

Roorkee Unit
Established : March 2010
Products : Electronic Equipment

Delhi Office
Location : Centrally located at Nehru Place, Ansal Tower, New Delhi.

QUALITY POLICY

- Manufacturing & Supplying various products & equipments of consistent quality to the satisfaction of our customers.
- Continually improving the cost performance ratio of our identified products.
- Involvement of all employees in improvement and innovation in all spheres of management.

OUR HUMAN RESOURCE

The Company has an Employee strength of more than 300 which includes:
Ph.D./Post Graduates/Graduates in Science and Engineering besides Skilled Technicians and other staff.



INDOSAW
Committed To Excellence

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LIGHT & OPTICS SPECTROMETER

SPECTROMETRY KIT SK024/SK001

Experiments:
Exp-1 To determine the refractive index of the material of prism using sodium light.
Exp-2 To determine the dispersion power of the prism.
Exp-3 To determine the resolving power of the prism.
Exp-4 To determine the wavelength of sodium light using a plane diffraction grating.
Exp-5 To determine the resolving power of a plane diffraction grating.
Exp-6 To verify Cauchy's equation **(Mercury light source required)**.

Principle and Working:
The working of a spectrometer is based on the principle that when light falls on an optical device such as a prism or diffraction grating each wavelength is refracted or bent by a unique angle. A precise spectrum can be determined by measuring the angles at which light is refracted or bent.

Key Topics:
- Refractive index.
- Resolving power.
- Dispersion.
- Prism.
- Diffraction grating.

Salient Features :
- Large base dia. 220 mm
- Two double ended verniers (Four verniers).
- Smooth motion of telescope & vernier scale.
- Spindle & other critical components manufactured on CNC machine.



Two double ended verniers
(Four verniers).



SK001

Contents:

Cat No.	Item Name	SK024	Sk001
SL806	Advanced spectrometer	1	
SL448	Intermediate spectrometer		1
SL930	Sodium light source	1	1
SW915	Prism	1	1
SL795	Diffraction grating	1	1
SL439	Micrometer slit	1	1
SI1048	Magnifier with LED	1	1
R1437	Allen Key	1	1
P4463	Wooden box	1	1 (P0466)
SW440	Mercury light source	(Optional)	

Additionally required
Order separately for mercury light source to perform Cauchy's equation experiment.

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ADVANCED SPECTROMETER SL806



USED IN - SK024

INTERMEDIATE SPECTROMETER SL448



USED IN - SK001

SPECIFICATIONS

Cat No.	SL806	SL448
Scale	Brass, dia. 175mm.	Brass, dia. 150mm
Objective	Achromatic lens, f = 178mm, Aperture 32mm	Achromatic lens, f = 178mm, Aperture 32mm
Slit	German silver with knurled screw	German silver with knurled screw
Reticle	90° cross etched on glass	90° cross etched on glass
Least count	20 seconds	1 minute
Eyepiece	15X, Ramsden eyepiece	15X, Ramsden eyepiece
Vernier	**4 verniers** (Telescope & Prism table)	2 verniers
Base	220mm dia., Aluminium casting	170mm dia., Aluminium casting
Special Features	Manufactured on **CNC machine.** **Supplied in wooden box**	Manufactured on **CNC machine**

SPECTROSCOPE (BUNSEN-KIRCHOFF) SL807



Salient Feature:
- Direct wavelength reading after scale calibration.

Key Topics:
- Emission & absorption spectrum of any spectrum tube.

SPECIFICATIONS

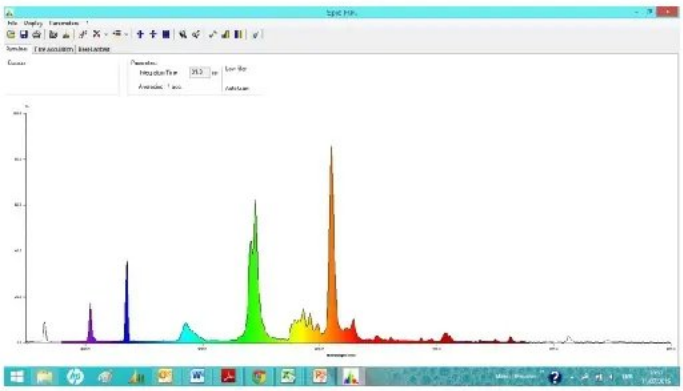
Observation tube	: Moveable, with locking screw, slidable eyepiece
Objective	: Aperture 18mm, f=160mm with symmetrical slit
Scale tube	: Stationary, 200-division scale
Eyepiece	: 15X
Prism	: Flint glass (60°)
Total height	: 25 cm (approx.)
Base dia.	: 170mm, Aluminium

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SPECTROMETRY-SPECTROPHOTOMETRY SN1056

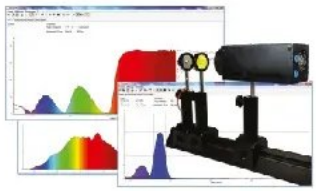
Experiments:

Exp-1 To study 3D chemical kinetics.
Exp-2 To study coloured filter spectrum.
Exp-3 To study line spectrum.
Exp-4 To study Beer Lambert's law.
Exp-5 To study solar spectrum.
Exp-6 To study Wien's law.
Exp-7 To study reflection spectrum analysis.
Exp-8 To study sodium absorption peak.
Exp-9 To study colour temperature.
Exp-10 To study device calibration and uncertainty.

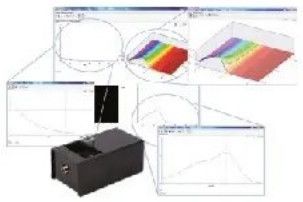


Key Topics:

- 3D chemical kinetics study
- Coloured filter spectrum study
- Line spectrum study
- Beer Lambert's law
- Solar spectrum
- Wien's law
- Reflection spectrum analysis
- Sodium absorption peak
- Colour temperature
- Device calibration and uncertainty



Coloured filter spectrum study



3D chemical kinetics study



Optical fibres allow great freedom of movement. Used for demonstrations during classes, they will let you move from source to source easily. The simple, intuitive software, with its multi-station system, allows measurement and superimposition of curves. It is ideal for showing the gases making up different bulbs, such as mercury in energy saving light bulbs. Combined with a video projector, the SPID spectrometer will prove indispensable in your classes. Three display modes, simple, coloured and spectroscope mode, are available.

Contents:

S. No.	Item Name	Qty.
1	Set of light source	1
2	Spectrometer	1
3	Optical fibre 2m-50 μm	1
4	Optical stands	2
5	Fibre-holder token	1
6	USB Cable	1
7	Absorption module with power cable	1
8	Set of filter	1
9	Software CD	1

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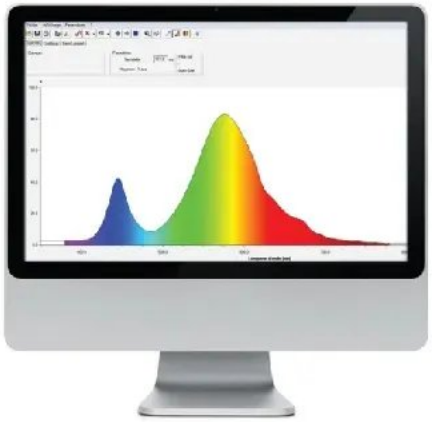
SPECTROMETER SN1054

Experiments:

Exp-1 To observe the spectrum of any light source : Ray Spectrum, Continuous Spectrum (Sun, Glowing Lamp, Candle), Fluorescent Spectrum.

Exp-2 Detections, photometric measures



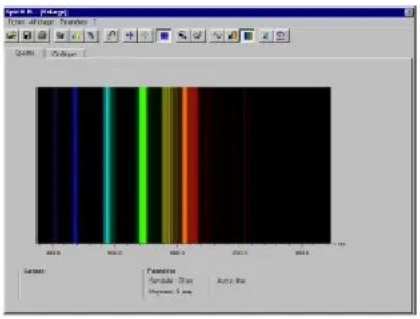


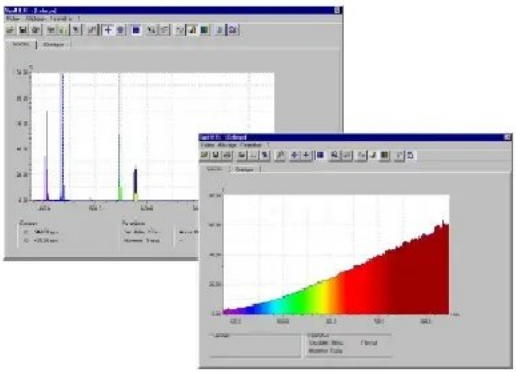
didalab











Spectrum of a « Energy saver » light source Spectrum of a mercury lamp and and of a incandescent light bulb

SPECIFICATIONS

Spectral range	: 350 - 900 nm
Accuracy (in measuring the wavelength)	: 0,5 nm
Wavelength resolution	: 1,5 nm
Transmission	: from 0 to 100 %
Resolution	: 0.1%
Optical setting	: Czerny Turner
Sensor	: linear silicium CCD sensor



Absorption Module



Optical fork

Contents:

S. No.	Item Name	Qty.
1	Spectrometer	1
2	Software CD	1
3	USB cable	1
4	2-meters optical fiber – 50 µm	1
5	2-meters optical fiber – 100 µm (Optional)	1
6	Absorption module (Optional)	1
7	Linear sensitivity and colorimetry (Optional)	1
8	Luxmeter (Optional)	1
9	Optical fork (Optional)	1
10	Collimator (Optional)	1

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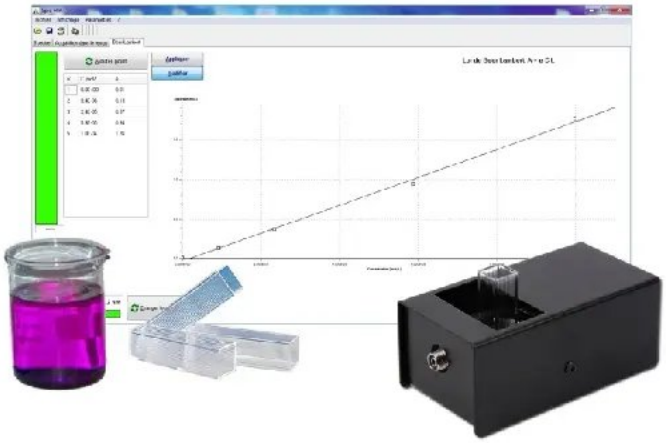
BEER LAMBERT AND KINETICS SN1055

Experiments:

Exp-1 To study the kinetics of a solution during a given time.
Exp-2 To study the colour spectra of lights and filters.
Exp-3 To study Beer-Lambert (law) : concentration of chemical solutions.
Exp-4 Study of transmission spectrum, ray spectrum, continuous spectrum (sun, glowing lamp, candle)

didalab

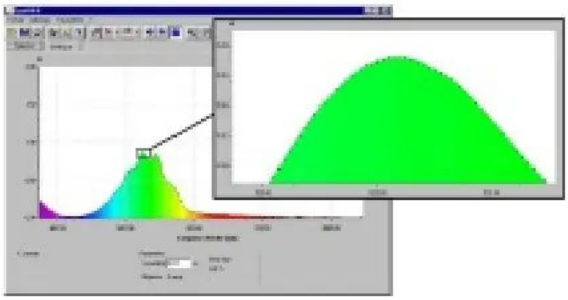


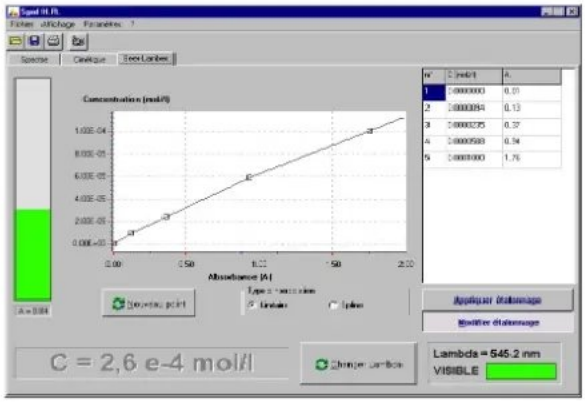




BEER LAMBERT LAW

Beer-Lambert's law with potassium permanganate. At first, we measure the absorbance maximum in spectrum mode. Then, we make a calibration for several concentrations . Once the calibration is done, we can find the concentration of an unknown solution.





SPECIFICATIONS

Spectral range	: 350 - 900 nm
Accuracy (in measuring the wavelength)	: 0,5 nm
Wavelength resolution	: 1,5 nm
Transmission	: from 0 to 100 %
Resolution	: 0.1%
Absorption	: from 0 to 3 Á
Lamp	: Quartz halogen
Optical setting	: Czerny Turner
Sensor	: linear silicium CCD sensor

Contents:

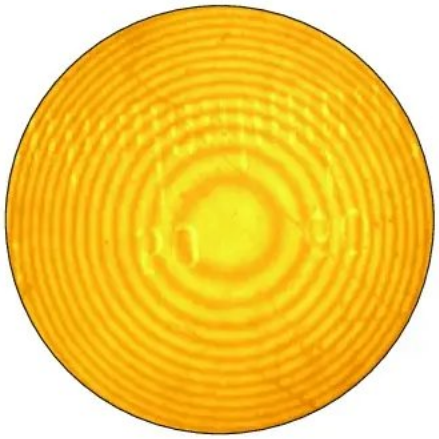
S. No.	Item Name	Qty.
1	Spectrometer	1
2	Software CD	1
3	USB cable	1
4	Set of 100 tanks	1
5	2-meters optical fiber – 50 µm	1
6	Absorption module with Power cable	1
7	2-meters optical fiber – 100 µm (Optional)	1
8	Linear sensitivity and colorimetry (Optional)	1
9	Luxmeter (Optional)	1
10	Optical fork (Optional)	1
11	Collimator (Optional)	1

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MICHELSON INTERFEROMETER SK002

Experiment:
Exp-1 To determine the wave length of monochromatic light. using sodium light source.

Key Topics:
- Interference.
- Wave length.
- Coherent sources.
- Superposition.
- Virtual light sources.
- Circular fringes



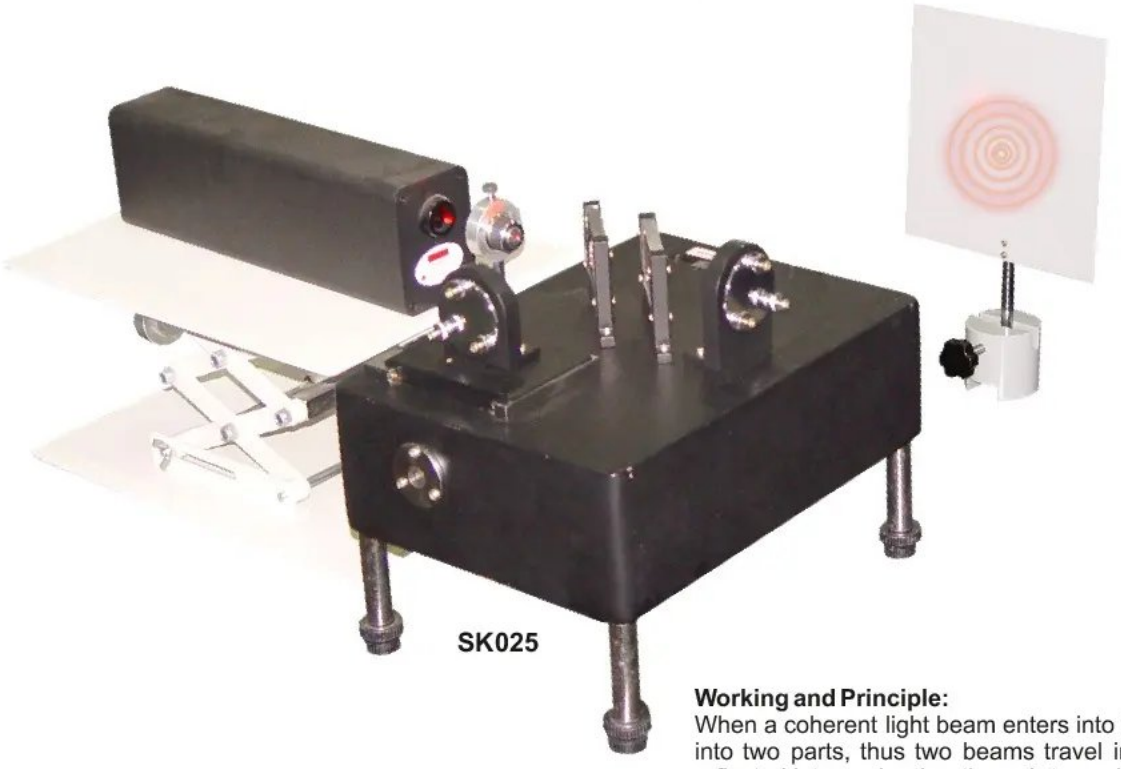
SODIUM LIGHT FRINGES

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MICHELSON INTERFEROMETER SK025 / SK079

Experiment:
Exp-1 To determine the wave length of monochromatic light. (using diode laser or He- Ne laser).

Salient Features :
- Precise measurement, mirror control is extremely fine with the micrometer of least count of 0.0001mm.
- Heavy base for high stability.
- The mirrors and beam splitter are flat upto λ/8.



SK025

Fringes of Michelson Interferometer with He-Ne laser.

SK079 : With Diode Laser



Working and Principle:
When a coherent light beam enters into beam splitter, it is divided into two parts, thus two beams travel in different directions, are reflected into each other through two mirrors forming interference patterns when they are combined and superimposed.
In the present setup, measuring the wavelength of sodium light or He-Ne laser, using an equation:

$$\lambda = 2.\Delta L/n$$

Where ΔL is the total displacement whereas n is the number of intensity maxima counted.

Contents:

Cat. No.	Item Name	SK002	SK025	Sk079
SW933	Michelson Interferometer	1	1	1
SL930	Sodium light source	1		
CD1448	Telescope with Holder	1		
C0423	Pin hole	1		
C0390	Ground glass	1		
C0379	Glass/Pin Holder	1		
R3891	He -Ne laser		1	
SB139	Beam Expender		1	1
CD556	Objective Holder		1	1
C1734	Object screen		1	1
SW978	Lab jack		1	
SG110	Cylindrical base		1	2
CH829	Diode laser			1
R7950	Power Adopter			1

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PRECISION INTERFEROMETER SK059

Experiments:

Michelson Interferometer

Exp-1 Interference fringes observation.
Exp-2 Equal thickness interference.
Exp-3 Determination of wavelength.
Exp-4 Refractive index of transparent slice.
Exp-5 Equal inclination interference.
Exp-6 White light interference.
Exp-7 Precise comparing of wavelengths.
Exp-8 Refractive index of air.

Fabry-Perot Interferometer

Exp-9 Multiple beam Interference
Exp-10 Measurement of the wavelength separation of sodium D-lines.
Exp-11 Measurement of wavelength of He-Ne laser.

Twyman-Green interferometer

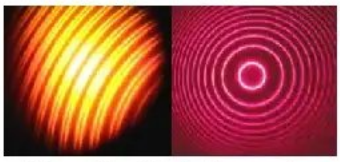
Exp-12 Demonstration of Twyman-Green interferometer.

Salient Features :

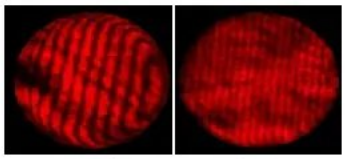
- Includes both He-Ne laser and sodium tungsten lamp.
- Highly stable, Easy operation & **Precision optics**.
- Innovative design, with **three modes of operation**.



Michelson Interferometer



Fabry-Perot Interferometer



Twyman-Green Interferometer

Key Topics:

- Interference.
- Wave length.
- Coherent sources.
- Superposition.
- Refractive index.
- Michelson.
- Fabry-Perot.
- Twyman-Green.



IMPORTED



This equipment combines the historically important Michelson interferometer, the high resolution Fabry-Perot interferometer and the useful Twyman-Green interferometer.
Measurements are precise in three classical modes of operation. Switching between the three modes of operation and aligning components are very simple, as this complete set of high quality components is carefully mounted on a heavy, stable base.

Contents:

S. No.	Item Name	Qty.
1	Interferometer main frame	1
2	He-Ne laser	1
3	Laser holder	1
4	Ground glass screen	1
5	Holder for beam expander	1
6	Extension arm	1
7	Two-in-One observation screen	1
U	O	
9	Transparent slice clamp	1
10	Sodium-Tungsten lamp	1
11	Air chamber and pump with gauge	1

SPECIFICATIONS

Flatness of beam splitter & compensator plate	: 0.1λ
Minimum travel reading	: 0.00025mm
Travel of moving mirror	: 0.625mm (travel of fine micrometer: 25mm)
Sodium-tungsten lamp	: Sodium: 10W, Tungsten:15W
He-Ne laser output	: 0.7 ~ 1nW@632.8nm
Overall dimension	: 350mmx350x245mm
Weight	: Approx. 15kg

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FABRY PEROT SN1063

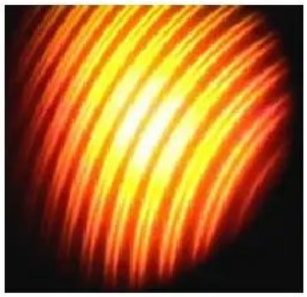
Experiments:
Exp-1 To observe multiple beam Interference.
Exp-2 To measure wavelength separation of Sodium D-lines.

Salient features
- Including Sodium Lamp with Power Supply
- Smooth Mirror Movement
- Compact Design
- Two Micrometers with Observation Microscope

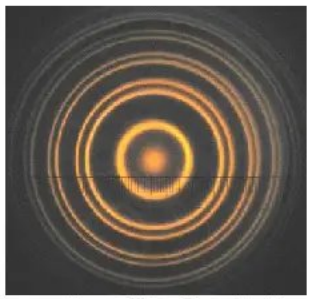
Key Topics:
- Interference.
- Wave length.
- Coherent sources.
- Febry Perot



IMPORTED



Multiple beam interfearence



Separation of Sodium D-Lines

Principle and Working:

The Fabry-Perot interferometer is a standalone device that can be used to observe multiple-beam interference and measure the wavelength separation of Sodium D-lines. When equipped with other components, this device can be used to conduct other experiments such as to observe the spectral shift of a Mercury isotope or the splitting of spectral lines of atoms in a magnetic field (the Zeeman effect).

Contents:

S.No.	Item Name	Qty.
1.	Fabry-Perot Interferometer	1
2.	Observation Lens (f=45 mm)	1
3.	Lens Holder with Post	1
4.	Mini Microscope	1
5.	Microscope Holder with Post	1
6.	Magnetic Base with Post Holder	2
7.	Ground Glass Screen	2
8.	Pin-Hole Plate	1
9.	Low-Pressure Sodium Lamp with Power Supply	1
10.	User's Manual	1

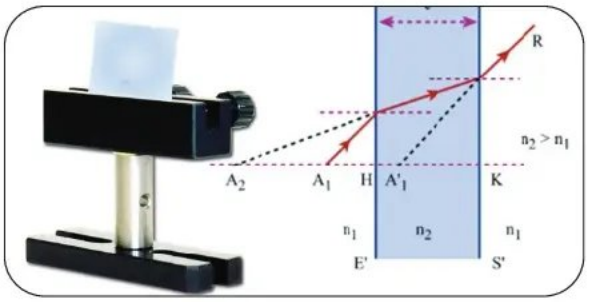
SPECIFICATIONS

Flatness of Reflective Mirrors	: 0.1λ
Diameter of Reflective Mirrors	: 30 mm
Reflectance of Mirrors	: 95%
Effective Travel of Preset Micrometer	: ~ 3 mm
Min Division Value of Preset Micrometer	: 0.01 mm
Travel of Fine Adjustment of Movable Mirror	: 1.25 mm
Resolution of Fine Adjustment	: 0.0005 mm
Low-Pressure Sodium Lamp	: 20 W

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MACH-ZENDER STUDY SN1057

Experiments:
Exp-1 To measure the thickness of glass slide.
Exp-2 To study the Mach-Zender.
Exp-3 To study two-beam interferences.



Glass slide thickness



Principle and Working:

The Mach-Zender interferometer consists of two semi-reflecting plates (beamsplitters) and wo mirrors. A light beam is divided into two, after which both beams are recombined by eans of a semi-reflecting mirror. One of these beams will be named the Reference beam, while the other will allow us to take measurements on the vacuum index or plate thickness.

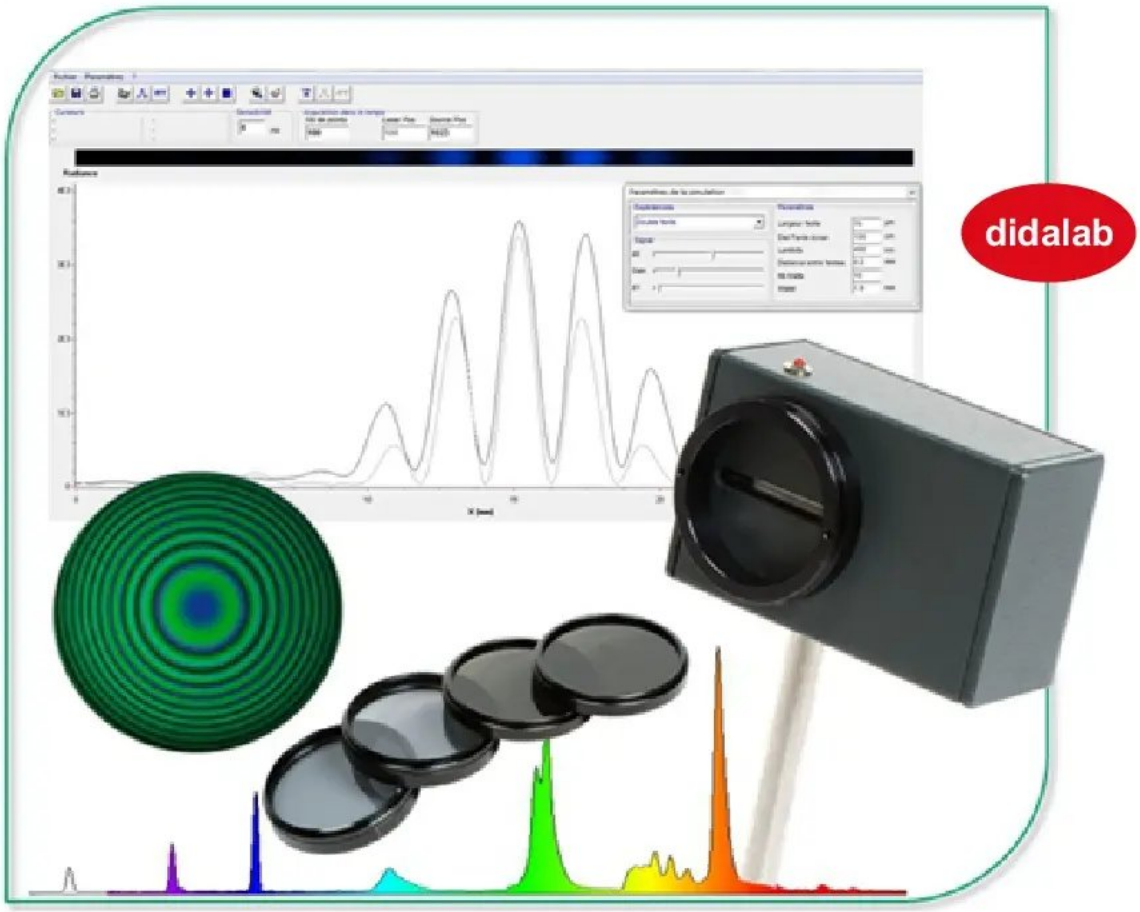
Contents:

S. No.	Item Name	Qty.
1	Mach Zender interferometer	1
2	He-Ne laser	1
3	10x lens	1
4	Half-moon stand	3
5	Millimetric universal screen	1
6	Lens holder	1
7	Basic slide holder	1
8	Superior Caliens camera	1

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CALIENS CAMERA SN1064

Experiments:
Exp-1 The Study of diffraction and interferences
Exp-2 The Sampling of light images – Complete software, user friendly.
Exp-3 The Analysis of analogical/digital signals, function of the resolution of the converter
Exp-4 The Modelling of theorical curves.
Exp-5 The Time acquisition of the interferograms of the Michelson interferometer
Exp-6 The Initiation to spectrometry with Fourier transform



SPECIFICATIONS

- Sensor : 2048 pixels (14-µm wide)
- (Sensitive zone : approx. 30 mm).
- Adjustable integration time : 2 ms to 5 s
- Time acquisition
- Fourier's transform
- Spectrometric calibration

Additionally required:
Now, with this additional cable, you can explain the principle of CCD photosensitvie sensors and show the relation between the light received by the sensor and the electrical measure.

Principle and Working:

The CCD camera is constituted of one optical head directly interfaced with a PC computer through USB port.
Once adjusted, it is possible to sample and operate luminous pictures with the help of complete & easy-to-use software program.

Contents:

S. No.	Item Name	Qty.
1	CCD camera	1
2	Complete software, operating with Windows	1
3	USB cable	1
4	Ø 10-mm rod	1
5	Shading filter, density 3	1
6	Set of 4 filters(2 polarizers, 2 0.9-density)	1
7	Carrying case	1
8	Complete documentation	1

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TWO BEAM INTERFERENCE SK005/SN629

Experiment:
Exp-1 To determine the wavelength of monochromatic light source using Fresnel's biprism.

Salient Features
- Optical bench is heavy, rigid and stable.
- Fine measurement is also possible while using micrometer saddle.
- Saddle can hold rod from 8mm to 15mm.
- Height can be adjust using levelling screws.

Key Topics:
- Interference.
- Fresnel biprism.
- Coherent sources by refraction.
- Wave length.
- Virtual light source.



Fringe View

SODIUM LIGHT SOURCE SL930



Salient Features :
- Mount horizontal or vertically.
- Metal housing.
- Electrical safety tested.

SPECIFICATIONS

Starting Voltage	: 470 Volts
Input Voltage	: 220V, 50 Hz
Lamp House	: 300x85mm(LxØ)
Aperture dia.	: 25mm

Scope of Supply : Complete with housing for sodium vapor lamp, transformer, Base, Mounting rod, Bosshead and Sodium Bulb.

Principle and Working:
Fresnel's Biprism used to create two Virtual coherent light sources by refraction and reflection respectively and observe interference phenomenon. Monochromatic light in these experiments is produced by sodium light source or he-ne laser. The wavelength (λ) can be determined by the formula

$$\lambda = \beta d/D$$

where β is fringe width.
D is a distance between virtual source and screen or eyepiece.
d distance between two virtual source.

Contents:

Cat No.	Item Name	SK005
SL435	Fresnel biprism	1
SL885	Universal lens holder (Biprism)	1
C13018	Optical bench triangular	1
SL802	Adjustable slit self centering	1
SL930	Sodium light source	1
SL233	Micrometer eyepiece	1
SL756	Convex lens in holder (FL 200mm)	1
C11829	Transverse slider	1
C11837	Fixed slider	3
SL754	Convex lense in holder (FL 100mm)	1

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TWO BEAM INTERFERENCE SN629

Experiment:
Exp-2 To determine the wavelength of monochromatic light source using Fresnel's mirror.

Key Topics:
- Interference.
- Virtual coherent source by reflection refractive index.
- Fresnel mirror.
- Wave length.
- Virtual light source.

Salient Features
- Optical bench is heavy, rigid and stable.
- Fine measurement is also possible while using micrometer saddle.
- Saddle can hold rod from 8mm to 15mm.
- Height can be adjust using levelling screws.
- He-Ne Laser have inbuilt power supply.



He-Ne LASER R3891

SPECIFICATIONS

Wavelength	: 632.8nm
Working current	: 4mA ~ 6mA
Output power	: > 2mW
Working time	: > 8 hrs.
Working voltage	: 220V AC, 50Hz
Input power	: <2 W
Dimension(LxBxH)	: 300x62x82mm
Weight	: 1.5 kg (approx.)

Principle and Working:
The Fresnel mirror is operated using grazing light incidence, whereby one mirror is tilted by approx. 1°- 2° with respect to the light beam. After adjusting the light source so that both mirrors are illuminated with equal luminous intensity, the inclination of the two reflected light beams can be adjusted with respect to each other by turning the knurled screw. The wavelength (λ) can be determined by the formula

$$\lambda = \frac{ADf}{b^2}$$

D is a distance between virtual source and screen or eyepiece.
b is the distance between the lense and the screen.
A is separation between two virtual light source.
f is the focal length of lense.
Angle of prism:- δ = th -1)α
μ = refractive index of prism
α = angle of prism

Contents:

Cat No.	Item Name	SN629
C13018	Optical bench triangular	1
SL756	Convex lens in holder	1
C11829	Transverse slider	1
CD533	Fresnel mirror	1
CD556	Objective holder	1
SO016	Screen	1
SG110	Cylindrical base	1
SP142	Vernier caliper	1
SP124	Measuring tape	1
R3891	He-Ne laser 2mW	1
C11837	Fixed slider	3
C13041	Extension arm	1
SB139	Beam expender	1
C12636	Fixed slider (large width)	1

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NEWTON'S RINGS APPARATUS SK008

Experiments:

Exp-1 To determine the wavelength of sodium light.
Exp-2 To determine the refractive index of a liquid by using Newton's rings apparatus.
Exp-3 To find the radius of curvature of planoconvex lens using Newton's rings experiment, given λ=5893A°.
Exp-4 To find the thickness of a thin sheet of paper (air wedge experiment).

Salient Features:

- All the components including sodium lamp, microscope, power supply & optics are housed in single piece compact body **(stand alone setup)**.
- Optical glass plate mounted at 45° **(no adjustment required)**.
- Smooth moving collimating facility.
- **Quick adjustment,** good quality, well defined distinct fringes.



Newton rings fringes



Key Topics:

- Interference.
- Newton's rings.
- Refractive index.
- Thickness of sheet wavelength.
- Radius of curvature.

Principle and Working:

A plano-convex lens is placed with its convex surface on the optically plane glass plate so as to enclose a thin film of air of varying thickness between the lens and the plate. Light from an extended monochromatic source is converted into a parallel beam of light by using planoconvex lens of large radius of curvature and made to fall on an optically plane glass plate inclined at an angle of 45° to the vertical, where it gets reflected on to the Plano-convex lens. The wavelength of monochromatic light source is determined from the radii of the interference rings.

NEWTON'S RINGS APPARATUS SW916

SPECIFICATIONS	
Dimension	: 390 x 480 x 170mm approx.
Micrometer	: 0.01 mm least count
Eyepiece	: Ramsden 10X
Objective	: 3X
Weight	: 12.6 kg approx.

PLANO CONVEX LENS R4797



SPECIFICATIONS	
Dia.	: 61.5mm, Glass
Focal length	: 200mm

SPHEROMETER (DISC BRASS) SP821



SPECIFICATIONS	
Types	: 3 legs
Vertical scale	: 6mmx6mm (WxT)
Micrometer	: Dia. 40mm, Brass
Lower disc	: Dia. 60mm
Range	: 10-0-10mm
Least count	: 0.01mm

Contents:

Cat. No.	Item Name	Qty.
SW916	Newton's ring apparatus	1
SP821	Spherometer	1
R4797	Plano convex lens with plane glass plate	1
R7708	Plain glass plate pair (50 x 35 x 2mm)	1
R4798	Plain glass (108 x 70 x 1.2mm)	1

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NEWTON'S RINGS APPARATUS SK029

Experiments:

Exp-1 To determine the wavelength of sodium light.
Exp-2 To determine the refractive index of a liquid by using newton's rings apparatus.
Exp-3 To find the radius of curvature of planoconvex lens using newton's rings experiment, given λ=5893A$^{O.}$
Exp-4 To find the thickness of a thin sheet of paper (air wedge experiment).

Salient Features:

- Modular approach, components can be used in other experiments.
- Economy model.

Key Topics:

- Interference.
- Newton ring.
- Refractive index.
- Thickness of sheet wavelength.
- Radius of curvature.



Newton rings fringes

Principle and Working:

The light from monochromatic source is made to fall on an optically plane glass plate inclined at an angle of 45° to the vertical, where it gets reflected on to the plano-convex lens. The wavelength of monochromatic light source is determined from the radii of the interference rings.

Contents:

Cat. No.	Item Name	Qty.
C11665	Reflector assembly	1
SL930	Sodium light source	1
SPA13	Bridge type microscope	1
R6118	Wooden block	1
SP821	Spherometer double disc with glass plate	1
R4797	Plano convex lens with plane glass plate	1
SL268A	Lens arrangement	1
R7708	Plain glass plate pair (50 x 35 x 2mm)	1

PLANO CONVEX LENS R4797



SPECIFICATIONS

Dia.	: 61.5mm, Glass
Focal Length	: 200mm

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ADVANCED POLARIMETER SK011

Experiment:

Exp-1 To measure the rotation of the polarisation plane through optically active liquids and determine the concentration of sugar solution.

Salient Features :

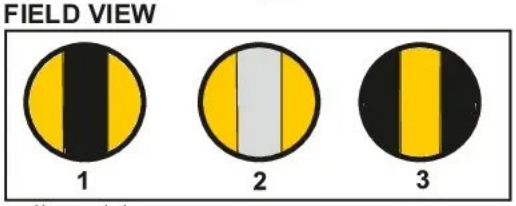
- Stand alone setup integrates the sodium lamp, power supply and polarimeter in one unit.
- **Inbuilt reading magnifier** to read the circular scale.
- Easy to take reading because the scale reading and triple shades are **visible simultaneously**.



Key Topics:

- Polarimeter
- Half wave plate
- Optical rotation
- Optical activity
- Specific rotation
- Monochromatic light
- Concentration.

FIELD VIEW



POLARIMETER TUBE WITH CENTRAL BULB

SPECIFICATIONS

Cat No.	Length
SW843	200mm
SW844	100mm

With central bulb, metallic caps & cover glasses packed in a velvet case.

COMPACT QUARTZ POLARIMETER SW441

SPECIFICATIONS

Measuring range of optical rotation	: +/- 180
Division Value	: 1°
Least count	: 0.05°
Magnifying factor of the magnifying glass	: 4 times
Monochromatic light source	: 5893A°
Power line voltage	: 220V, 50Hz
Working current	: 1.3A
Discharging power	: 20W
Stabilization time(approx.)	: 5 minutes

Principle and Working

A polarimeter is an instrument which measures the rotation of the polarisation plane through optically active liquids. It is used to analyse the concentration and contents of substance like sugar solutions. The polarizer produces linear polarised light. This polarised light passes through the half wave plate and then the sample substance. After this it passes through the analyser to the eyepiece. In the eyepiece a triple shadow field can be observed and the angle of rotation is measured with a circular scale and vernier.

Contents:

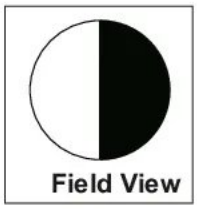
Cat. No.	Item Name	Qty.
SW441	Compact quartz polarimeter superior	1
SW844	Polarimeter tube (small)	1
SW843	Polarimeter tube (big)	1
SC217	Beaker 250 ml	1
SC376	Funnel	1
SC438	Pipette	1
SF450	Glass rod	1

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LAURENT'S HALF SHADE POLARIMETER SK018

Experiment:
Exp-1 To observe the rotation of the plane of polarization of monochromatic light by sugar solution for determining the concentration of solution of optically active substance.

Salient Features :
- Polarimeter function can be carried out precisely in an economical unit.
- Sturdy metal housing and modular construction.



Key Topics:
- Polarimeter
- Half wave plate
- Optical rotation
- Optical activity
- Specific rotation
- Monochromatic light
- Concentration.
- Half-shade.

POLARIMETER TUBE SW843



SPECIFICATIONS

Length : 200mm
With central bulb, metallic caps & cover glasses packed in a velvet case.

LAURENT'S HALF SHADE SL289

SPECIFICATIONS

Circular scale	:0° - 360°
Least count	:1°
Vernier Reading	: 6 min.
Dimensions	: Dia. 12 mm, length 200mm

SODIUM LIGHT SOURCE SL930

SPECIFICATIONS

Starting Voltage	: 470 Volts
Input Voltage	: 220V, 50 Hz
Lamp House	: 300x85mm(LxØ)
Aperture dia.	: 25mm

Scope of Supply : Complete with housing for sodium vapor lamp, transformer, Base, Mounting rod, Bosshead and Sodium Bulb.

Contents:

Cat. No.	Item Name	Qty.
SL289	Polarimeter Laurent's half shade	1
SW843	Polarimeter tube (big)	1
SL930	Sodium light source	1
SC217	Beaker	1
SC376	Funnel	1
SC438	Pipette	1
SF450	Glass rod	1

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POLARIZATION OF LIGHT BY HALF-WAVE PLATE SK073

Experiments :

Exp-1 To measure the light intensity of plane polarised light as a function of the analyzer position.
Exp-2 To study the polarization of light by half wave plate.
Exp-3 To verify the inverse square law.
Exp-4 To verify Malus-law.

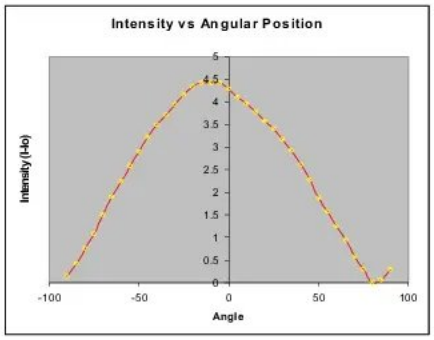
Salient features :

- Monochromatic light.
- Computer connectivity.
- Precise measurement using light sensor.



Key Topics:

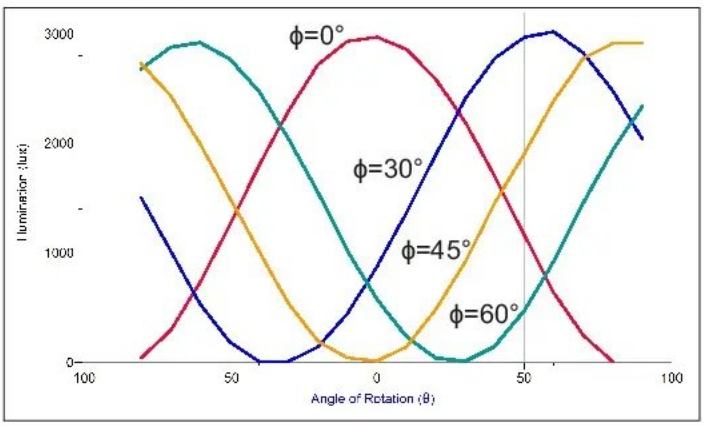
- Polarization
- Malus law
- Polarizer, Analyser
- Half-wave plate
- Plane of polarization



Principle and Working :

A wave plate or retarder is an optical device that alters the polarization state of a light beam traveling through it.

In the present setup, the diode laser light passes through polarizer to produce linearly polarized light. It then passes through the half wave plate λ/2. The λ/2 plate produces linear polarised light. For different angles of the λ/2 plate with respect to optic axis only the polarisation plane changes. The maximum and minimum are not changed which can be investigated with the analyser over the range -90 to +90 degrees.



Illumination (Lux) as a function of the analyzer position θ for various half wave plate positions ϕ.

Contents :

Cat No.	Item Name	Qty.
C13018	Optical bench Triangular	1
C11829	Transverse saddle	1
CH829	Diode laser with adapter	1
SL801	Polarizer / Analyzer	1
CD495	Half wave plate	1
IMC176	Light sensor	1
IMC170	Data logger	1
CD542	Light sensor holder	1
C11837	Fixed saddle	4
C13049	Software CD (MiLAB)	1
IMC188	Sensor cable (mini USB)	1

Additionally required
Computer is not supplied with this setup.

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POLARIZATION OF LIGHT BY QUARTER-WAVE PLATE SK175

Experiments :

Exp-1 To Measure the light intensity of plane polarised light as a function of the analyzer position.
Exp-2 To study the polarization of light by quarter wave plate.
Exp-3 To study the polarization of light by two quarter wave plate.
Exp-4 To verify the inverse square law.
Exp-5 To verify Malus-law.

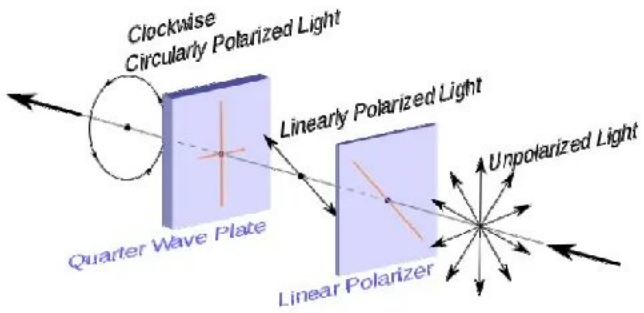
Salient features :

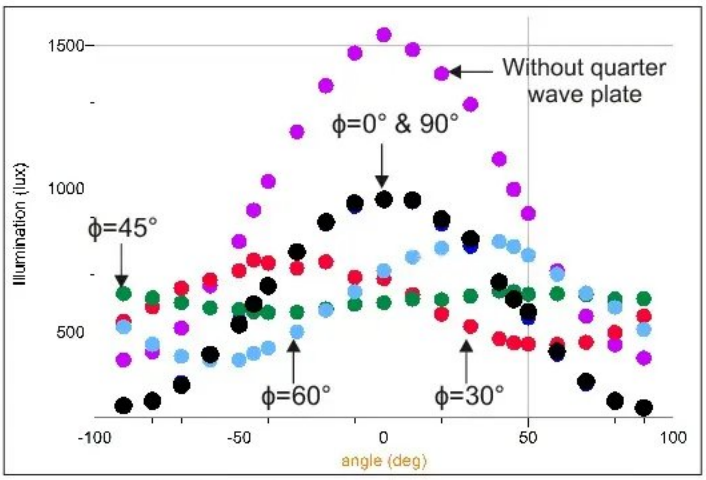
- Halogen light source.
- Computer connectivity.
- Precise measurement using vernier light sensor.

Key Topics:

- Polarization
- Malus law
- Polarizer, Analyser
- Circularly and elliptically polarized light.
- Plane of polarization.







Illumination (Lux) as a function of the analyzer position θ for various quarter wave plate positions ϕ.

Principle and Working :

A wave plate or retarder is an optical device that alters the polarization state of a light beam traveling through it.
In the present setup, halogen light source with yellow light filter passes through a polarizer to produce linear polarized light. This polarized light then falls on a quarter wave plate λ/4. The emergent light passes through analyser. It is investigated at different angles of λ/4 plate (0°, 30°, 45°, 60° and 90°) between the optic axis of the wave plate and the direction of the incident light. The light intensity can be investigated with the analyser over the range -90° to +90°. At 0° and 90° of λ/4 with respect to optic axis, the transmitted light is linearly polarized, at 45° it is circularly polarized, and at 30° and 60° it is elliptically polarized.

Contents :

Cat No.	Item Name	Qty.
C13018	Optical bench Triangular	1
C11829	Transversal slider	1
SW840	Halogen light source	1
SL801	Polarizer / Analyzer	2
CD499	Quarter wave plate	2
IMC176	Light sensor	1
IMC170	Data logger	1
CD542	Light sensor holder	1
SE080	Power supply	1
R7903	Yellow light filter	1
C11837	Fixed slider	4
C13049	Software CD	1
C12636	Fixed slider (large width)	1
IMC188	Sensor cable (mini USB)	1
R0696	Power cord	1

Additionally required
Computer is not supplied with this setup.

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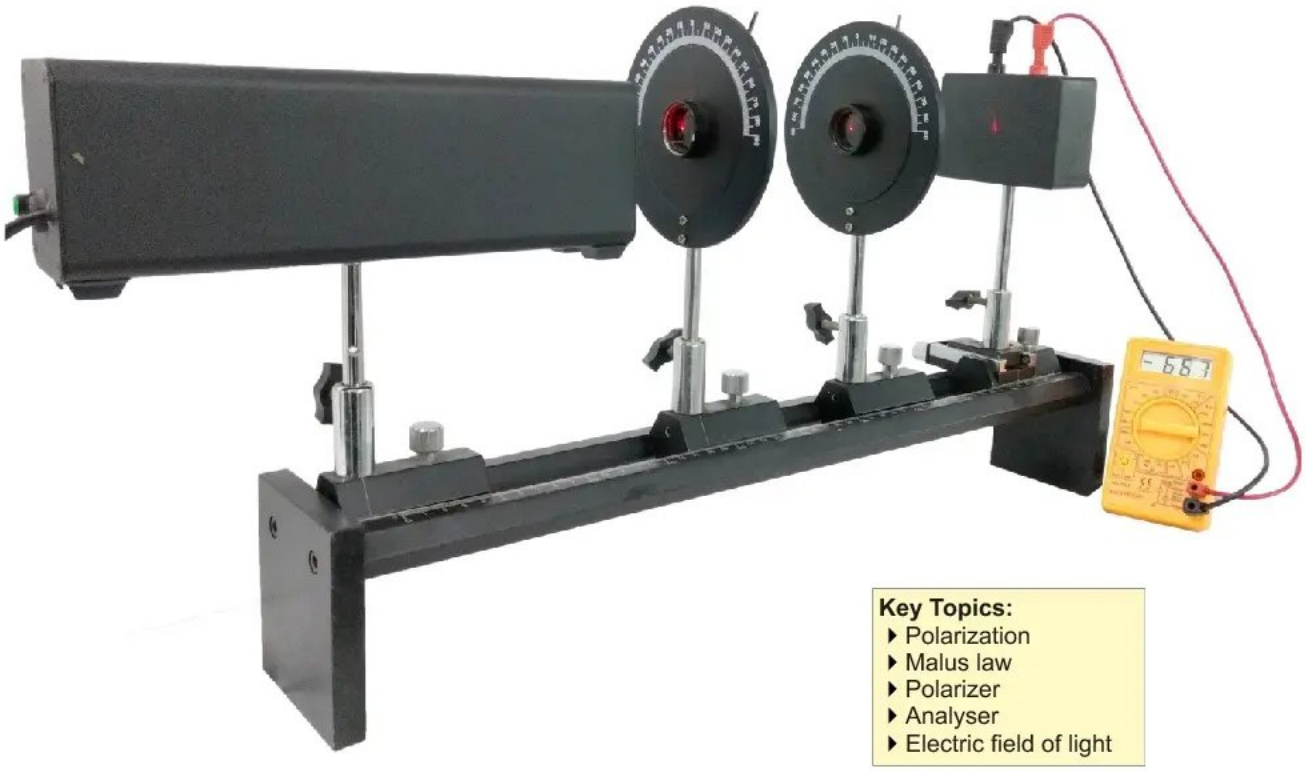
POLARIZATION OF LIGHT AND VERIFICATION OF MALUS LAW SK045

Experiments:

Exp-1 To measure the light intensity of plane polarized light as a function of the analyzer position.
Exp-2 To verify Malus law.
Exp-3 To verify inverse square law.

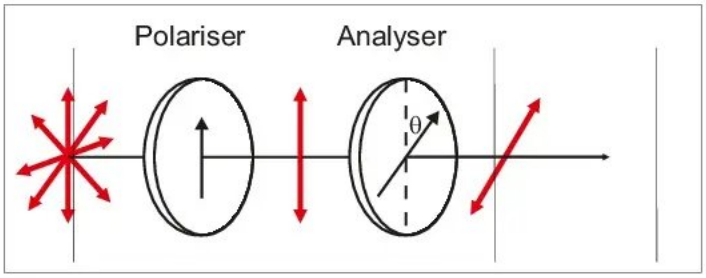
Salient features:

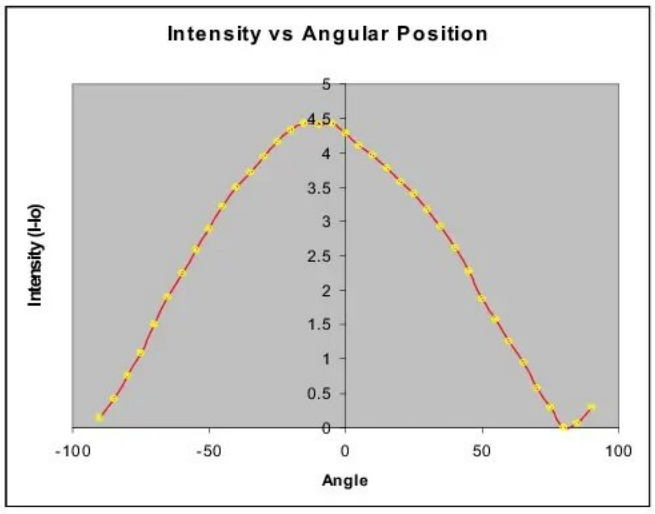
- Pin hole photo detector.
- He-Ne laser with in-built power supply.
- Optical bench with central support.
- Transversal saddle for Y-axis motion.



Key Topics:

- Polarization
- Malus law
- Polarizer
- Analyser
- Electric field of light





Principle and Working:

When a light beam passes through a polarizer filter, it gets linearly polarized. When this linearly polarized light passes through analyzer, its intensity depends on the angular position of the analyzer. The maximum light intensity is transmitted when the optical axis of polarizer and analyzer coincide. The intensity of transmitted beam depends on the angular position between the optical axis of the polarizer and analyzer (θ) and is defined by Malus law as $I=I_0 \cos^2\theta$ where I_0 is the intensity of incident light.
Further the intensity of light depends on the distance between the source and the detector and is defined by the inverse square law.

Contents:

Cat No.	Item Name	Qty.
R3891	He-Ne laser	1
SL214	Optical bench, 1meter	1
SL216	Fixed saddle	3
SE067	Digital multimeter	1
SL801	Polarizer / Analyzer	2
SL436	Transverse saddle	1
SN1016	Photo detector	1
SN204	Flexible plug lead red	1
SN201	Flexible plug lead black	1

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Fax:+91-171-2699102, 2699222, E-mail:deducation@indosaw.com (Indian Customer), eenquiry@indosaw.com (Foreign Customer)

KERR EFFECT SK019

Experiment:

Exp-1 To demonstrate the kerr effect in nitrobenzene solution (only observation).

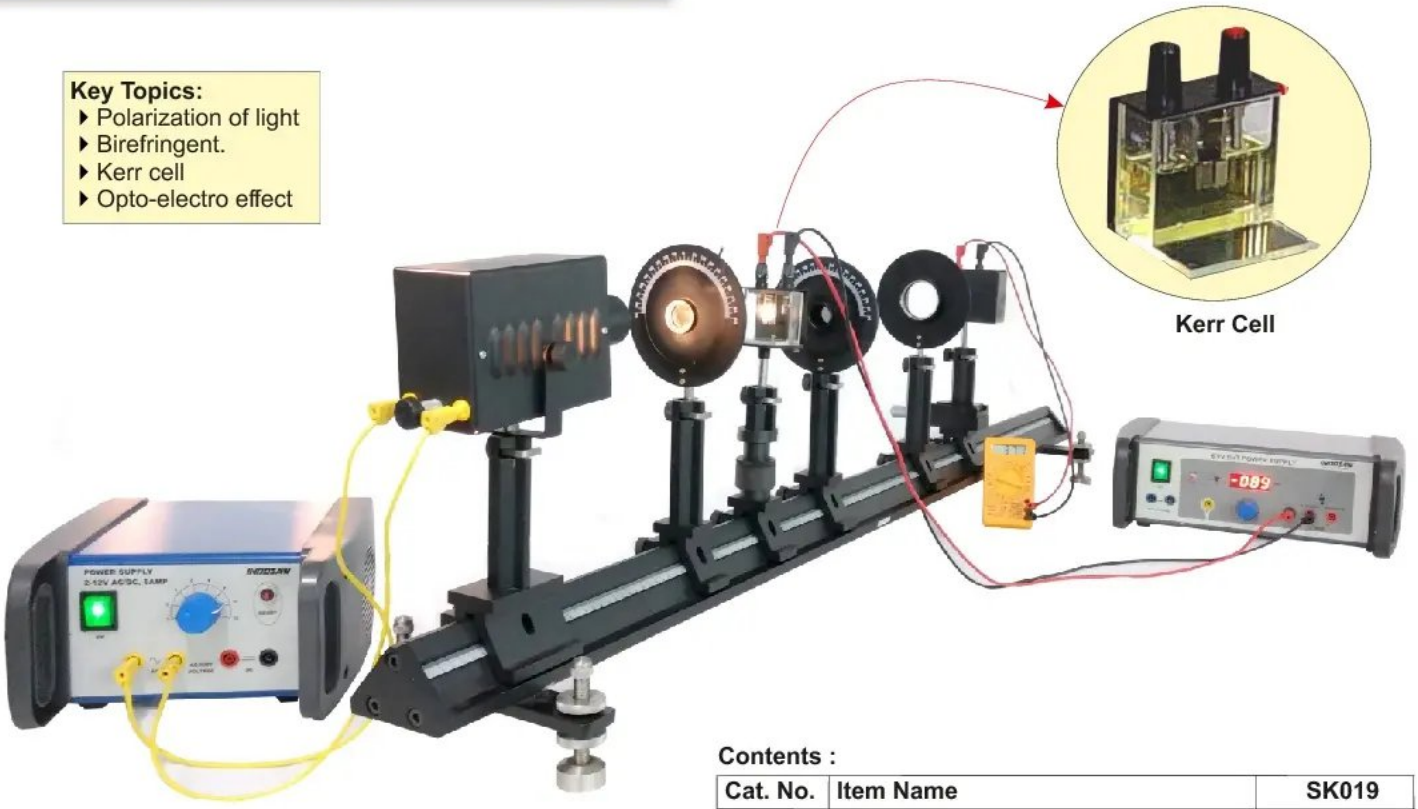
Exp-2 To measure the light intensity as a function of voltage across the kerr cell using photo detector.

Salient Features

- All electrical connections are made using **safety sockets.**
- Easy to setup experiment.
- Can be performed by diode laser and halogen lamp.

Key Topics:

- Polarization of light
- Birefringent.
- Kerr cell
- Opto-electro effect



Kerr Cell

Principle and Working :

Certain materials under the influence of strong electric field become doubly refractive. The effect known as Kerr effect can be observed in this experiment with nitrobenzene solution.

In the present setup, a small glass container mounted with plate capacitor is filled with liquid. The container is kept between two filters placed at 90°. There will be dark field of view on screen initially but after applying electric field, the field of view brightens, because the light beam becomes elliptically polarised when passed through the birefringent liquid.

Contents :

Cat. No.	Item Name	SK019
SLA19	Kerr cell	1
SL801	Polarizer / Analyzer	2
SW840	Halogen light source	1
C0526	Object screen	1
SE1005	High voltage power supply	1
SE080	Power supply	1
SL223	Prism table	1
C13018	Optical bench triangular	1
SL754	Convex lens in holder	1
SLA65	Set of filters	1
SN204	Flexible plug lead,50cm (red)	1
SN201	Flexible plug lead,50cm (black)	1
C11829	Transversal slider	1
SN1016	Pin hole photodetector	1
SE067	Digital Multi meter	1
R0696	Power cord	2
C11837	Fixed slider	4
C12636	Fixed optical slider	1

KERR CELL SLA19



SPECIFICATIONS

Electrode gap : 1mm.
Voltage limit : 5kV, DC (max.)
Dimensions : 50x50x20 mm

HALOGEN LIGHT SOURCE SW840



SPECIFICATIONS

Halogen bulb : 12V, 50W
Operating voltage : 12V, 5A
Safety sockets : 4mm
Rod dia : 10mm

***Additionally Required**

Nitrobenzene, 500ml not supplied with the set up, make your own arrangement.

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FARADAY EFFECT SK063/SK058/SK194

Experiments:

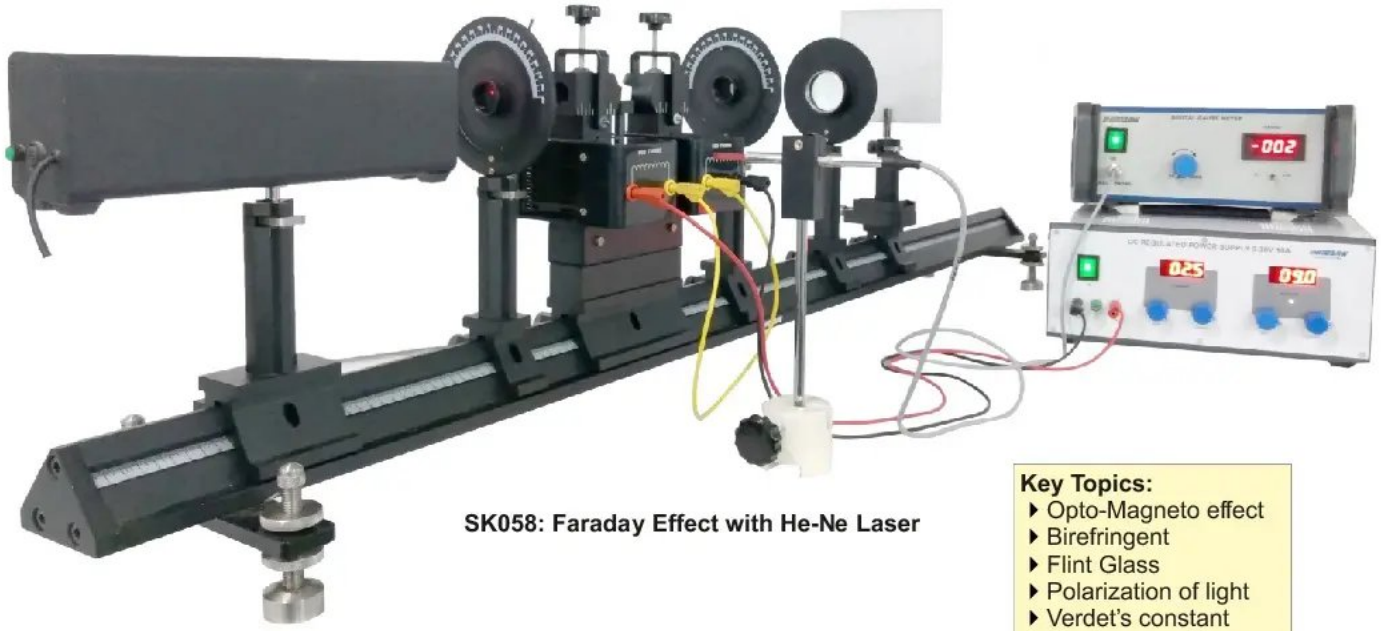
Exp-1 Observing the rotation of the polarization plane when polarized monochromatic light passes through flint glass under influence of a magnetic field.

Exp-2 Determining Verdet's constant from the relation between rotation angle and magnetic flux.

Exp-3 Verification of the relationship between Verdet's constant and wavelength (for SK063 only)

Salient Features

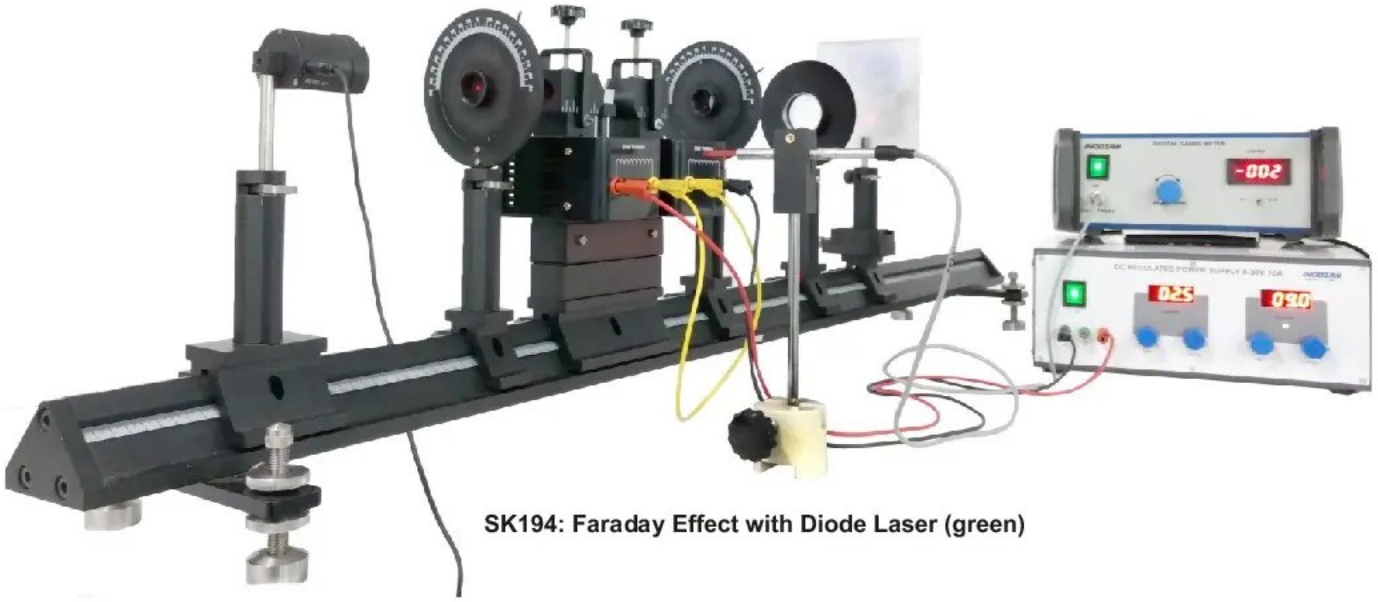
- Experimental setup with He-Ne laser as well as halogen light source.
- All electrical connections are made using **safety sockets**.
- **Compact electromagent**
- Digital Gauss Meter.



SK058: Faraday Effect with He-Ne Laser

Key Topics:

- Opto-Magneto effect
- Birefringent
- Flint Glass
- Polarization of light
- Verdet's constant
- Electromagnetism.



SK194: Faraday Effect with Diode Laser (green)

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FARADAY EFFECT SK063



SK063
Faraday Effect with Halogen Light

Contents:

Cat. No.	Item Name	SK058	SK194	SK063
CD1451	Flint glass	1	1	1
C5986	Flint glass holder	1	1	1
C11848	Electromagnet unit with slider	1	1	1
SL801	Polariser / Analyser	2	2	2
C0526	Object screen	1	1	1
C13018	Optical bench, 1 m	1	1	1
C11837	Fixed saddle	4	5	4
C12636	Long width saddle	1		1
SE1004	Power supply (0-30V DC,10A)	1	1	1
SE080	Power supply (2-12V AC/DC)			1
SEA20	Digital gauss meter with probe	1	1	1
CD1450	Hall probe holder	1	1	1
SL754	Convex lens (F=10cm)	1	1	1
SN201	Plug lead 100 cm, Black	2	2	2
SN204	Plug lead 100 cm, Red	1	1	1
SN206	Plug lead 50 cm, Yellow	1	1	1
SW840	Halogen lamp			1
R3891	He-Ne laser	1		
C13050	Diode laser (green)		1	
SG100	Cylindrical base	1	1	1
R0696	Power cord	2	2	3
R7950	Power Adapter		1	
SLA65	Set of filters			1

Principle and Working

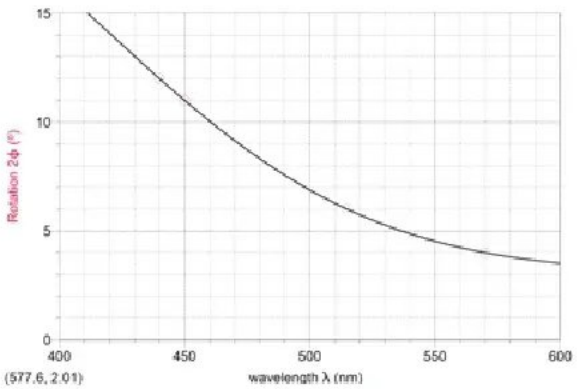
If a transparent isotropic material is placed in a strong magnetic field and linearly polarized light is transmitted in the direction of the magnetic field, the plane of polarization of linearly polarized light rotates by an angle.

In the present setup the optical activity of flint glass is investigated in a magnetic field. The angle of rotation of plane polarized light is proportional to the length (L) and magnetic field (B).

$$\Delta\Phi = V.L.B$$

Where, V-Verdet's constant

The magnetic field is measured using Gauss meter with axial probe.



Rotation of the polarization plane 2φ as function of the wave-length λ

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DIODE LASER DIFFRACTION EXPERIMENT SK078/SK173

Experiments:

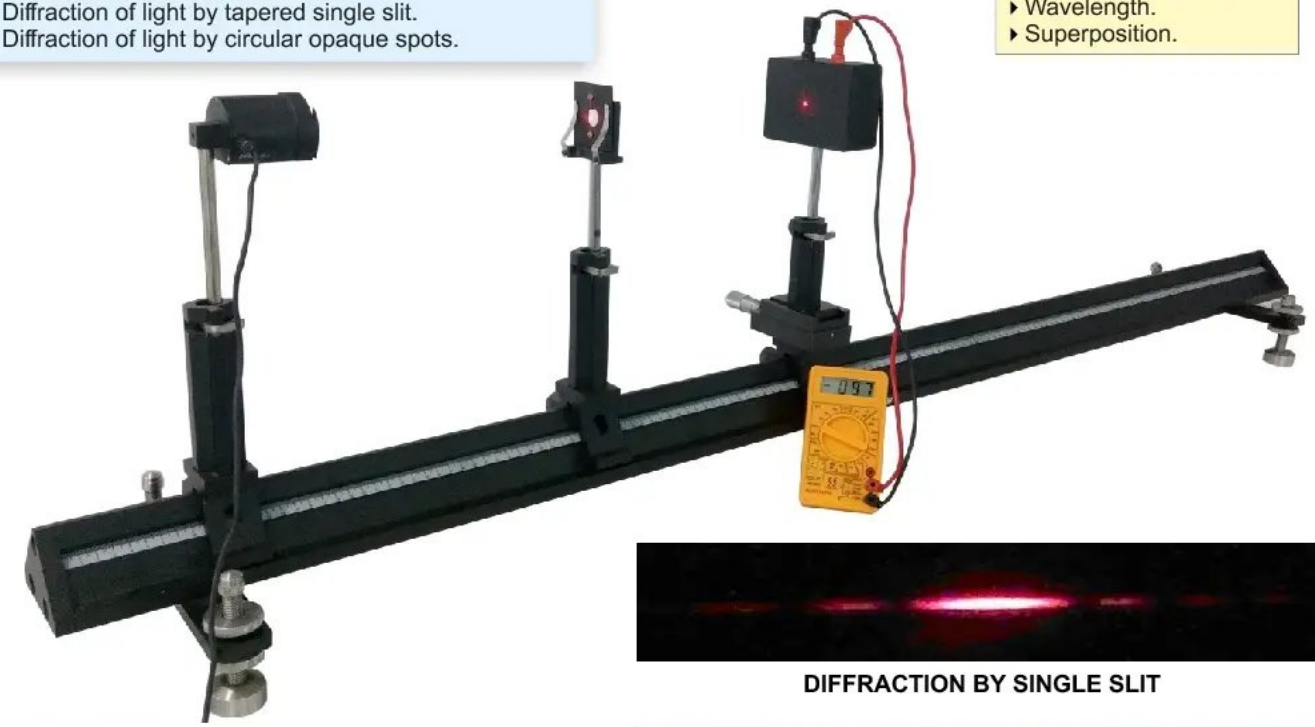
Exp-1 Diffraction of light by single slit.
Exp-2 Diffraction of light by double slit.
Exp-3 Diffraction of light by multiple slit.
Exp-4 Diffraction of light by fine wire.
Exp-5 Diffraction of light by cross wire.
Exp-6 Diffraction of light by wire mesh.
Exp-7 Diffraction of light by transmission grating.
Exp-8 Diffraction of light by coarse grating.
Exp-9 Diffraction of light by circular aperture (Pinhole).
Exp-10 Diffraction of light by grid.
Exp-11 Diffraction of light by grey filter.
Exp-12 Diffraction of light by tapered single slit.
Exp-13 Diffraction of light by circular opaque spots.

Salient features :

- Imported diffraction slide set in SK078.
- Set of 13 slides in SK173.
- Class II diode laser.
- Silicon detector.

Key Topics:

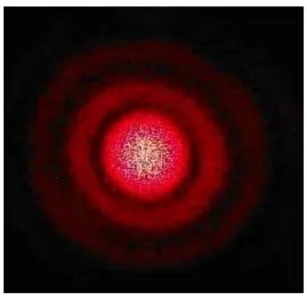
- Diffraction.
- Uncertainty of location.
- Wave-particle, Nature.
- Fresnel diffraction.
- Wavelength.
- Superposition.



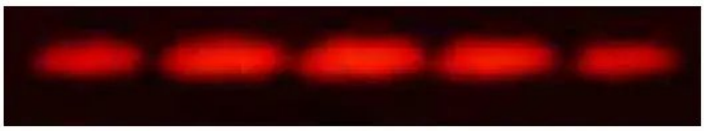
DIFFRACTION BY SINGLE SLIT



Diffraction by grid pattern



Diffraction by hole



DIFFRACTION BY DOUBLE SLIT

Principle and Working:

Diffraction phenomenon of light can be observed when a laser beam passes through a diffraction slit. The intensity pattern can be determined using a pin photo detector with fine movement across the diffraction pattern.

In the present setup, the light intensity in the terms of current or voltage is noted at closed intervals by finely traversing the detector movement and observing the light intensity on a digital multimeter. The intensity versus distance curve is plotted on a graph for calculations. The device consists of one meter long optical bench with two transverse saddle for laser and slit mount and one transverse saddle with micrometer for detector. A number of diffraction slits and gratings are provided with this setup.

Contents :

Cat No.	Item Name	SK078	SK173
C13018	Optical bench triangular	1	1
C11837	Fixed slider	4	4
C11829	Transversal slider	1	1
CH829	Diode laser with power adaptor	1	1
CD555	Slit holder	1	1
SN1016	Pin hole photo detector	1	1
SE067	Digital multimeter	1	1
SL744	Diffraction slide set (Imported)	1	
R5199	Set of 13 slides (Indian)		1
CD732	Single wire	1	1
CD733	Cross wire	1	1
LP18	Connecting lead	1	1
SL795	Diffraction grating (15000 lines)		1
C1734	Object screen	1	1

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LASER KIT SK027/SK038/SK195

Experiments:

Exp-1 To demonstrate that light spreads when it passes through a narrow aperture.
Exp-2 To observe the diffraction patterns by holes, single slit and double slit, mesh, grating, grid, opaque spots.
Exp-3 To demonstrate Young's fringes.
Exp-4 To demonstrate Fresnel's diffraction.
Exp-5 To measure wavelength of light using a millimeter scale as a grating.
Exp-6 To demonstrate fringes of equal inclination.

Salient features :

- Imported slits.
- He-Ne laser with in-built power supply.
- Translucent screen to view the diffraction pattern.
- Hexagonal optical bench with locking arrangement.



Key Topics:

- Diffraction.
- Fresnel diffraction.
- Fraunhofer diffraction
- Interference.
- Uncertainty of location.
- Wave-particle, Nature of light.
- Fringes of equal inclination.
- Wavelength.

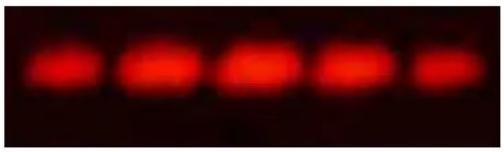
Principle and Working:

Diffraction phenomenon of light cab be observed when a laser beam passes through a slit or grating. The diffraction pattern can be observed on a translucent screen.

In the present setup single slit, double slit, multiple slit, single tapered slit, fine grating, holes, circular opaque spot, gray filter, mesh and coarse grating are used for diffraction experiments with a he-ne laser.



DIFFRACTION BY SINGLE SLIT



DIFFRACTION BY DOUBLE SLIT

Note: SK038 same as SK027 but supplied with SL744 (precision grating set) instead of R599.

Contents :

Cat No.	Item Name	SK027	SK038	SK195
CH829	Diode laser with adaptor			1
R3891	He-Ne laser	1	1	
C13018	Optical bench triangular	1	1	1
C1734	Screen (30 x 30 cm)	1	1	1
R5199	Set of 13 objects (Indian)	1		1
SL744	Diffraction slides (Imported)		1	optional
CD555	Slit holder	1	1	1
R5011	Metal scale	1	1	1
C4737	Slit (Blade)	1	1	1
SP124	Measuring tape (3m)	1	1	1
R4195	Clip	1	1	1
SL072	-10cm concave lens	1	1	1
SL070	-5cm concave lens	1	1	1
SL062	+10cm convex lens	1	1	1
SL064	+20cm convex lens	1	1	1
C0487	Prism table	1	1	1
SG110	Cylindrical base	1	1	1
C11837	Fixed slider	3	3	4
C11829	Transversal slider	1	1	1
C12636	Fixed slider (large width)	1	1	

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PARTICLE SIZE MEASUREMENT SK172

Experiments:

Exp-1 Determination the wavelength of He-Ne laser using diffraction grating.

Exp-2 Determination the particle size of lycopodium powder.

Salient features :

- Imported slits.
- He-Ne laser with in-built power supply.
- Translucent screen to view the diffraction pattern.

Key Topics:

- Diffraction.
- Fresnel diffraction.
- Fraunhofer diffraction
- Uncertainty of location.
- Wave-particale.



Shine an expended He-Ne laser beam through a plate dusted with lycopodium powder to construct circular rings on the screen which are nearly spherical and have a very uniform average diameter. The quality of the ring depends on the evenness of dusting.

Wavelength of given laser source of light

$$\lambda = \frac{\sin\theta}{Nn} \text{ meter}$$

N = No. of lines per meter of grating
Grain size (diameter) '2d' of the grain

$$2d = \frac{n\lambda D}{x_n}$$

Where

n - Order of diffraction
λ - Wavelength of laser used in meter
D - Distance between glass plate and screen in meter
x_n - Distance between central bright spot and the n^{th} fringe in meter

Contents :

Cat No.	Item Name	Qty.
R3891	He-Ne laser	1
C13018	Optical Bench triangular	1
C1734	Screen (30 x 30 cm)	1
C13053	Glass plate (40 x 40mm)	2
SL745	Diffraction grating (imported)	1
CD555	Slit holder	1
C4737	Slit (Blade)	1
SP124	Measuring tape (3 m)	1
R10705	Lycopodium powder 50gm	1
C11837	Fixed slider	2
C12636	Fixed slider large width	1

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FOCAL LENGTH OF A COMBINATION OF LENSES USING NODAL SLIDE ASSEMBLY SED1006

Experiment :
Exp- To find out focal length of a combination of lenses using nodal slide assembly.

Salient Features :
- Multipurpose A-base modular construction.



Key Topics:
- Lens.
- Nodal point.
- Principal axis.
- Centre of curvature.
- Focal point.
- Principal point.
- Equivalent focal length.
- Optical centre.

Experimental set-up has been designed specifically for determination of focal length of a combination of two convergent lenses using Nodal Slide Assembly. The set-up consists of Nodal Slide Assembly, Light source, slit, convex lenses, object screen and base support.
The set up is complete in all respect and requires no other accessories. Practical experience on this set up carries great educative value for Science and Engineering Students.
This setup helps students to understand the basic property of lens like focal length, focus point, principal point and nodal point centre of curvature etc.
The focal length (F) of a combination of two convergent lenses using Nodal Slide Assembly is given by:

$$1/F = 1/f_1 + 1/f_2 - d/f_1 f_2$$

where, f_1, and f_2 are the focal length of lens-1 and lens-2 respectively and d refers to the distance between the two lenses.

Contents:

Cat No.	Item Name	Qty.
SL803	Lamp housing	1
SE080	Power supply 2-12V AC/DC	1
C13018	Optical bench Triangular	1
C11837	Fixed slider	3
CD555	Transversal slider	1
C13019	Cross slit big	1
C13040	Reflecting mirror	1
CD1316	Noddle slide assembly	1
SL064	Lens	2
C1734	Metal screen	1

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OPTICAL FIBER KIT SEA92

Experiments:

Exp-1 Calculate the numerical aperture and study the losses that occur in optical fiber cable.
Exp-2 To study losses at FIBER junctions.
Exp-3 To measure losses in dB of two optical FIBER patchcords and the coefficient of attenuation.
Exp-4 To study the relationship between the LED forward current and the LED optical power output.
Exp-5 To study the relationship between the optical input power, and the resultant photo current.
Exp-6 To study the AC characteristics of a linear intensity modulation system.
Exp-7 To study external circuitry to transmit an audio signal through an optical FIBER using the analogue transmitter and receiver.

Salient features:

- In-built function generator.
- Separate transmitter & receiver section.
- Microphone input section.
- Audio amplifier output section.
- Fiber cable 1m and 5m PMMA.
- In line SMA adaptor.

Key Topics:

- Fiber communication.
- Numerical aperture.
- Photo detector.
- Photo transistor.
- Optical losses.
- Conversion efficiency.
- Intensity modulation system.
- Audio signal.
- Coefficient of attenuation.
- Input power and photo current.



In order to understand the fundamental of optical fibers and analogue optical fiber communication, this kit has been designed. Wiring diagram for Fiber Optic Analogue Transmitter, Fiber Optic Analogue Receiver, Fiber Optic LED Driver and Optical Power Meter has been shown on the panel of kit.
In the present setup, eight experiment can be performed by using this trainer. The user can design a number of other interesting experiments and small projects based on the kit. Provided with detailed instruction manual.

Contents :

S.No.	Item Name	Qty.
1	One - meter PMMA Fiber Patchcord	1
2	Five meter PMMA Fiber Patchcord	1
3	In -Line SMA Adaptor	1
4	Mandrel	1
5	Numerical aperture measurement Zig	1
6	Fibre optics Trainer	1
7	Speaker	1
8	Mic	1
9	Circular screen	1
10	Connecting leads	8

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OPTICAL FIBER CHARACTERIZATION AND TRANSMISSION SK177

Experiment:

Exp-1 To measure the numerical aperture of single and multi-mode fibers.
Exp-2 To study the characteristic of 650nm diode laser.
Exp-3 To study the characteristic of fiber optics photodetector.
Exp-4 Measurement of splicing losses, bending losses and air gap losses in multi-mode fibers.
Exp-5 To determine the refractive index of transparent solids.

Salient features:

- Separate transmitter & receiver section.
- Multimode Fiber cable 2m and 2m PMMA.
- Single mode fiber cable 5m
- In line SMA adaptor.
- Modular approach.
- High precision digital micro volt metre.
- Reflective index of transparent solids



Key Topics:

- Fiber communication.
- Numerical aperture.
- Photo detector.
- Photo transistor.
- Optical losses.
- Conversion efficiency.
- Intensity modulation system.
- Single mode fiber.
- Coefficient of attenuation.
- Refractive index.
- Characteristics of diode laser.

In fiber-optic communication, both single and multi-mode optical fibers are used for the transmission of optical signals. Diode laser is used as light source, whether the system transmits digital or analogue signals. Laser fiber coupler is used to couple light from laser to fiber input end efficiently. There are mounts to hold input and output ends of the fiber firmly. Compute numerical aperture from the formula:

$$NA = \sin\theta_{max} = W/(4L^2+W^2)^{1/2}$$

The relationship between an laser optical output Po and the laser forward current I_f is given by

$$Po = KI_f \text{ (over a limited range)}$$

Where K is a constant.

Contents :

Cat.No.	Item Name	Qty.
R9390	Two - meter PMMA Fiber (Multimode)	1
R9391	Two - meter SPMA Fiber (Multimode)	1
C13051	Single mode fiber	1
CD1032	In -Line SMA Adaptor	1
CD1020	Mandrel with rod	1
R9396	NA measurement JIG	1
C13018	Optical bench triangular	1
SR010	Digital Micro volt metre	1
C11837	Fixed slider	1
C11829	Transversal slider	2
CD1027	Laser diode Tx unit	1
CD1028	Laser diode Rx unit	1
CD1033	Circular screen with angle measurement	1
SL141	Transparent solid	1
SN206	Flexible gun type lead(Yellow - 50cm)	4
LP17	Flexible lead pair(Red & Black - 50cm)	2
R9398	Adaptor 9V, 1 Amp DC	2
SE067	Digital Multimeter	1
C13052	Single mode fibre Tx module	1

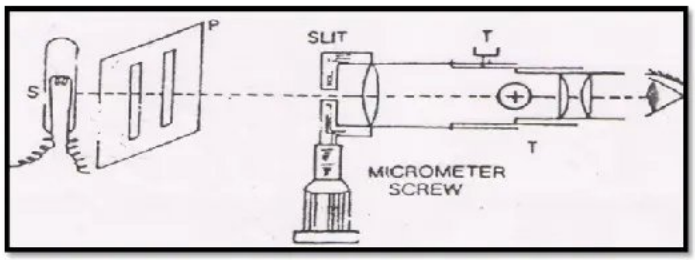
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RESOLVING POWER OF A TELESCOPE SED1005

Experiment :
Exp- To determine the resolving power of a telescope.

Salient Features :
- Modular approach.
- Components can be used for other laboratory experiments.

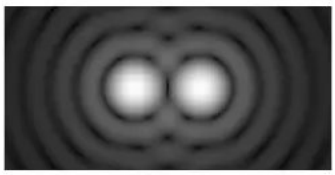
Key Topics:
- Resolving power.
- Monochromatic light.
- Critical width.
- Traveling microscope.
- Consecutive slit.



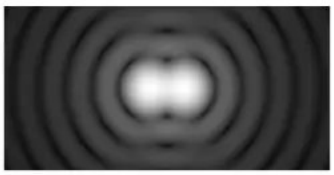




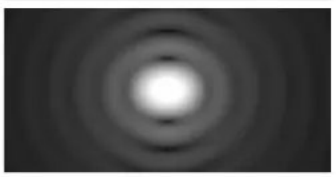




Points far apart



Rayleigh criterion



Points closer than the Rayleigh criterion

Principle and Working :
Resolving power of a telescope is defined as the reciprocal of the smallest angle subtended at the objective lens of the telescope by two point objects which can be just distinguished as separate.
Resolving power of telescope is given by :

Resolving Power = D/d = a/λ

∵ resolving power for rectangular aperture = **a/λ**
Where, λ = 589 nm mean wavelength of light used
D = is distance of the objects from objective of the telescope.
d - is distance between two consecutive slits or objects
a - is critical width of the rectangular slit for just resolution of two slits or objects.

Contents:

Cat No.	Item Name	Qty.
SL930	Sodium light source	1
SPA13	Bridge type microscope	1
SL439	Micrometer slit	1
CD415	Telescope	1
SP124	Measuring tape	1
CD555	Slit holder	1
SW092	Bosshead	2
SG067	Rod	2
SG101	'A' base	2
SG110	Cylindrical base	1
C2102	Slit (1mm, 2mm)	2

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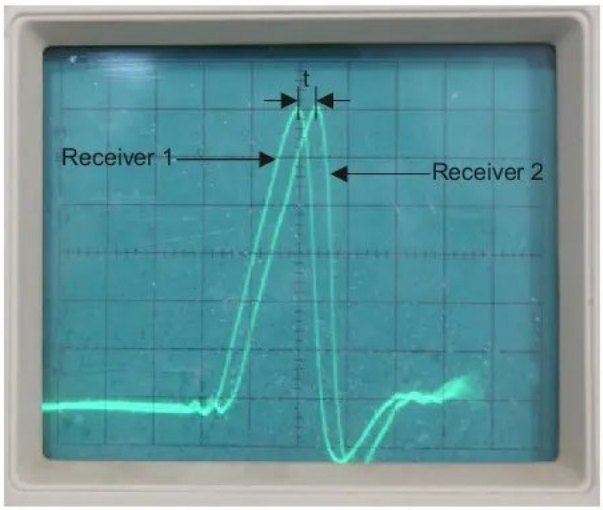
SPEED OF LIGHT SK077

Experiment:
Exp- To determine the Speed of Light in air.

Salient Features :
- 1MHz internal modulation frequency.
- Dual photo detector.



Key Topics:
- Speed of light.
- Internal modulation.
- Laser beam.
- Peak difference.
- Path difference.



Signal from Receiver 1 and Receiver 2



Principle and Working :

The LASER beam from the Transmitter strikes the Beam Splitter to split the beam in two perpendicular directions. The first beam is transmitted through Transmitter directly and is received in first channel of the receiver. The second perpendicular beam from Beam Splitter travels a larger distance by being reflected back from a mirror placed about 5 meter or more and is received in second channel of the receiver.

In the present setup, the time difference between the two peaks of received LASER signals can be observed on a oscilloscope (>40MHz) and can be used to calculate the Speed of Light.

Additionally required:
Oscilloscope is not supplied with the setup.

Contents:

Cat.No	Item Name	Qty
CD818	LASER Transmitter Module	1
CD819	Receiver Module	1
R7950	Power Adaptor 5V	2
CD820	Beam Splitter	1
SL752	Convex Lens f = 50mm	2
SG110	Cylindrical Base	5
C821	Reflecting Mirror in Mount	1
SG101	'A' Base	1
CD1079	Support Rod	1
C7659	BNC to BNC Cable	2
SE037	Oscilloscope >40MHz (Not Supplied)	1
SP124	Measuring tape (3m)	1
SW092	Boss Head	1

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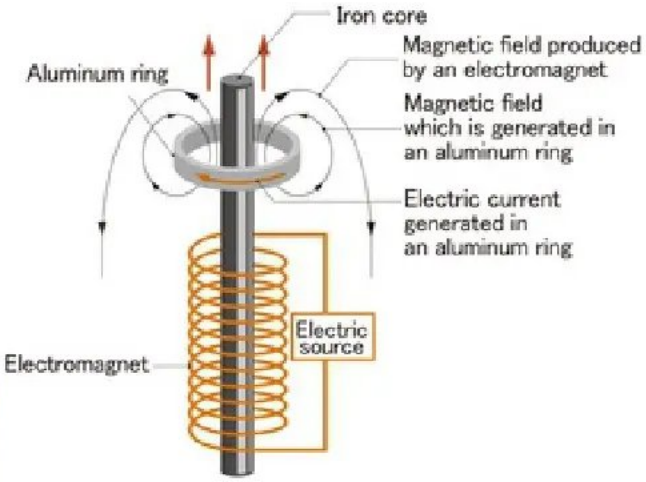
ADVANCE RING LAUNCHER SL1049

Experiments:
Exp-1 To demonstrate the Lenz's law and effects of electromagnetically induced currents.

Key Topics:
- Electromagnetic induction.
- Magnetic flux.
- Faraday laws.
- Lenz's law.
- Eddy current.
- Self induction.
- Mutual induction.

UNIQUE CHARACTERISTICS:
- Activation of the circuit by solenoid insertion and thus provides overcurrent protection.
- Confirmation of activation by voice message.
- Necessary instruction and precautions are displayed on the unit.
- IR Remote for safe launching.
- Separate indication LED for Power, Activation Status, Remote Pulse and Launch Pulse.







Warning Message Before Launch

Ring launcher demonstrates the Lenz's law and effects of electromagnetically induced currents in a unique setup.

An iron core placed in a solenoid. The ring fits over the coil at some height. When we press launch button on control panel to energize the coil, a large magnetic induction builds-up on the axis of coil, generating oppositely directed induced current in the ring. The two oppositely directed inductions repel, aluminium ring shoots up-to several in air and feet. No effect is seen when using aluminium slit or acrylic ring.

Transformer principle observed with coil of wire having low voltage lamp, which lights briefly. Overheating of coil is prevented by automatic one-shot timing feature.

Contents :

Cat. No.	Item Name	Qty.
C13055	Ring Launcher unit	1
C5929	Iron core	1
CD392	Adjustment collar	1
C5940	Aluminum Ring	1
C5941	Aluminum Ring with split	1
C5942	Plastic Ring	1
C7617	Coil with lamp	1
C10515	Core holding ring	1
R0696	Power cord	1
C13054	Remote	1

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MICROWAVE OPTICS SYSTEM SN636

Experiments:

Exp-1 To study optical phenomena in microwave optics system (inverse square law and angular dependence).
Exp-2 To study the reflection in microwave.
Exp-3 To study the refraction in microwave.
Exp-4 To study the polarization on microwave.
Exp-5 To study the double slit interference.
Exp-6 To study the single slit diffraction phenomena.

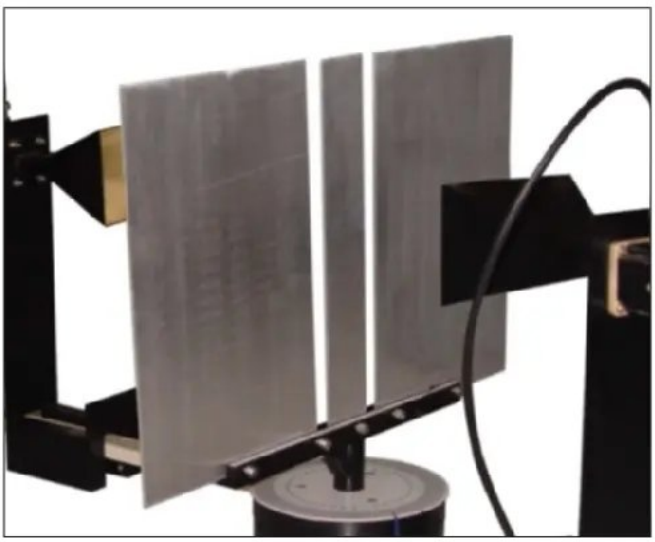
Salient features

- Transmitter and receiver horn mounted on heavy base.
- 0-360° goniometer scale.
- Gunn diode power supply.
- Pin modulation.
- Different accessories for study the microwave optics.

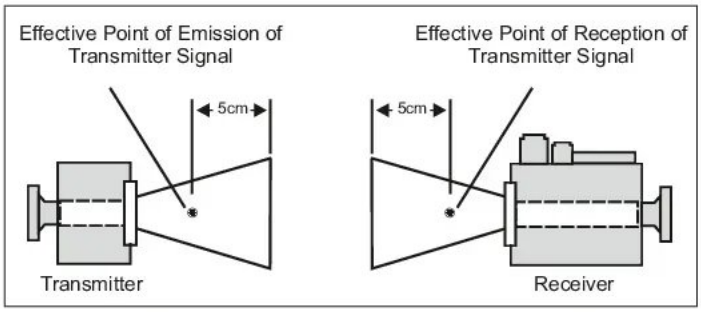
Key Topics:

- Gunn diode.
- Reflection & Refraction.
- Polarization
- Diffraction.
- Interference.
- Transmission.
- Reception.





Double Slit Arrangement



Transmitter and Receiver Section

Microwave apparatus is used for study of Wave Phenomenon of the radiation produced, because its properties are very similar to those of light.
In the present setup, used for the students to understand and learn the basic concepts of wave phenomenon. Demonstration of wave nature e.g., reflection, refraction, Polarization, Interference and diffraction of the radiation produced, can be done using this kit.

Contents:

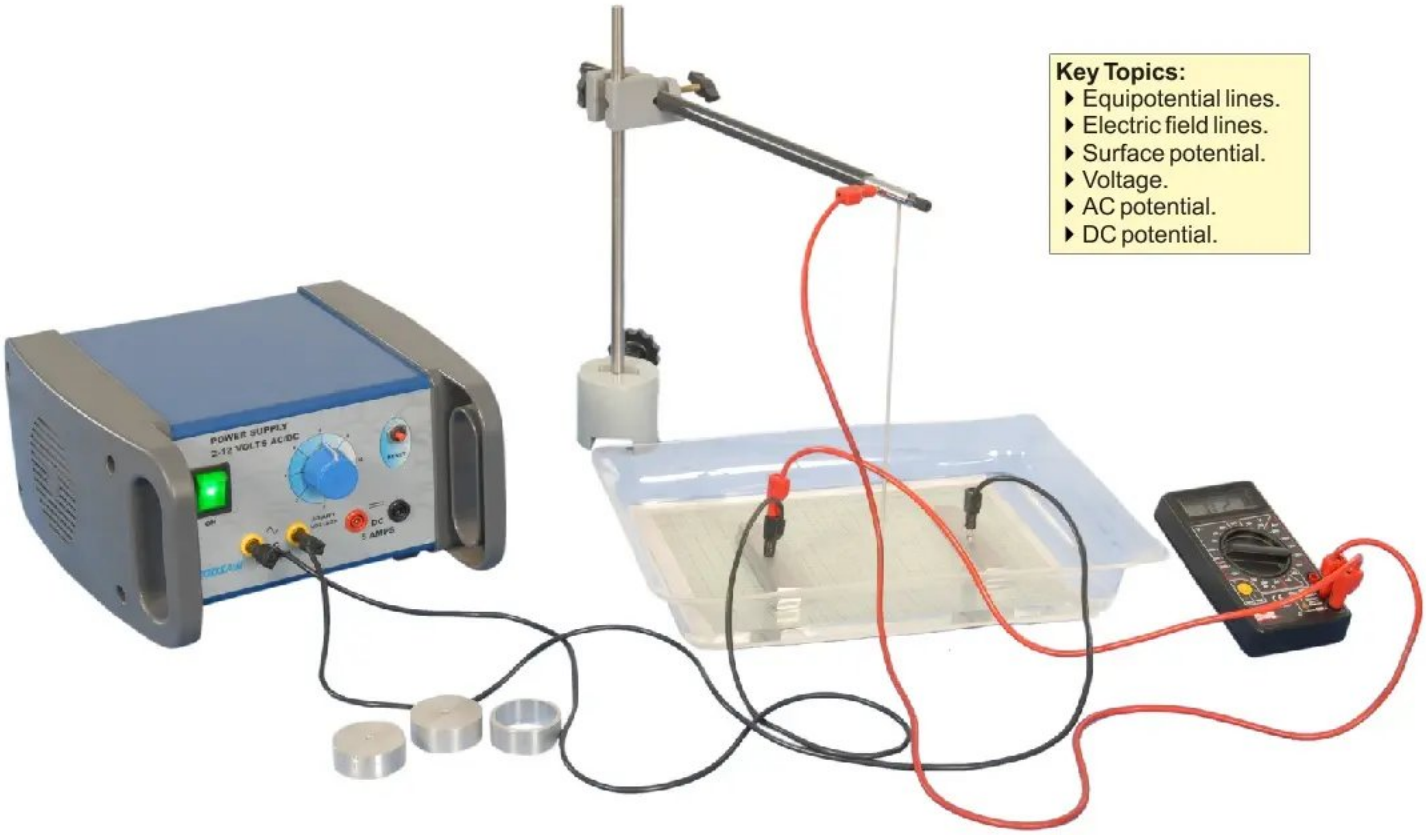
Cat No.	Item Name	Qty.
C8029	Microwave Transmitter	1
C7661	Microwave Receiver	1
C7662	Gunn Diode Power Supply	1
C7660	Goniometer Scale	1
C7663	Aluminum Reflectors size 200x300mm	2
C7664	Aluminum Reflectors size 50x300mm	1
C7665	Aluminum Reflectors size 300x300mm	1
C7666	Acrylic Reflectors size 300x300x3mm	1
C7667	Semi-Silvered reflector size 300x300mm	1
C7668	Polarizing Grill size 190x300mm	1
SE067	Digital Multi-meter	1
R9931	BNC to BNC cable	1
R9932	BNC to Banana plug	1

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FIELD LINES AND EQUIPOTENTIAL LINES SK044

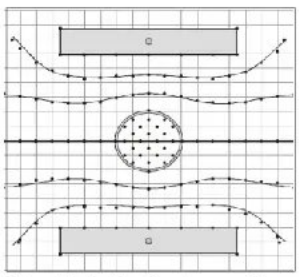
Experiments:
Exp-1 To investigate the equipotential lines of electric fields.
Exp-2 To draw the equipotential lines for bar electrode.
Exp-3 To draw the equipotential lines for disc electrode.
Exp-4 To draw the equipotential lines for ring electrode.

Salient features :
- Multipurpose power supply.
- Point needle for tracing the field line.
- Easy setup and connection.
- Electrical safety tested.

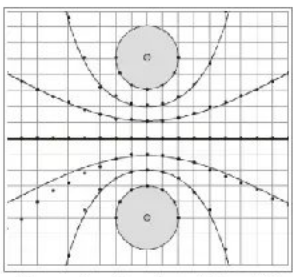


Key Topics:
- Equipotential lines.
- Electric field lines.
- Surface potential.
- Voltage.
- AC potential.
- DC potential.

Principle and Working:
An equipotential line is a collection of points in space when each point has the same value of electric potential.
In the present setup, a voltage is applied between a pair of electrodes placed in a plastic trough filled with distilled water and voltage is measured at different points with a needle connected to a multimeter. The points are marked on another graph paper with reference to the graph placed under the trough.



Parallel electrodes with a conductor ring (Exp-2)



Disc electrodes (Exp-3)

Contents :

Cat No.	Item Name	Qty
CA556	Trough	1
SP730	Needle	1
C7862	Rod with socket	1
SE067	Digital multimeter	1
SG110	Cylindrical base	1
C7863	Bar electrode	2
C7864	Disc electrode	2
C7865	Ring electrode	1
C7866	Stand rod	1
SW092	Boss head	1
SE080	Power supply (2-12 V AC)	1
SN204	Flexible plug lead red	2
SN201	Flexible plug lead black	2

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DIELECTRIC CONSTANT SK042

Experiments:

Exp-1 To determine the capacitance of plate capacitor by charge measurement.

Exp-2 To measure the capacitance as a function of area of plates.

Exp-3 To measure the capacitance as a function of distance between the plates.

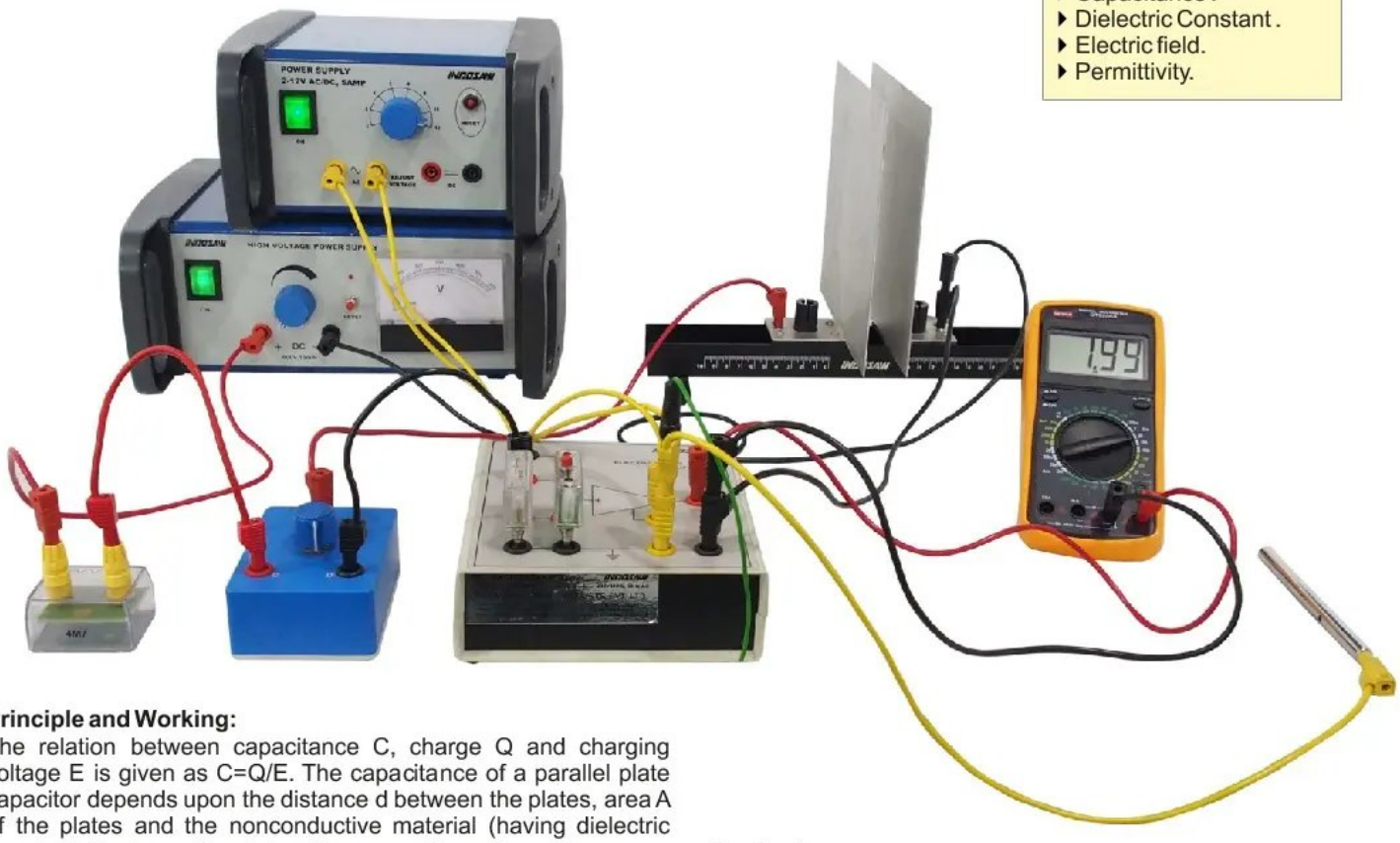
Exp-4 To determine the dielectric constant of different dielectric materials .

Salient Features

- Charge measurement by **electrometer amplifier.**
- All electrical connections are made using **safety sockets.**
- Capacitors plates are attached to **insulated riders.**
- Electrical safety tested.

Key Topics:

- Capacitance .
- Dielectric Constant .
- Electric field.
- Permittivity.



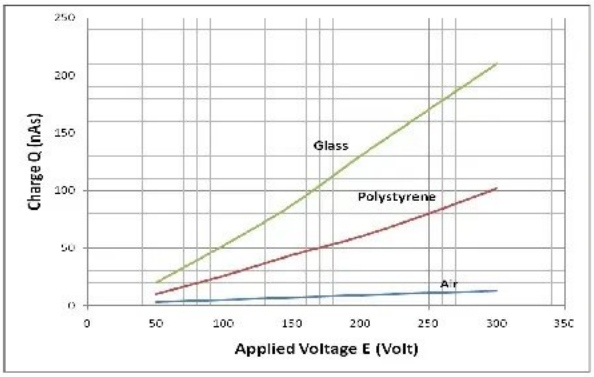
Principle and Working:

The relation between capacitance C, charge Q and charging voltage E is given as C=Q/E. The capacitance of a parallel plate capacitor depends upon the distance d between the plates, area A of the plates and the nonconductive material (having dielectric constant ε_r) between the plates. Thus capacitance is

$$C = \varepsilon_r \varepsilon_0 A/d$$

Where $\varepsilon_0 = 8.85 \times 10^{-12}$ As/Vm (permittivity in free space),

In present setup, the parallel plate are charged by 600 V DC power supply. The charge Q on the parallel plate is measured by electrometer amplifier as voltage. The distance between plate is adjusted by placing spacer on the edges of plate.



Contents :

Cat. No.	Item Name	Qty
SEB03	Dielectric constant kit	1
SD003	Electrometer amplifier	1
SE067	Digital multimeter	1
SE080	Power supply (2-12 V AC/DC)	1
SEB02	High voltage power supply (0-600V DC)	1
SN200	Flexible plug leads (50 cm), black	2
SN203	Flexible plug leads (50 cm), red	2
R4589	Earthing lead (100 cm), green	1
C4341	2 way switch	1
C4108	Capacitor module 0.01μF	1
C4179	Capacitor module 100nF	1
C4178	4.7 MΩ Resistance box	1
SN200	Flexible plug leads (25 cm), black	2
SN203	Flexible plug leads (25 cm), red	2
SN207	Flexible plug leads (50 cm), yellow	3
LP18	Flexible plug leads (100 cm), red & black	1

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PERMEABILITY AND PERMITTIVITY OF AIR SK201

Experiments:

Exp-1 To measure the force between current carrying conductor and determine the permeability of air.

Exp-2 To measure the force of attraction between charged capacitor plates and determine the permittivity of air.

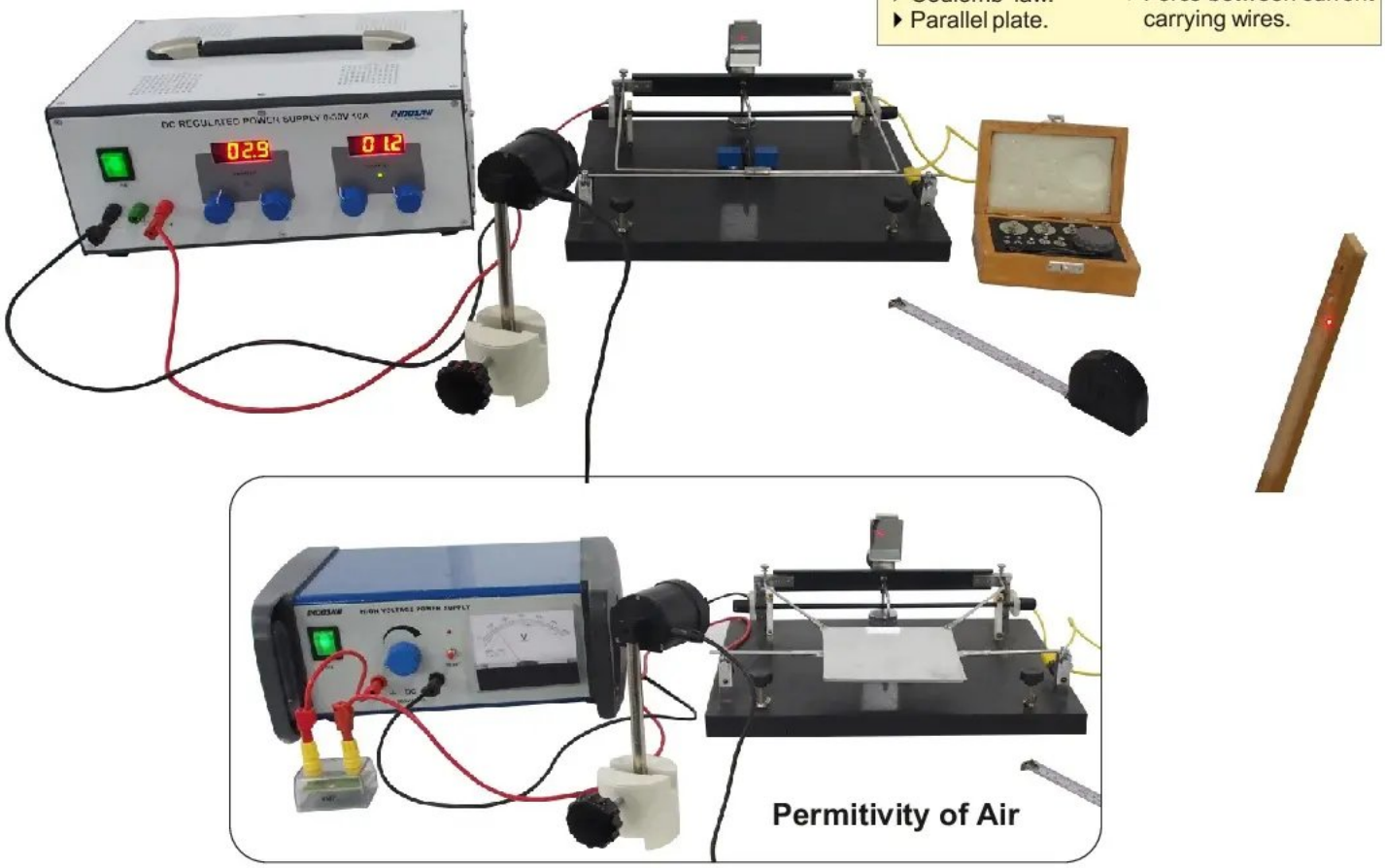
Exp-3 To verify the relationship of speed of light with permeability and permittivity of air.

Salient Features :

- High current power supply.
- High voltage DC power supply.
- Very sensitive coulomb and current balance.
- Diode laser based optical lever.

Key Topics:

- Permittivity of air.
- Null Method.
- Electrostatic force.
- current balance.
- Coulomb law.
- Parallel plate.
- Capacitor.
- Permeability.
- Speed of light.
- Magnetic field.
- Force between current carrying wires.



Permitivity of Air

Principle and Working:

Repulsive forces between two current carrying conductors, which is very small, is measured using a very sensitive balance technique based on a diode laser, scale and fractional weights to form an optical lever. This measurement is used to calculate permeability of air.

Similarly small attractive forces between two charged capacitor plates is measured. This measurement is used to calculate the permittivity of air.

An indirect estimate of the speed of light can be made from the experimental values of permeability and permittivity which verifies the relationship.

Contents:

Cat No.	Item Name	Qty.
SV244	Coulomb and current balance kit	1
SE1003	Power supply 0-30V DC, 0-20A	1
SEB02	Power supply 0-600V, 10mA	1
SG204	Weight box	1
SG110	Cylindrical base	2
CH829	Diode laser with adapter	1
SP134	Wooden scale (100 cm)	1
C4178	Resistance module	1
SN207	Flexible plug leads (50 cm), yellow	1
LP18	Flexible plug leads (100 cm), red & black	1
SP124	Measuring tape (3 metre)	1

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FARADAY'S LAW & INDUCED E.M.F SED1003

Experiments:

Exp-1 Verification of Faraday and Lenz's law of induction by measuring the induced voltage as function of time.

Exp2 Measurement of the induced voltage impulse as a function of the velocity of the magnet.

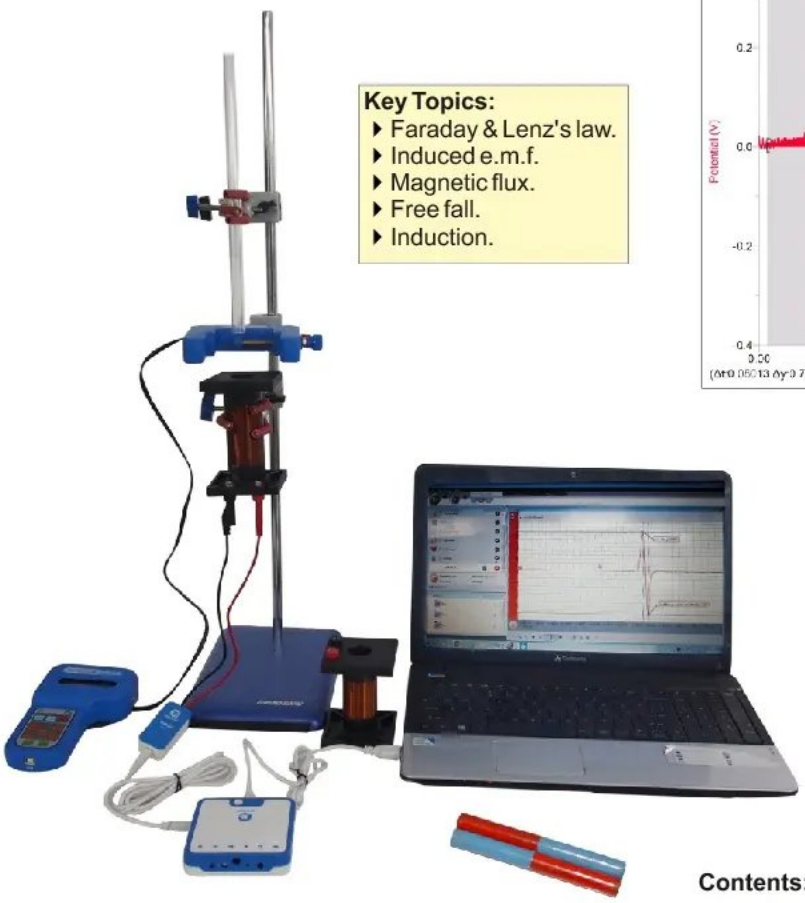
Exp-3 Calculation of the magnetic flux induced by the falling magnet as a function of the velocity of the magnet.

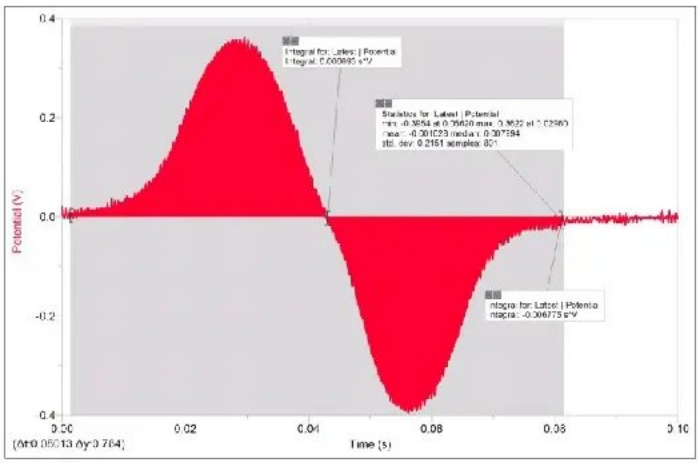
Salient Features :

- Multipurpose data logger.
- Easy setup with advanced software features.
- Microcontroller based digital timer.

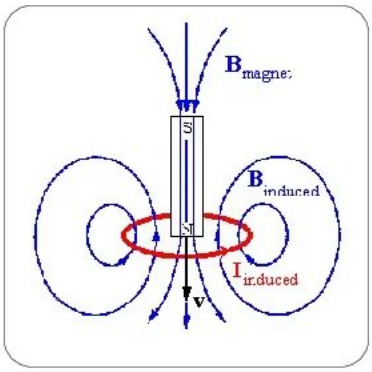
Key Topics:

- Faraday & Lenz's law.
- Induced e.m.f.
- Magnetic flux.
- Free fall.
- Induction.





Induced Voltage as Function of Time.



Principle and Working:

An induced e.m.f. (or induced current) is produced across a conductor when it is exposed to a change in a magnetic field. The mathematical law that relates the changing magnetic field to the induced current (or the induced voltage) is called Faraday's Law.

Lenz's law describes the magnetic flux through the circuit and gives the direction of the induced e.m.f. This gives rise to induced current which opposes the change in magnetic flux .

In the present setup, a permanent magnet falls with different velocities through a coil. The change in the magnetic flux generates an induced voltage impulse. The induced voltage impulse is recorded with voltage probe through Data Logger. Depending on the polarity of the permanent magnet the induced voltage impulse is negative or positive.

Additionally required
Computer is not supplied with the setup.

Contents:

Cat No.	Item Name	Qty
IMC170	Data Logger	1
IMC171	Voltage Sensor	1
SH319	Support Base	1
SH325	Support Rod	1
SV190	Three Fingle Clamp	1
SW092	Bosshead	3
CD121	Coil N=700, L=75mm, Dia=32mm	1
CD122	Coil N=1150, L=75mm, Dia=32mm	1
SE781	Cylindrical Magnet	1
CD120	Tube 300mm	1
C8599	Digital Timer with adapter	1
C8601	Photogate	1
C13049	Software CD	1
SW619	Burette Clamp	1
IMC188	Sensor cable (mini USB)	1

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MAGNETIC FIELD IN HELMHOLTZ COIL SED1002

Experiments:

Exp-1 To measure the spatial distribution of the magnetic field between a pair of identical coils in helmholtz arrangement.

Exp-2 To investigate the spacing between coils at which magnetic field is uniform and to measure its spatial distribution.

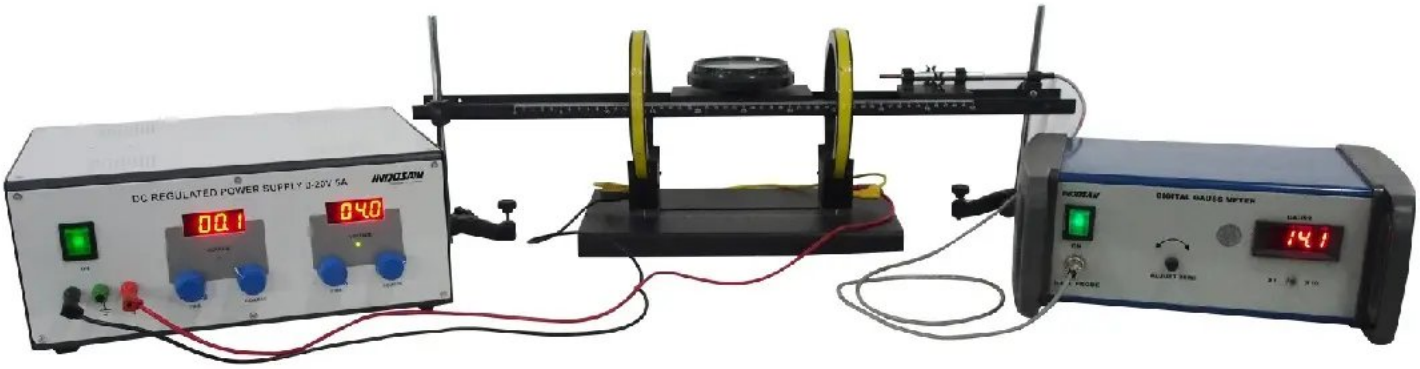
Exp-3 To demonstrate the superposition of the magnetic fields of the two individual coils.

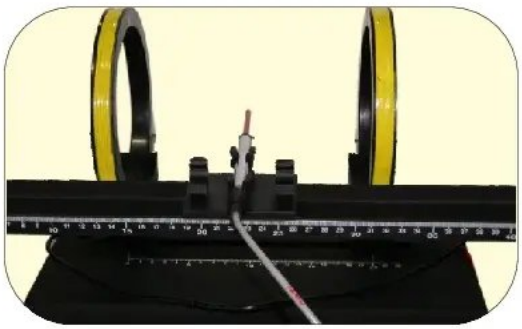
Salient Features :

- Digital gaussmeter with axial probe to measure magnetic field.
- Distance between coils is adjusted in U channel bench.
- Easy & simple approach.
- Electrical safety tested.

Key Topics:

- Helmholtz coil arrangement.
- Axial hall probe.



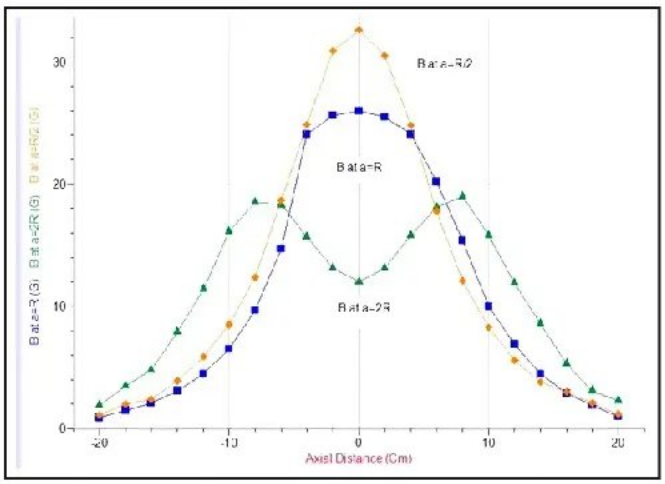


Magnetic Field setup in Plane x=0

Principle and Working:

A helmholtz arrangement consists of a pair of identical coils placed symmetrically along a common axis. A fairly uniform magnetic field can be produced in this setup when they are separated by a distance equal to their radius and having equal currents in the same direction flowing through them.

In the present setup, the spatial distribution of the magnetic field of a pair of identical coils in helmholtz arrangement and superposition of the individual fields by the coils is investigated using a digital gaussmeter with axial probe.



Spatial Distribution of the Magnetic Field

Contents :

Cat No.	Item Name	Qty.
SE1044	Power supply DC 0-20V, 5 Amp	1
C4939	Digital gauss meter with axial probe	1
SV628	Coil N=390, dia=150mm	2
SH317	Support base	2
CD038	Support rod	2
CD036	Base for helmholtz coil	1
CD043	U channel small	1
CD042	Deflection compass with Base	1
CD039	Axial probe holder	1
SE067	Digital multimeter	1
SN201	Lead 100cm black	2
SN204	Lead 100cm red	1
SN206	Lead 50cm yellow	1

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BIOT SAVART'S LAW SK022

Experiments:

Exp-1 To study the magnetic field of a circular conductor as a function of the current.

Exp-2 To study the magnetic field of a circular conductor as a function of distance from the axis of the conductor.

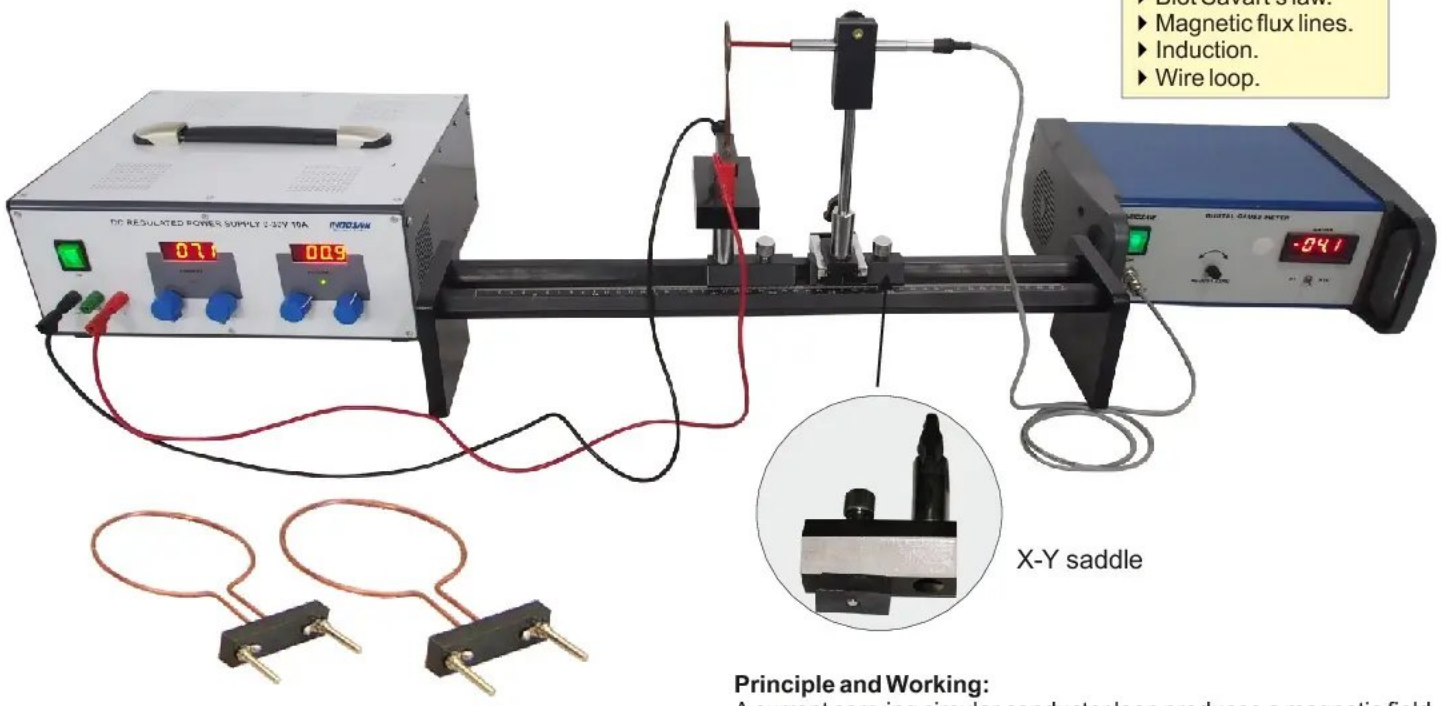
Exp-3 To study the magnetic field as a function of loop radius.

Salient Features :

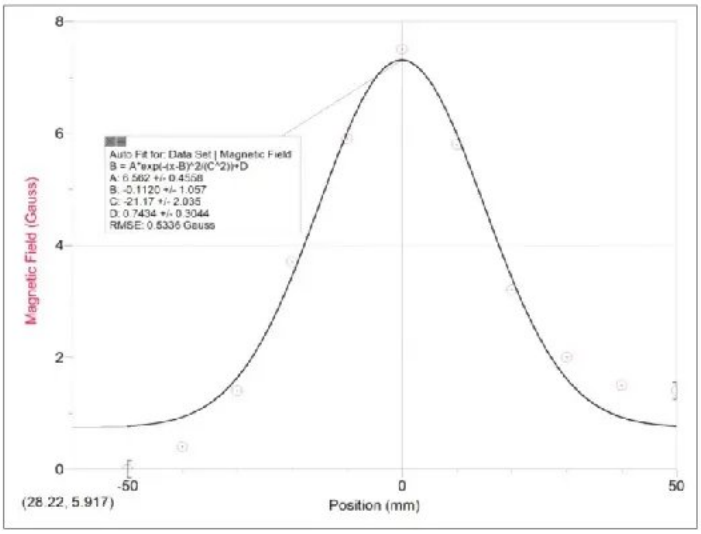
- Specially designed hexagonal optical bench with **locking arrangement** for precise positioning.
- **Smooth motion** of uprights.
- Circular loop with **different radii**.
- Magnetic field measurement with axial probe.
- High current power supply.
- Electrical safety tested.

Key Topics:

- Biot Savart's law.
- Magnetic flux lines.
- Induction.
- Wire loop.



X-Y saddle



Magnetic field *B* of the conductor loops (R=20mm) as a function of the distance *x* at 20 Amp

Principle and Working:

A current carrying circular conductor loop produces a magnetic field along its axis which is defined by Biot Savart's law.

$$B = \frac{\mu_o}{2} \cdot \frac{I \cdot R^2}{(R^2+x^2)^{3/2}}$$

Where R=Radii of the loop, x =Distance from axis through center.

In present setup, three conductor loops of different radii mounted on a special loop holder is provided for investigation. The magnetic field is measured using axial hall probe. A high current power supply is provided to produce the magnetic field.

Contents :

Cat. No.	Item Name	Qty.
C13056	Optical bench (0.5mtr)	1
SEB05	Set of 3 circular loops with holders	1
Se1003	Power supply 0-30 V DC, 20 A	1
C4939	Gauss meter with axial probe	1
SN204	Flexible plug lead (100 cm), red	1
SN201	Flexible plug lead (100 cm), black	1
SL216	Fixed saddle	1
CD567	Transversal Saddle with micrometer	1
C4238	Axial Probe holder	1

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MAGNETIC FILED ALONG THE AXIS SED1001

Experiments:

Exp-1 To study Biot-Savart's law.
Exp-2 To study the magnetic field along the axis of a current carrying multiturn coil.
Exp-3 To study the dependancy of magnetic field on coil diameter and number of turns.

Salient Features :

- Modular approach.
- Multipurpse power supply.
- Multiturn coils of various diameters.
- Magnetic field measurement with axial probe.
- Electrical safety tested.
- Experiment can be performed at low current.

Key Topics:

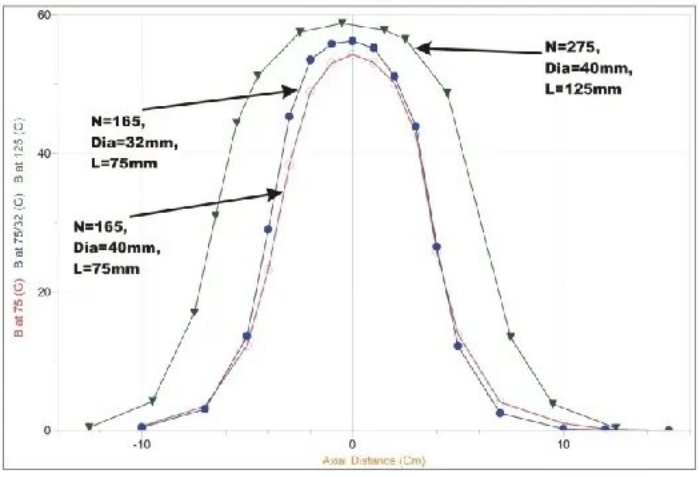
- Biot Savart's law.
- Magnetic flux density.
- Induction.
- Wire loop.
- Magnetic flux.



Principle and Working:

A current carrying coil produces a magnetic field along its axis which is defined by Biot Savart's law.

In the present setup, the study of magnetic field along the axis is investigated with coils having different dimensions and turns. The magnetic field is measured using a axial hall probe and digital gaussmeter.



Dependence of Magnetic Field in L, N, & Diameter

Contents :

Cat No.	Item Name	Qty.
SE079	Power supply DC 0-20V, 5 Amp	1
C4939	Digital gauss meter with axial probe	1
C13056	Optical bench	1
C13042	Coil holder	1
SL216	Fixed saddle	1
CD567	Transversal saddle	1
C4238	Axial probe holder	1
SN201	Lead 100cm black	1
SN204	Lead 100cm red	1
CD074	Coil N=165, L=75mm, dia=32mm	1
CD075	Coil N=220, L=100mm, dia=32mm	1
CD076	Coil N=275, L=125mm, dia=32mm	1
CD077	Coil N=165, L=75mm, dia=40mm	1
CD078	Coil N=220, L=100mm, dia=40mm	1
CD079	Coil N=275, L=125mm, dia=40mm	1

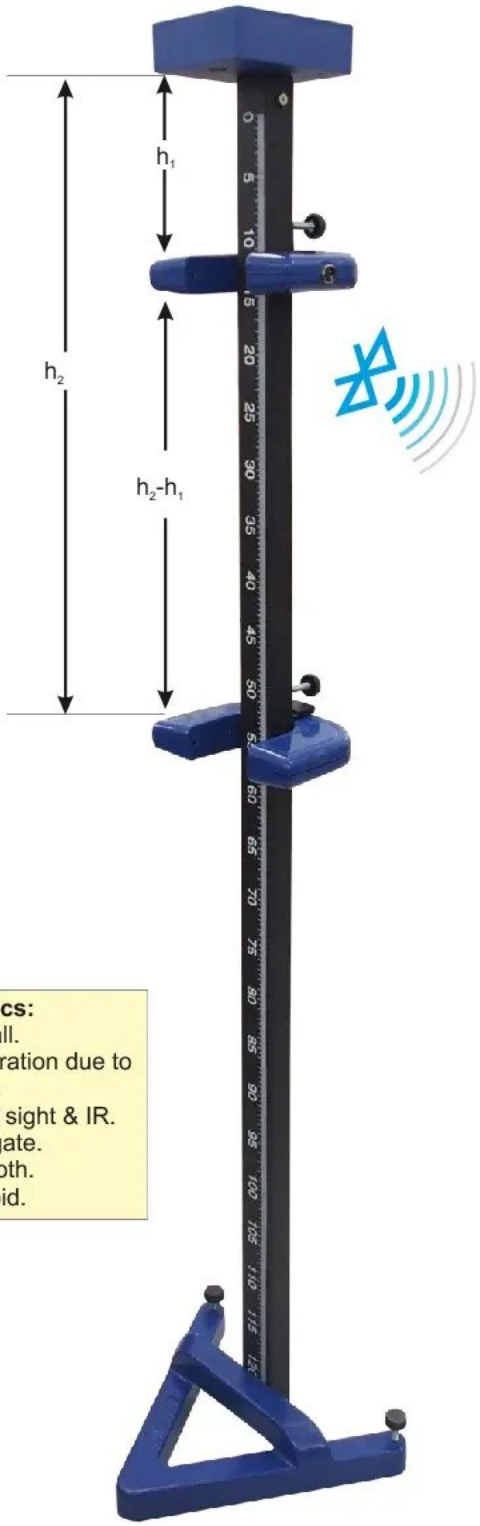
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FREE FALL APPARATUS WITH WIRELESS PHOTOGATES & SOLENOID SK196

Experiments:

Exp-1 To determine the value of "g" by dropping metal ball using solenoid through a pair of photogates.



Key Topics:

- Free fall.
- Acceleration due to gravity.
- Line of sight & IR.
- Photogate.
- Bluetooth.
- Solenoid.

Salient Features:

- Unique wireless solution to perform 'g' by free fall experiment.
- Master and slave Photogates communicate with laptop on wireless bluetooth link.
- Master Phtogate has inbuilt Digital Timer with 100 micro-second resolution.
- A special solenoid module is triggered from Master Photogate to release ball.
- Inbuilt rechargeable cells.
- Communication between Master Slave Photogates and Solenoid is through IR signal.
- Graphical display of blocked pluses can be observed on PC software provided with the system.
- Easy to set up and accurate result.
- Wireless Master and Slave Photogates can be used with air track and dynamic trolleys, to study linear motion on inclined plane and collision experiments.

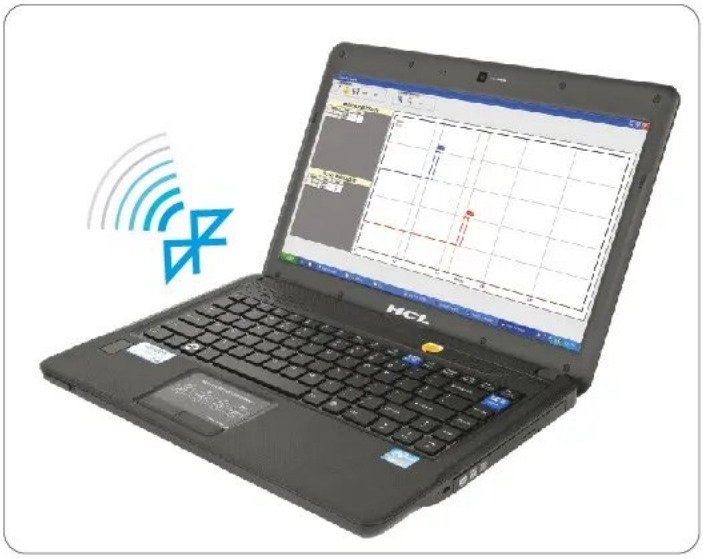
Principle and Working:

Free fall instrument is necessary for the quantitative analysis of free falling objects and measurement of value of 'g', acceleration due to gravity.

In the present setup, the value of "g" may be obtained with the help of Master - Slave Photogates and a falling ball dropped by solenoid using the equation,

$$g = \frac{2(h_2 - h_1)}{t_2^2 - t_1^2}$$

where $h_2 - h_1$ is the distance between the Photogates.



Contents:

Cat No.	Item Name	Qty.
C13067	'g' by free fall stand	1
C13068	Master photogate	1
C13069	Slave photogate	1
C13010	Wireless solenoid module	1
SW924	Steel Ball	1
SU0 293A	Thread Reel	1

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VARIABLE 'g' PENDULUM SK064

Experiment:

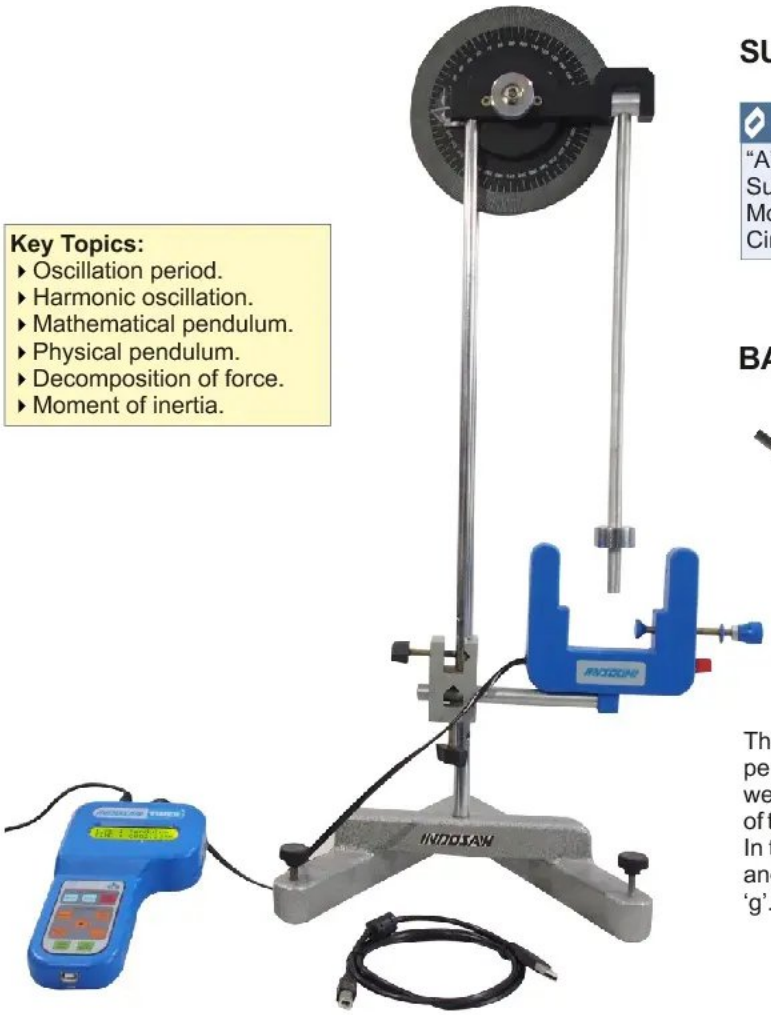
Exp-1 To measure the period of oscillation of pendulum, by changing the angle θ.
Exp-2 Effect of large amplitude on time period.
Exp-3 To measure the period of oscillation by changing the length of pendulum.
Exp-4 As the variable g-pendulum also allow to vary the acceleration due to gravity acting on pendulum.

Salient features:

- Hand-held digital timer with data logging facility & membrane keypad.
- Small slits on the inside edge of the photogate for emitting & receiving infra red beam.
- Many other experiments can also be performed with the same timer.
- Quick & accurate results.

Key Topics:

- Oscillation period.
- Harmonic oscillation.
- Mathematical pendulum.
- Physical pendulum.
- Decomposition of force.
- Moment of inertia.



SUPPORT BASE & SUPPORT ROD

SPECIFICATIONS	
"A" shape base	: Cast iron
Support rod	: Mild steel
Mounting rod	: Mild steel
Circular disk	: PVC

BAR PENDULUM CD821



SPECIFICATIONS	
Rod	: Al pipe, 360 x 10 mm
Dimension	: 30 x 10 mm (OD x ID)
Material	: Mild steel

The pendulum used here can act as a mathematical (simple) pendulum. However, depending on the position of the pendulum weight, the length measured between the pivot point and the centre of the moveable weight can be varied.
In the present setup one can rotate the oscillation plane around the angle θ with respect to the vertical plane thus altering the value of 'g'. The time period of oscillation at angle θ is given as:

$$T(\theta) = 2\pi(L/\, g_{eff})^{1/2}$$

where $g_{eff} = g.\cos\theta$

DIGITAL TIMER & PHOTOGATE C8599/C8601

SPECIFICATIONS	
Display	: 2 line LCD
Type	: Micro controller based
Time resolution	: 0.1 milli second
Mode	: Time, Speed & Acceleration
Photogate	: 1 No.
Interface	: USB
Operating voltage	: 5V DC
Photogate detector	: Infra-Red

Microcontroller based and in-built test functions.
Supplied with a pair of photogate and photogate mounting rod.

Contents :

Cat No.	Item Name	Qty.
CD821	Bar pendulum	1
CD822	Bar pendulum holder	1
CD823	Circular disk	1
C8599	Digital timer with adapter	1
C8601	Photogate	1
CD824	Mounting rod	1
SH319	"A" shape base	1
SH325	Support rod	1
SW092	Boss head	2

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MOMENT EXPERIMENT S3010

Experiments:

Exp-1 To determine Moment as a function of the distance between the origin of the coordinates and the point of action of the force.

Exp-2 To determine Moment as a function of the angle between the force and the position vector to the point of action of the force.

Exp-3 To determine Moment as a function of the force.

Salient Features:

- High precision dynamo meter.
- Modular approach.
- Strong and heavy base.
- Frictionless movement of disk.



Key Topics:

- Moments.
- Couple.
- Equilibrium.
- Statics.
- Lever.
- Coplanar forces.
- Torque.

Principle and Working:

Coplanar forces (weight, spring balance) act on the moments disc on either side of the pivot. In equilibrium, the moments are determined as a function of the magnitude and direction of the forces and of the reference point.

The spring balance is adjusted to zero in the position in which the measurement is to be made in each case. The straight line from the push-in button to the pivot point is adjusted to the horizontal by moving the swivel clamp on the stand rod. The fishing line to weight pan then runs along a row of holes. The spring balance should be mounted in the swivel clamp so that it forms an angle Φ with the fishing line.

Contents:

Cat No.	Item Name	Qty.
C11750	"A" base assy.	2
C10512A	Spring balance 2N	1
R10512	Spring balance 1N	1
SG110	Cylindrical base	1
C11761	Disc assy.	1
C11767	Movable clamp	1
C11853	Slotted weight set	1
C12527	Cotton thread	1
SH316	Retort rod	2
SP135	Meter rule	1
SW092	Boss head	1

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CENTRIPETAL FORCE AND MOMENT OF INERTIA SV259

Experiments:

Exp-1 To measure the force required under static conditions to displace the mass the same distance against the pull of the spring.

Exp-2 To calculate the moment of inertia.

Salient Features :

- Easy setup.
- Computer connectivity.
- Labquest mini may be used in other experiments also.
- Sturdy base.



Key Topics:

- Centripetal force.
- Moment of inertia.
- Oscillation period
- Angular speed.
- Restoring force.
- Axis of rotation.
- Center of gravity.
- Linear velocity.



It consist of a having mass supported from a cross arm attached to a vertical shaft. The cross arm is counter balanced by having mass. An vertical rod can be adjusted on the base as a radius vector. A ball bearing pulley mounted on a rod on the base is used for measuring the force exerted by a spring with which mass is coupled to the shaft.

By knowing the mass, the speed of rotation and the radius, the centripetal force can be calculated. A photogate sensor is used for measuring rotation time during experiment.

Contents:

Cat No.	Item Name	Qty.
SV241	Centripetal force base unit	1
SV250	Slotted mass set	1
C8599	Digital timer with adapter	1
C8601	Photogate	1
C12041	Support base	1
C0509	Support rod	1
SW052	Boss head	1
C13057	Weight (200gm)	2

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CENTRIPETAL FORCE EXPERIMENT SK202

Experiments:

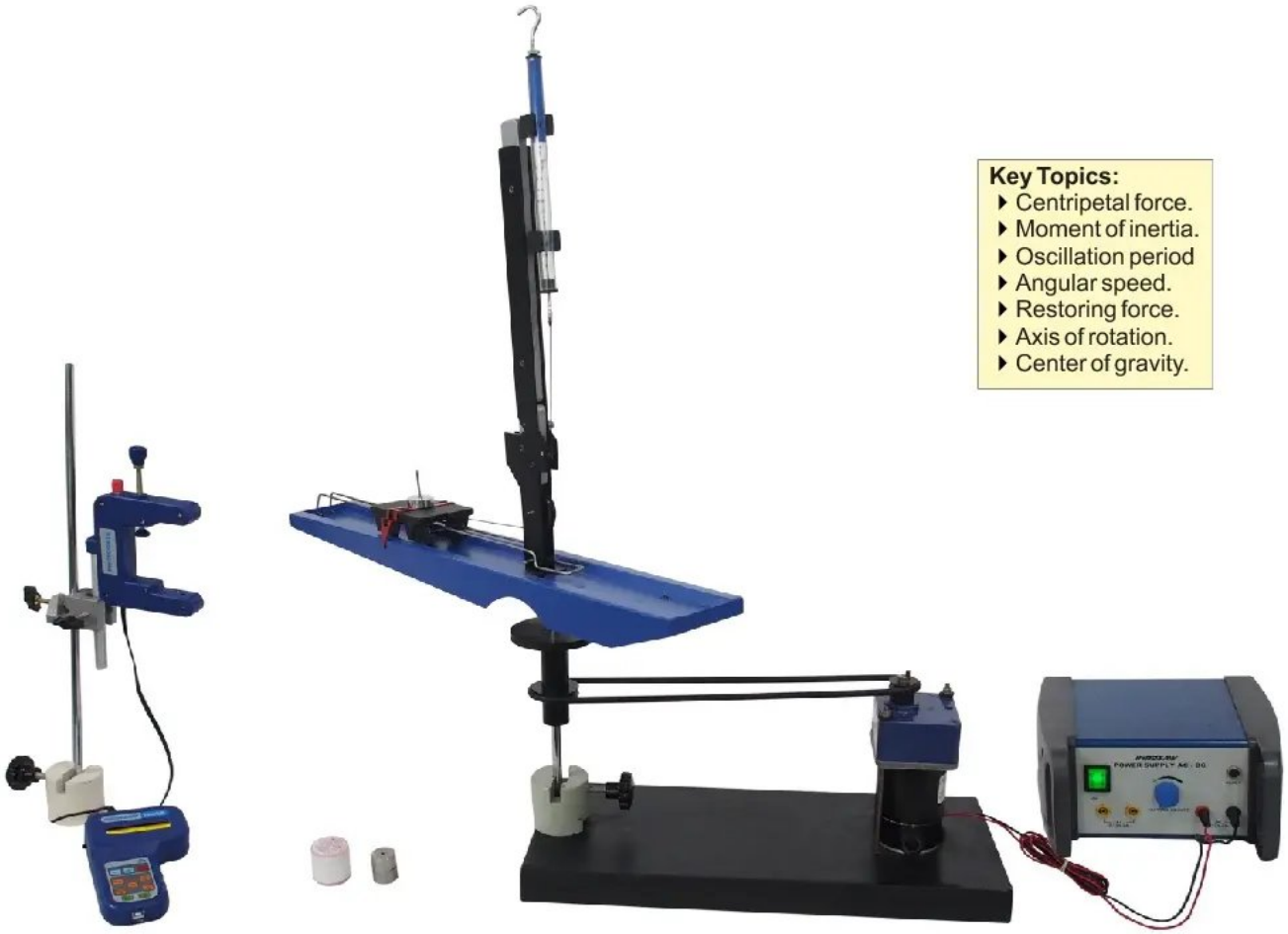
Exp-1 To determine the relation between centripetal force and angular velocity.

Exp-2 To determine the relation between centripetal force and rotating mass.

Exp-3 To determine the relation between centripetal force and radius of the circular movement.

Salient Features :

- Easy setup.
- Sturdy base.
- High precision dynamometer
- Multipurpose digital timer with photogate
- Power supply with short circuit protection.



Key Topics:

- Centripetal force.
- Moment of inertia.
- Oscillation period
- Angular speed.
- Restoring force.
- Axis of rotation.
- Center of gravity.

Principle and Working:

In this experiment a car is gradually loaded with the additional weights. The centrifugal force apparatus with a constant angular velocity is rotated with each given mass. The force occurring is determined with the help of a spring balance. The car is connected below the pulley to a spring balance by a thread and a decoupling hook. The spring balance is pushed down to the maximum possible position. Now a constant angular velocity is set to the motor, which remains constant during the entire course of the experiment. The force experienced by the measuring car without any additional weight is read. The position r of the red pointer is marked by a piece of adhesive tape.

Content:

Cat No.	Item Name	Qty.
C13064	Base with motor	1
C13065	Centripetal apparatus	1
C8599	Digital timer with adapter	1
C8601	Photogate	1
SG110	Cylindrical base	1
C12041	Support rod	1
C0509	Boss head	1
Sg557	Slotted mass set	2
SE080	Power supply 2-12V	1
C10512A	Dynamo meter	1
R8797	Thread roll	1
C13066	Vehicle	1

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PROJECTILE MOTION EXPERIMENT SK088

Experiments:

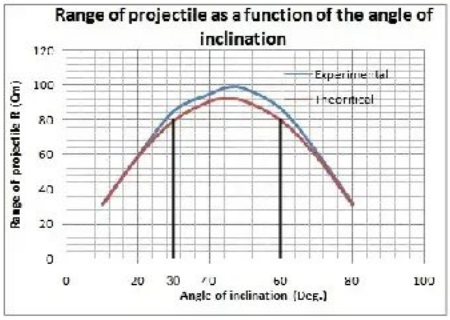
Exp-1 To determine the range of projectile as a function of the angle of inclination.

Exp-2 To determine the (maximum) range as a function of the initial velocity.

Salient features:

- It is easy to fixed on the table.
- Two fixed photogates to measure the speed.
- Fexible Launch Positions at the different spring load.
- Angle can be adjusted easily.
- Spring Mechanism.





Key Topics:

- Range of a ball.
- Projectile Range Versus Angle.
- Projectile Path.
- Conservation of energy.
- Initial Velocity of the Ball.
- Maximum range.
- Two angle for same range.

PROJECTILE LAUNCHER SH332

SPECIFICATIONS

Angle	: 90° - 0° - 90° through plumb line
Clamping	: Bench or Table via 'U' clamp
Clamping width	: upto 35mm
Tension	: Spring loaded
Projectile ball	: Plastic, 15mm dia. (approx.)

Supplied with 3nos. projectile balls.

DIGITAL TIMER & PHOTOGATE SJ162

SPECIFICATIONS

Display	: 2 line LCD
Type	: Micro controller based
Time resolution	: 0.1 milli second
Mode	: Time, Speed & Acceleration
Photogate	: 2 Nos.
Interface	: USB
Operating voltage	: 5V DC
Photogate detector	: Infra-Red

Microcontroller based and in-built test functions.

Supplied with a pair of photogate and photogate mounting rod.

The projectile motion is for experimentally determining trajectories when a projectile is launched either horizontally or at an angle. Angles between 0° and 90° may be selected. Varying the tension in the spring can also enable different launch velocities.

Contents :

Cat No.	Item Name	QTY.
SH332	Projectile Launcher	1
SJ162	Digital Timer with photogates	1
C13043	Photogate clamps	2
CA1001	Bench clamp	1

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LAW OF MOTION KIT ADVANCE SW471

Experiments:

Exp-1 To find the velocity of an object.
Exp-2 To determine the average speed of an object.
Exp-3 To determine the acceleration of a moving object.
Exp-4 To demonstrate the elastic collision.
Exp-5 To demonstrate the law of conservation of energy.
Exp-6 To demonstrate the transfer of energy.
Exp-7 To plot a graph between velocity and time using picket fence.

Special features:

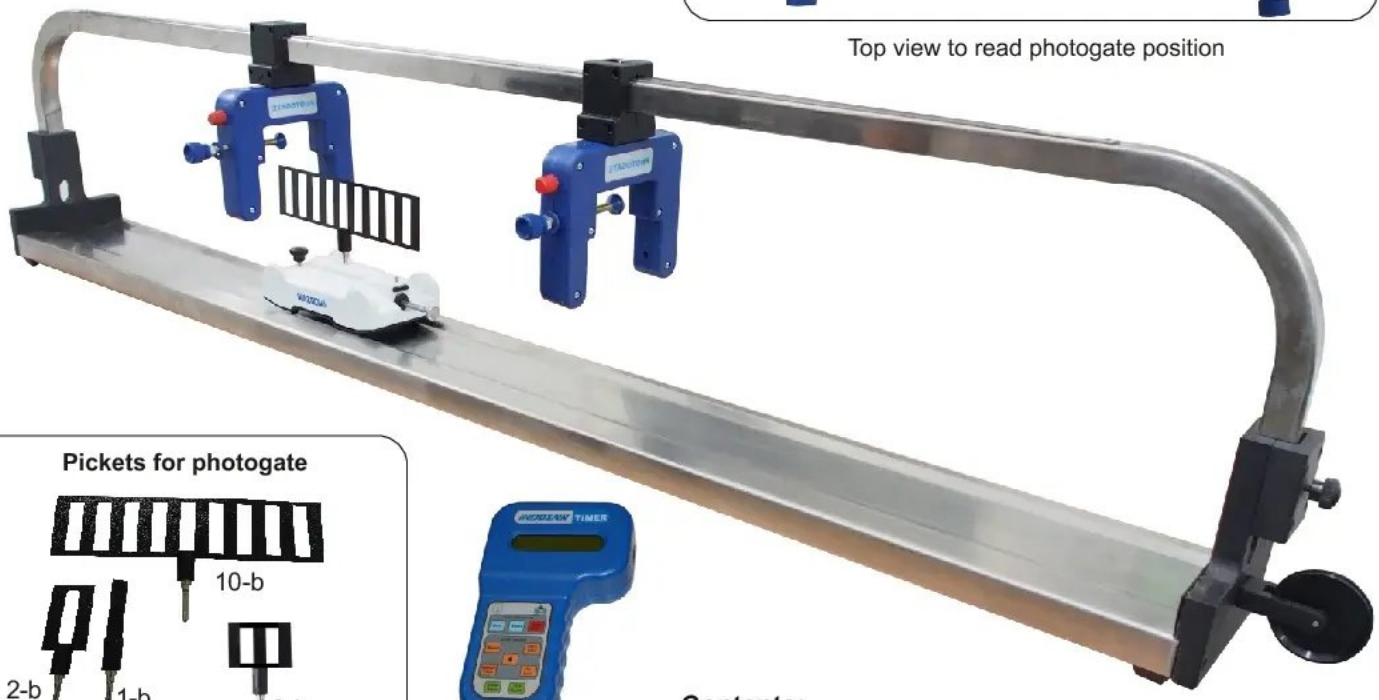
- No noise as in Air Track experiment.
- **Facilitating the study of mechanics both qualitatively & quantitatively.**
- **Low friction wheels of trolley.**
- Superior quality SS track.
- 4 mm socket on trolley for attaching various accessories & weight.
- **Multipurpose hand-held digital timer with data storage facility.**
- **Photogate with sensitivity-adjustment knob.**
- Precise and accurate data.

Key Topics:

- Linear motion.
- Newton law of motion.
- Elastic collision.
- Inelastic collision.
- Conservation of momentum.
- Conservation of energy.
- Mass ratio.



Top view to read photogate position



Pickets for photogate

Contents:

Cat No.	Item Name	Qty.
SH299	Track for dynamic trolley	1
SP075	Dynamic trolley	2
SJ162	Digital timer with photogates	1
SN360	Accessories for dynamic trolley	1
SH504	Slotted Masses	1
C13044	Photogate rider	1
C13045	Photogate mount	2
C13046	Side clamp (left)	1
C13047	Side clamp (right)	1

Law of motion kit has been designed to study the linear motion of the object, elastic collision, Newton's law of motion and recording the path time diagram of linear motion using photo- gates.

In the present setup, the runway used for all experiments is made of superior quality stainless steel having smooth surface with linear grooves for smooth motion of trolley and it has stainless steel stoppers with rubber sheet at ends. A plastic pulley is fixed at one end to hang a weight.

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COMPREHENSIVE STUDY OF LAWS OF MOTION USING SCI CARS KIT SJ155

Experiments:

Exp-1 Study of linear motion under low friction and plot of distance, velocity, momentum, energy (kinetic, potential and total energy) and acceleration as a function of time.
Exp-2 Study of linear motion in an inclined plane.
Exp-3 Study of damped harmonic oscillation in potential well.
Exp-4 Study of dependence of kinetic energy on mass and velocity.
Exp-5 Study of elastic collision: conservation of momentum and energy.
Exp-6 Study of inelastic collision: conservation of momentum.
Exp-7 Study of explosion : conservation of momentum.
Exp-8 Study of damped harmonic oscillation in horizontal track and determination of spring constant.
Exp-9 Study of crash test and comparison of different attenuators.
Exp-10 Demonstration of air balloon propelling vehicle.
Exp-11 Demonstration of air drag on the motion of vehicle.

Salient Features:

- Novel tool for Comprehensive study of motion experiments with precise time displacement resolution.
- Unrestricted movement of car and data recording on any track - horizontal, up-down, curved tracks which is not possible with any other tool in the Industry.
- A Very Good Alternative to Noisy Air Track
- Very Little Friction
- No Need of Conventional Photogate
- Wireless : Live Data Collection via Bluetooth
- Experiment in Curved Track.
- Recording of time-distance data covering more than 5 meters of car movement.
- Free Software: To analyze time motion data.
- Easy to mount and comprehensive set of accessories.
- Supplied with Detailed Instruction Manual







WHAT WE WILL LEARN:

- Motion In One Dimension : Straight and Curved Tracks.
- Distance, Velocity & Acceleration.
- Newton's Laws of Motion.
- Linear Momentum, Kinetic and Potential Energy.
- Force and Friction.
- Damped harmonic oscillation.
- Conservation of Momentum.
- Conservation of Energy.
- Conversion of Potential Energy to Kinetic Energy and Vice Versa.
- Elastic and Inelastic Collision.
- Concept of Horizontal and Inclined Motion.
- Concept of Potential Well Track.
- Spring constant.

Contents:

Cat No.	Item Name	Qty.
C12594	SCI CAR (Master)	1
C12595	SCI CAR (Salve)	1
C13002	Linear track (SS)	1
C13001	Curved track (SS)	1
C13013	Set of accessories	1
C13071	SCI CAR Software	1

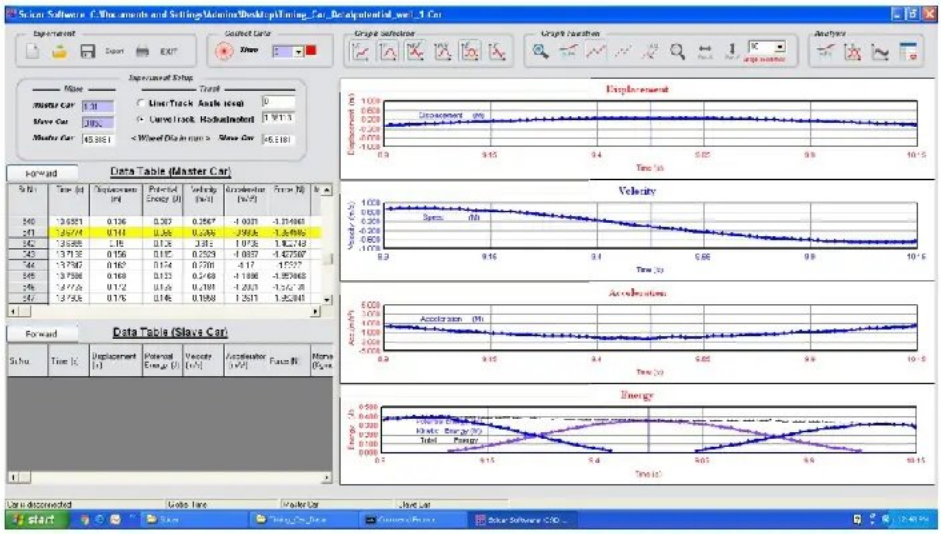
Additionally Required
Computer is not supplied with the setup.

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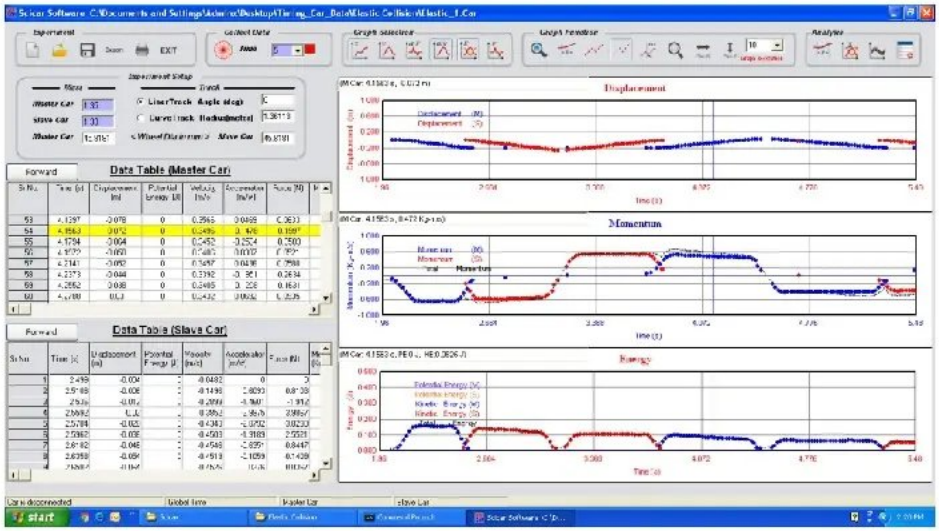
CAR ACCESSORIES



CAR ACCESSORIES



MOTION IN POTENTIAL WELL



ELASTIC COLLISION

DESIGN & TECHNOLOGY ASPECTS

- Motion Data Collection : Unrestricted on any linear or curved track as the design does not require any external electronics to be mounted on tracks.
- Two Cars : Master – Slave configuration to study collisions. Master can be used for single car experiments on curved or linear track.
- Motion Encoding : Dual Channel Encoder with 2 mm resolution at car wheels on master and slave cars.
- Communication between Master Slave : "Infrared Transmission" by slave and reception by Master with signal conditioning circuitry. Master Slave each have dedicated controller for communication.
- Communication between Master to PC : Wireless Bluetooth. Master transmits motion data of both cars along with time stamp by main controller.
- Time Resolution : 100 microsecond
- Accessories : Magnetic Bumper attachments for collisions, crash test and explosion.
- Clamping arrangement for using various accessories like elastic ribbon, balloon propulsion and drag sheet.
- Dedicated software for analyzing motion.

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LINEAR AIR TRACK WITH DIGITAL TIMER SK099

Experiments:

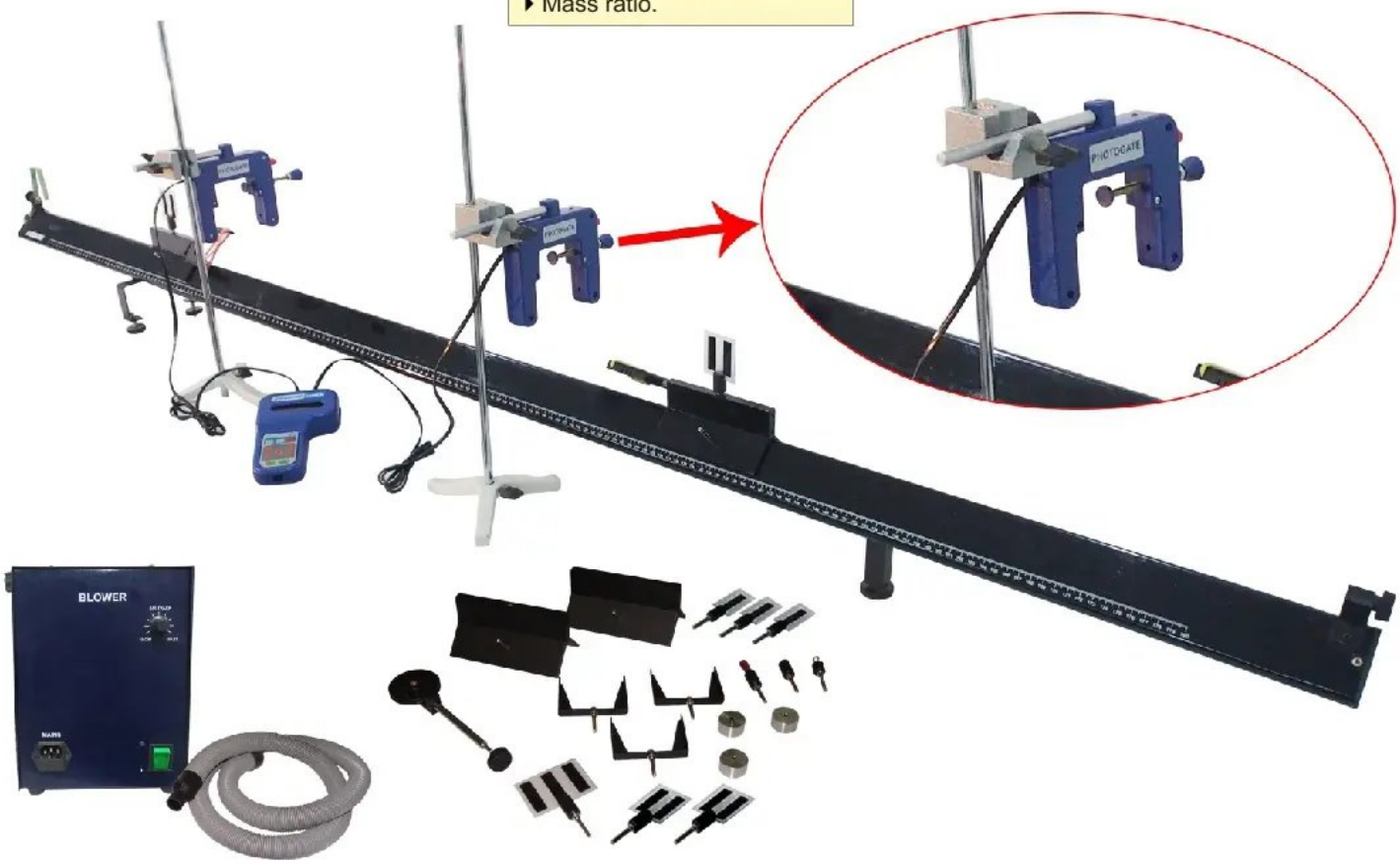
Exp-1 To study the linear motion under virtually frictionless conditions.
Exp-2 To study the elastic and inelastic collision.
Exp-3 To study the concept of velocity.
Exp-4 To study the concept of accelerations.
Exp-5 To study the conservation of momentum & energy.
Exp-6 To study the dependency of mass ratio to kinetic energy.

Special Features:

- Accessories simply plug into the ends & top of vehicle.
- **Facilitates the study of mechanics.**
- Linear motion under frictionless condition.
- Multipurpose hand-held digital timer with data storage facility.
- Photogate with sensitivity-adjustment knob.
- Precise and accurate data.
- Many other experiments can also be performed with the same timer.

Key Topics:

- Linear motion.
- Newton law of motion.
- Elastic collision.
- Inelastic collision.
- Conservation of momentum.
- Conservation of energy.
- Mass ratio.



Triangular section track made of aluminium with perforations. An inlet cover is given at one of the ends, which is connected to hose of an air blower. The gliders move on an air cushion thus minimizing friction.
Apparatus is used for performing experiments to investigate laws of motion, speed, acceleration, and momentum. Digital Timer with two photogates along with various accessories are used for conducting all experiments.

Contents:

Cat No.	Item Name	Qty.
C9305	Linear air track	1
CH238	Air Blower with pipe	1
SP059	Linear Air track accessories	1
SJ162	Digital timer with photogates	1
SW092	Boss head	2
C12041	Support Base	2
C0509	Support Rod	2

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LINEAR AIR TRACK WITH DATA LOGGING SK076

Experiments:

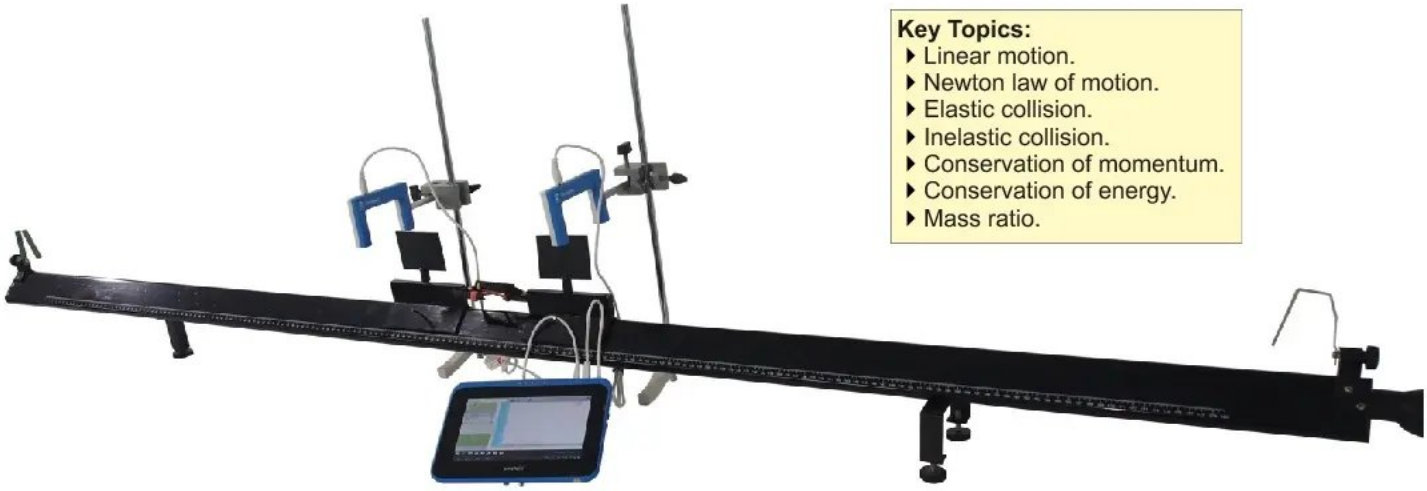
Exp-1 To study the linear motion under virtually frictionless conditions.
Exp-2 To study the elastic and inelastic collision.
Exp-3 To study the concept of velocity.
Exp-4 To study the concept of accelerations.
Exp-5 To study the conservation of momentum & energy.
Exp-6 To study the dependency of mass ratio to kinetic energy.

Special Features:

- Accessories simply plug into the ends of vehicle.
- **The magnet on buffers are identically polarised so they will repel producing elastic collisions between two vehicles.**
- Interrupter cards. These are for interrupting light gates for timing applications.
- **Facilitates the study of mechanics.**
- Linear motion under frictionless condition.
- Precise and accurate data.
- Computer connectivity.

Key Topics:

- Linear motion.
- Newton law of motion.
- Elastic collision.
- Inelastic collision.
- Conservation of momentum.
- Conservation of energy.
- Mass ratio.







It is used for study of frictionless motion, elastic and inelastic collisions, velocity, acceleration, conservation of momentum etc.
In the present setup, a triangular section aluminium alloy track, length 200cm, with two row's of air holes through which air emerge forming air cushion on which the vehicles float. The vehicles show linear motion under virtually frictionless condition. Supported on three adjustable feet. At one end of track an air inlet tube connection is given. Supplied with accessories.

Additionally Required
Computer is not supplied with this setup.

Contents:

Cat No.	Item Name	Qty.
SH501	Air Track with accessories	1
CH238	Air Blower	1
IMC174	Photogate sensors	2
IMC170	Data Logger	1
C13049	Software CD	1
SW092	Bosshead	2
C12041	Support Base	2
C0509	Support rod	2
IMC188	Sensor cable (mini USB)	2

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COUPLED PENDULUM OSCILLATIONS SK067

Experiments:

Exp-1 Study the characteristic frequencies of the uncoupled pendulum.

Exp-2 To determine the coupling factors for various coupling lengths, the angular frequencies or "in-phase" and "in opposite phase" vibration, and the angular frequencies of the beat mode.

Exp-3 To study the linear relation between the square of the coupling lengths, beat mode, and the square of the frequency for "in-opposite phase" vibration.

Exp-4 To determine the spring constant of the coupling spring.

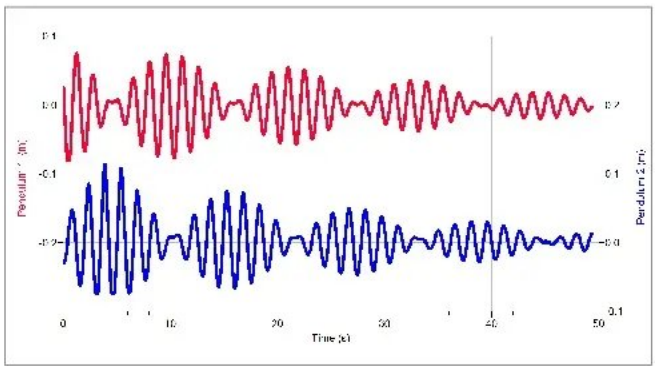
Salient features:

- Data logging interface.
- Easy setup.
- Multipurpose motion detector
- Graphical analysis.

Key Topics:

- Coupled pendulum.
- Uncoupled pendulum.
- Phase difference.
- Beat.
- Coupling factor.
- Coupling length.
- Spring constant.
- Physical pendulum.
- Variable mass pendulum.
- Variable length pendulum.





Two equal length pendulums with same mass have a particular characteristic frequency are coupled by a spiral spring. The amplitudes of both pendulums are recorded as a function of time for various vibrational modes and different coupling factors using a motion detector.

The setup can be used to study “in-phase”, “in-opposite phase”, and “beat” mode.

Additionally Required

Computer (not supplied with this setup)

Contents:

Cat No.	Item Name	Qty.
CD478	Couple pendulum rod	2
CD479	Couple pendulum weight	2
SH319	Support base	2
SH325	Support rod	2
CD480	Support beam	1
C13058	Mounting beam	2
CA384	Spring	2
IMC177	Rotary motion sensor	2
IMC170	Data logger	1
C13049	Software CD	1
IMC188	Sensor cable (mini USB)	1

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SURFACE TENSION SK047

Experiments:

Exp-1 To determine the surface tension of water by ring-pull out method.

Salient features:

- Modular approach.
- Precision dynamometer.
- Aluminum ring.



Key Topics:

- Surface tension.
- Ring pull out method.
- force sensor
- data-logging
- Tensile force.
- Limiting force.

Principle and Working:

Surface tension for water is determined using ring-pull out method. The experiment utilizes a force sensor on which a metal ring is suspended, which can be lowered or pulled out of water.

In the present setup, a metal ring is completely immersed in the liquid, so that the entire surface is wetted. The ring is than slowly pulled out of the liquid, drawing a thin sheet of liquid behind it. The liquid sheet tears when the tensile force exceeds a limit value,

$$F=\sigma\ 4\pi R,$$

where R denotes edge radius and σ surface tension of liquid.

A force sensor is used with computer interface to determine the tensile force in SK047 kit.

Contents :

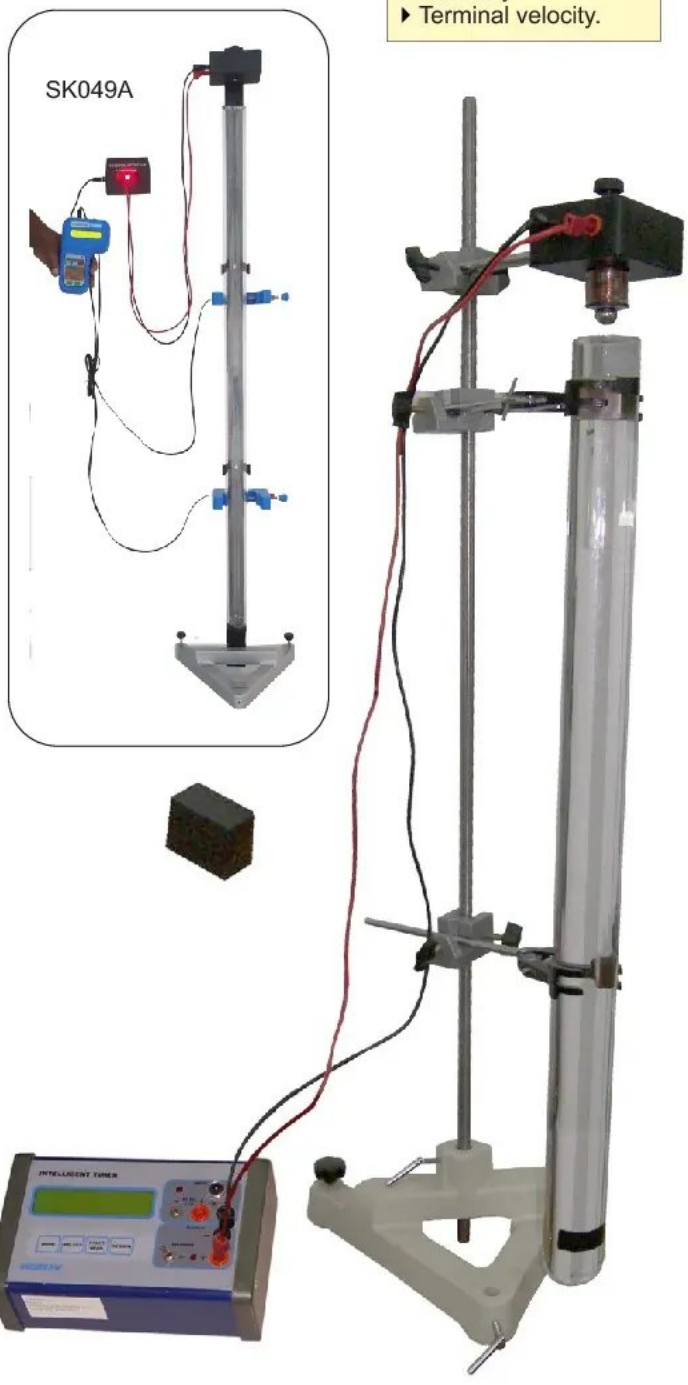
Cat No.	Item Name	SK047
SW979	Laboratory jack	1
SH310	Retort stand base	1
SH323	Stand rod, 75cm	1
C1265	Bosshead with hook	1
C7486	Ring	1
SC218	Beaker (500ml)	1
R5023	Vernier caliper	1
IMC20	Precision dynamometer	1
SC402	Perti dish	1
R4514	Cotton thread	1

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VISCOSITY OF GLYCERINE SK049/SK193

Experiment:
Exp- To determine the viscosity of glycerine.

Key Topics:
- Stoke's law.
- Free fall.
- Electromagnet.
- Viscosity
- Terminal velocity.



Salient features:
- Solenoid for holding the ball.
- Transparent long glass tube.
- Strong heavy base.
- Digital timer.

Principle and Working:
A body moving in a fluid is acted upon by a frictional force in the opposite direction to its direction of travel. The magnitude of this force depends on the geometry of the body, velocity of the body, and the internal friction of the fluid. A measure for the internal friction is given by the dynamic viscosity η. For a sphere of radius r moving at velocity v in an infinitely extended fluid of dynamic viscosity η, the frictional force according to Stokes' law is given as:

$$F_1 = 6.\pi.\eta.r.v$$

For a sphere moving along the axis of a cylinder of fluid of radius R, the frictional force is:

$$F_1 = 6\pi\eta vr\left(1+2.4.\frac{r}{R}\right)$$

$$\eta = \frac{2}{9}\cdot r^2 \cdot \frac{(\rho_2-\rho_1)\cdot g\cdot t}{s}\cdot\frac{1}{\left(1+2.4.\frac{r}{R}\right)}$$

Where, ρ_1 is the density of the fluid
ρ_2 is the density of the sphere
g is the acceleration due to gravity

In the present setup, the viscosity of glycerine is found by allowing a steel ball to fall through a column of glycerine and measuring the time taken by the ball to cover a known distance. The steel ball is released using an electromagnet and simultaneously time is measured with a digital timer.

Contents :

Cat No.	Item Name	SK193	SK049
CH149	Intelligent timer with adapter		1
C7932	Glass tube	1	1
R4522	Ferrite magnet	3	3
SV190	Three Finger Clamp		2
SG100	'A' base		1
C7050	Electromagnet	1	1
C9807	Stand rod		1
SB252	Glycerine	5	5
SW092	Boss-head		3
SN202	Flexible plug lead, 2m black	1	1
SN205	Flexible plug lead, 2m red	1	1
R3538	Steel ball 5.5mm dia.		1
R6061	Steel ball 11mm dia.		1
R2719	Steel ball 16mm dia.		1
C13059	Free fall setup with 'C' clamp	1	
SJ162	Digital timer with photogate	1	
SJ164	Solenoid driver	1	1

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FORCED OSCILLATORS & RESONANCE SP761

Experiments:
Exp-1 To investigate resonance in forced oscillations.
Exp-2 To find spring constant of a spring.

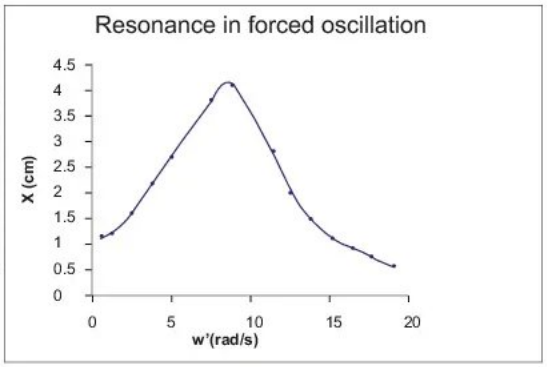
Salient features:
- **System can be driven at various frequencies.**
- Bright LED display of frequency.
- **Easy to measure Amplitude .**
- Mass on the spring oscillates free or when damped in water.

Key Topics:
- Free vibration.
- Forced vibration.
- Resonant vibration.
- Damped vibration.
- Spring constant.
- Force constant.
- Energy dissipation.



Sample results showing resonance in forced oscillations for spring with k=19.0Nm^{-1}, M_c=150gm. M_s= 5.5 gm, M_{sc}=18.2 gm.

ω=2πf	X
1.26	1.2
2.51	1.6
3.77	2.2
5.02	2.7
7.54	3.8
8.80	4.1
11.30	2.8
12.56	2.0
13.82	1.5
15.07	1.1
16.33	1.0
17.59	0.7
18.84	0.6





Frequency generator

The apparatus consists of a mass attached to a spring, which is connected to a cord passing over a pulley and further connected to a drive wheel. The frequency of the drive wheel is displayed in "Hertz" on control unit display. Mass on the spring can be made to oscillate free or when damped in a tube of water. The system can be driven at various frequencies and the amplitude can be measured with a scale.

Contents :

Cat No.	Item Name	Qty.
C5144	Base unit with frequency generator	1
CA478	Spring	1
C5155	Weight (50g)	4
C5170	Scale (10cm-0-10cm)	1
R10075	Power adapter	1
R2247	Thread roll	1
C5165	Acrylic cylinder	1

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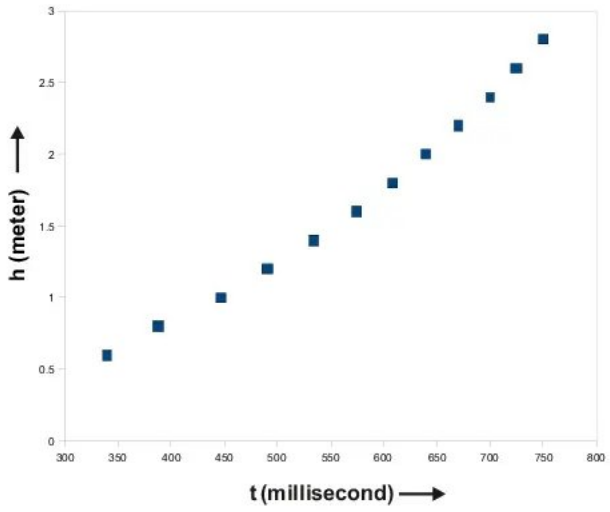
TIMING BALL SV684

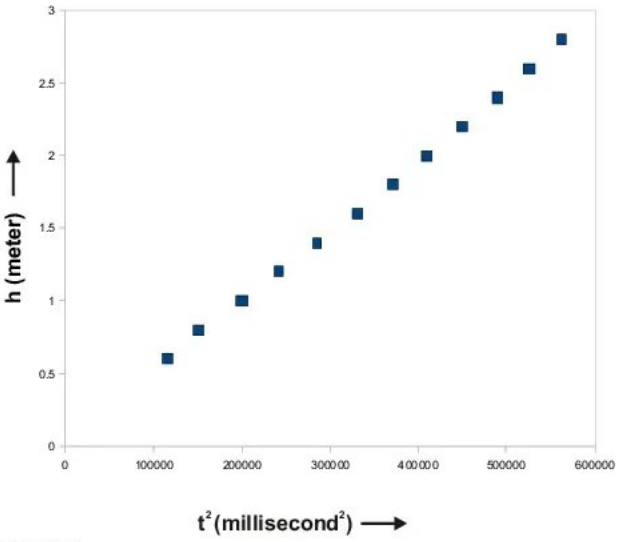
Experiments:
Exp-1 Measurement of **g**, acceleration due to gravity.
Exp-2 Measuring height of a person or building.
Exp-3 Effect of gravity during projectile Motion.
Exp-4 Experiments involving stopwatch.
Exp-5 Plotting height vs. time graph under free fall.
Exp-6 Experimental error analysis and statistical measurement.

Salient Features:
- No setup time.
- Very accurate and economical ball.
- Very easy to use to measure value of 'g'.
- In-built two axis impact detection mechanism.
- Start/Stop/Mode switch (act as start, stop function in stopwatch & to display time and height under free fall after impact).
- Auto shutdown after 30sec.
- Auto ranging display.
- Fun experiments.



Key Topics:
- Free fall.
- Acceleration due to gravity.
- Height determination.
- Straight line graph between h and t^2.





The Timing ball is a unique device that records time of flight from moment of release of ball to the moment of impact (on ground or object). It can be used to conduct a number of experiments involving acceleration due to gravity (g).
From the time measurement and known height of drop the value of 'g' acceleration due to gravity can be experimentally calculated. Further its velocity and kinetic energy can also be calculated using the known mass of the ball. The height of a person or building is calculated from the time value assuming the ideal value of 'g' which can also be directly displayed using the mode switch. Additionally the ball can be used as an auto-ranging stopwatch.

Contents:

Cat No.	Item Name	Qty.
SV684	Timing ball cell	1
RN003	Battery cell (AAA)	3

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COMPUTERIZED CAVENDISH BALANCE SN1036

Experiments:

Exp-1 Determining of G, the fundamental universal gravitational Constant.

Exp-2 Determining the time of oscillation of a freely swinging torsion pendulum.

Exp-3 Determining the damping constant of oscillation of a freely swinging torsion pendulum.



Principle and Working:

In this set-up, the angular acceleration of a beam containing two small lead balls is measured by an interface system that contains an integrated capacitive sensor. This angular deflection results from the gravitational attraction of two large lead balls held on a swivel arm onto the small lead balls on the beam. The beam containing the two small lead balls is held suspended by a thin tungsten thread. So when the larger balls are brought near to the smaller balls, the tungsten thread oscillates about its equilibrium position due to the restoring moment of rotation generated in the thread. The measurements can be monitored on a computer.

Contents :

S. No.	Item Name	Qty.
1	Cavendish Balance Apparatus	1
2	Interface Cable (USB)	1
3	Software	1

Additionally Required
Computer (not supplied with this setup)

GRAVITATIONAL BALANCE SN1035

Experiments:

Exp-1 Determining of G, the fundamental universal gravitational Constant.

Exp-2 Verifying the inverse-square law.



Principle and Working:

This instrument allows measuring G with a high precision (with a maximum error of 15%). In the initial displacement method, G is derived from the angular acceleration of the balance due to movement of the attracting masses from one side to the other. The equilibrium displacement method derives G from the change in the equilibrium position of the balance at rest due to the change in position of the large masses. The built-in oil damping system reduces the time needed for equilibrium.

Contents :

S. No.	Item Name	Qty.
1	Gravitational Balance Apparatus	1

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COMPACT WAVE TANK SA705

Experiments:

Exp-1 Wave phenomena of reflection, diffraction, refraction and interference.
Exp-2 Coherent addition of waves.
Exp-3 Reflection at circular obstacles.
Exp-4 Constructive and destructive interference.

Special features:

- Microcontroller based digital control for integrated wave generator and strobe.
- To study almost all the wave properties: reflection, refraction, interference and diffraction.
- Setting up and disassembling the ripple tank is not required. Accessories included in the body of wave tank.
- Synchronous and independent mode.
- Easy observation of propagation of waves.
- Vibration and strobe frequency from 50Hz to 250Hz in steps of 1Hz.

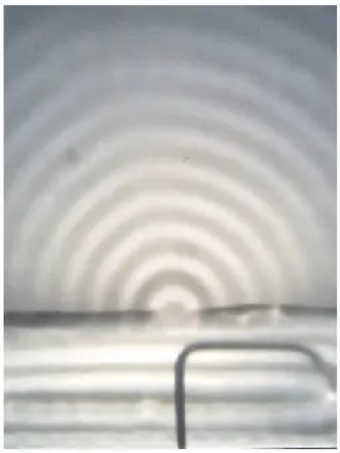


Key Topics:

- Reflection.
- Diffraction.
- Refraction.
- Interference.
- Speed of waves.
- Phase difference.
- Path difference.
- Gravity waves.



Refraction



Diffraction

There are two settings "synchronous" and "independent" mode for the light strobe. Perfectly stationary images are observed in "synchronous" mode in which the wave frequency is synchronised to strobe frequency. Independent control of the light frequency for slowly moving images are observed in "independent" mode.
The system has digital display of vibration as well as strobe frequency. The keypad is used to change the respective frequencies. Set of accessories is provided to comprehensively study wave phenomenon in water in a easy to use apparatus.

Contents:

Cat No.	Item Name	Qty.
C11688	Ripple tank base unit	1
CD1093	Tank	1
R10075	Power adaptor	1
R10025	Single point dipper	1
R10028	Double point dipper	1
R10030	Plane wave bar dipper	1
CD691	Curved reflector	1
C11722	Diffraction barrier big	2
C11718	Rectangular block shape	1
C11719	Convex lens shape	1
C11720	Concave lens shape	1
C11717	Triangular shape	1
C11721	Trapezoidal shape	1
SB289	Plastic dropper	1
R10163	Dust cover	1
C12581	Barrier "L" shaped with slot (big)	1
C12582	Barrier "L" shaped brass	1
C11724	Interference barrier "L" shaped	1
C11723	Interference barrier "L" shaped(small)	1

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DAMPING OSCILLATION IN VARIOUS MEDIUM SK066

Experiment:

Exp-1 To investigate the damping effect of air, water, oil or glycerin on an oscillating spring.

Exp-2 To investigate damping effect by changing spring constant (by connecting spring in series and parallel)

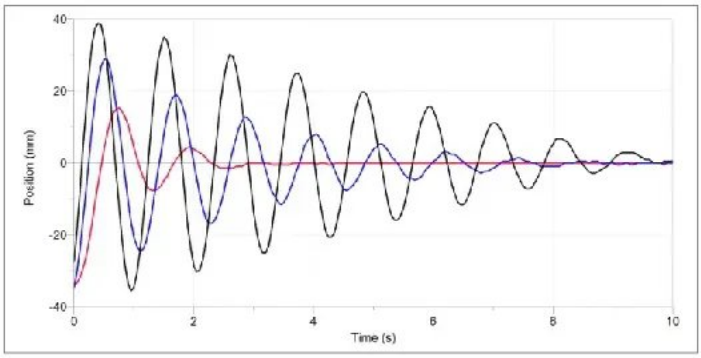
Salient features:

- Rotary motion sensor for angle and displacement measurements.
- Real time Data-logging interface.
- Mass on the spring oscillates free or damped in various liquids.
- Easy to measure amplitude.



Key Topics:

- Damping oscillation.
- Corresponding ratios.
- Heavily or under damped oscillations.
- Spring Constant.
- Energy dissipation.
- Relation between spring constant in series and parller.



Damping Oscillation in Air, Water and Glycerin

Principle and Working:

For a damped oscillation, energy is lost to overcome the resisting forces i.e. damping forces, such as air resistance, viscosity and friction. In different media, the strength of resisting forces varies, so does the extent of damping.

In the present setup, damping oscillation amplitude with time is recorded for various medium like air, water & other fluids by using rotary motion sensor connected with data logger.

Note : Computer is not supplied with the setup.

Contents:

Cat No.	Item Name	Qty.
CA384	Spring	2
SH319	Support Base	2
SH325	Support Rod	2
CD480	Support Beam	1
C13060	Mounting Rod	2
SG557	Slotted Mass Set	1
IMC177	Rotary Position Sensor	1
IMC170	Data logger	1
SC218	Beaker	1
SW092	Bosshead	1
C13048	Hanging strip	1
R8797	Thread roll	1
IMC188	Sensor cable (mini USB)	1
C13049	Software CD	1

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VELOCITY OF SOUND APPARATUS SV243

Experiments:
Exp-1 To determine velocity of sound in air or quantitative experiments on resonating columns.

Salient Features :
- Easy setup.
- Water reservoir can move up or down.
- Place for keeping tuning fork over tube facilitates easy resonance.



Key Topics:
- Nodes antinodes.
- Tunning fork.
- End correction.
- First resonance length.
- Second resonance length.
- Resonance.
- Velocity of sound with and without end correction.
- Stationary waves.
- Progressive waves.
- Wave length.



Tuning fork set

Used for determining velocity of sound in air or quantitative experiments on resonating columns. It contains a 120cm long plastic tube, graduated in cm. A water reservoir which can be easily moved up or down, connects the tube which is mounted on a support stand. A clamp for mounting tuning fork over the resonance tube is given.
In the present setup, the length of the air column in the tube is adjusted by raising or lowering the water level until the column of air resonates at the same frequency as the vibrating tuning fork.
By locating several such resonance positions and determining the distances between them, students can compute the wavelength of sound in air and its velocity.

Contents :

Cat No.	Item Name	Qty.
SP790	Tuning fork set	1
CD626	Stand base	1
CD627	Stand rod	1
CD629	Clamp assy. (Big)	2
CD640	Al vessel	1
CD641	Acrylic tube	1
CD633	Rubber pipe	1
CD630	Clamp assy. (small)	1

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THERMAL AND ELECTRICAL CONDUCTIVITY OF METALS SK068/SK197

Experiments:

Exp-1 To determine the heat capacity of the calorimeter.
Exp-2 To study the thermal conductivity of copper and aluminum at a constant temperature gradient.
Exp-3 To determine the electrical conductivity of aluminum and copper by plotting a current-voltage characteristic curve.
Exp-4 To verify the Wiedmann-Franz law and find out the Lorenz number.

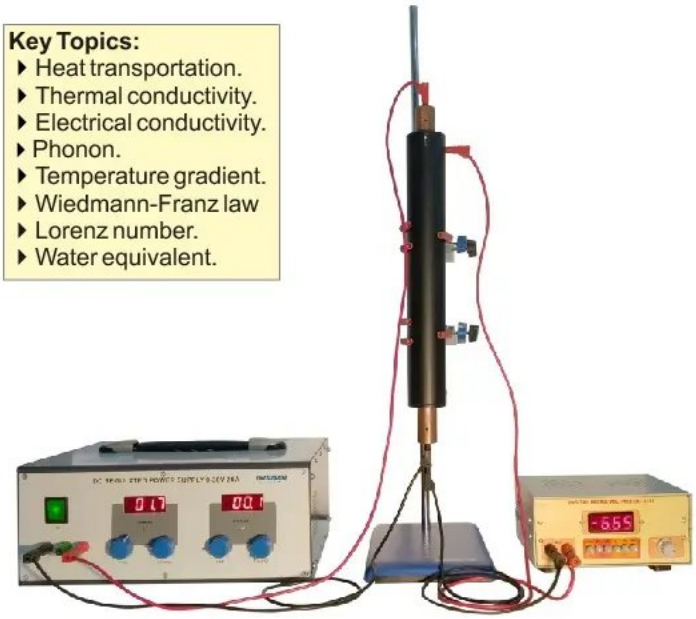
Salient features:

- Safety tested high current power supply.
- Multipurpose data logger.
- Sample rod (Copper & Aluminum).
- Digital Micro-voltmeter.
- Insulated Al/Cu rod for experiment.



Key Topics:

- Heat transportation.
- Thermal conductivity.
- Electrical conductivity.
- Phonon.
- Temperature gradient.
- Wiedmann-Franz law
- Lorenz number.
- Water equivalent.



Principle and Working:

The heat conduction occurs due to the temperature difference between different locations of a body. In this setup a one-dimensional temperature gradient along a copper and aluminum rod is investigated. The quantity of heat dQ transported with time dt is a function of the cross-sectional area A and the temperature gradient dT/dx perpendicular to the surface.

So $dQ/dt = -\lambda A (dT/dx)$

λ is the thermal conductivity of the substance.

The electrical conductivity of a metal (Copper & Aluminum) is determined by the resistance R of the rod and its geometric dimensions ($l=0.315$ m, $A=4.91 \times 10^{-4}$ m^2)

$\sigma = R.A/l$

At room temperature T the conduction electrons in metal have a much greater mean free path than the phonons. For this reason heat conduction in metal is primarily due to the electrons. The relationship between the thermal conductivity λ and the electrical conductivity σ is established by the Wiedmann-Franz law:

$\lambda/\sigma = L T$

Where L is Lorenz number.

***Additionally Required**
Computer (not supplied with this setup)

Contents :

Cat. No.	Item Name	SK197	SK068
C10652	Conductivity rod Cu	1	1
C10653	Conductivity rod Al	1	1
CP929	Lower Calorimeter Vessel	1	1
CD553	Calorimeter Vessel with heater	1	1
SW979	Laboratory jack	1	1
R8213	Digital weighing balance	1	1
R8212	Digital thermometer		3
IMC208	Temperature sensor	3	
IMC170	Data Logger	1	
C9378	Three finger clamp	2	2
CD066	Support base	1	1
CH833	Support rod	1	1
SW092	Bosshead	2	2
SE1003	Power supply 0-30V, 20amp	1	1
SR010	Micro voltmeter	1	1
LP18	Connecting lead(Red & Black)	2	2
SC218	Glass beaker 500 ml	1	1
R20019	Heat conductive paste	2	2
R10145	Laboratory gloves	1	1
SB1255	Syringe	1	1
SP816	Stop watch		1
SF536	Plastic beaker 2000ml	1	1
C13049	Software	1	
R5023	Vernier calliper	1	1

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SPECIFIC HEAT OF SOLIDS SK051

Experiments:
Exp-1 To determine the specific heat capacity of solids (Copper, lead glass).

Salient features:
- High quality Dewar flask.
- Digital thermometer & weighing scale.
- Three Samples (copper, lead & glass)
- Multipurpose A base can be used in other experiments also.

Key Topics:
- Heat.
- Specific heat capacity.
- Conservation of energy.
- Calorification.
- Water equivalent.



Principle and Working :

The specific heat capacity of copper, glass and lead are determined by heating the material in a steam chamber and then transferring the heated material into a weighed amount of water in a dewar vessel and measuring the temperature.

In the present setup, the system consists of mixing a given mass m_1 of a hot metal specimen specific heat c_1 at temperature T_1 with a known mass m_2 of water of specific heat c_2 at a lower temperature T_2 contained in a calorimeter of mass m_3 of specific heat c_3 initially at temperature T_2. Once again we assume the system to be thermally insulated from the surroundings, and the heat capacity of the thermometer, which records the temperature, can be neglected. Let the final temperature of the mixture be T_f. Energy conservation gives:

$$Q_{lost}(\text{Metal}) = Q_{gained}(\text{Water}) + Q_{gained}(\text{Calorimeter})$$

$$m_1c_1(T_1 - T_f) = m_2c_2(T_f - T_2) + m_3c_3(T_f - T_2) \quad \text{which,}$$

yields the unknown specific heat c_1 of the metal specimen as

$$c_1 = (m_2c_2 + m_3c_3)(T_f - T_2)/m_1(T_1 - T_f)$$

Contents :

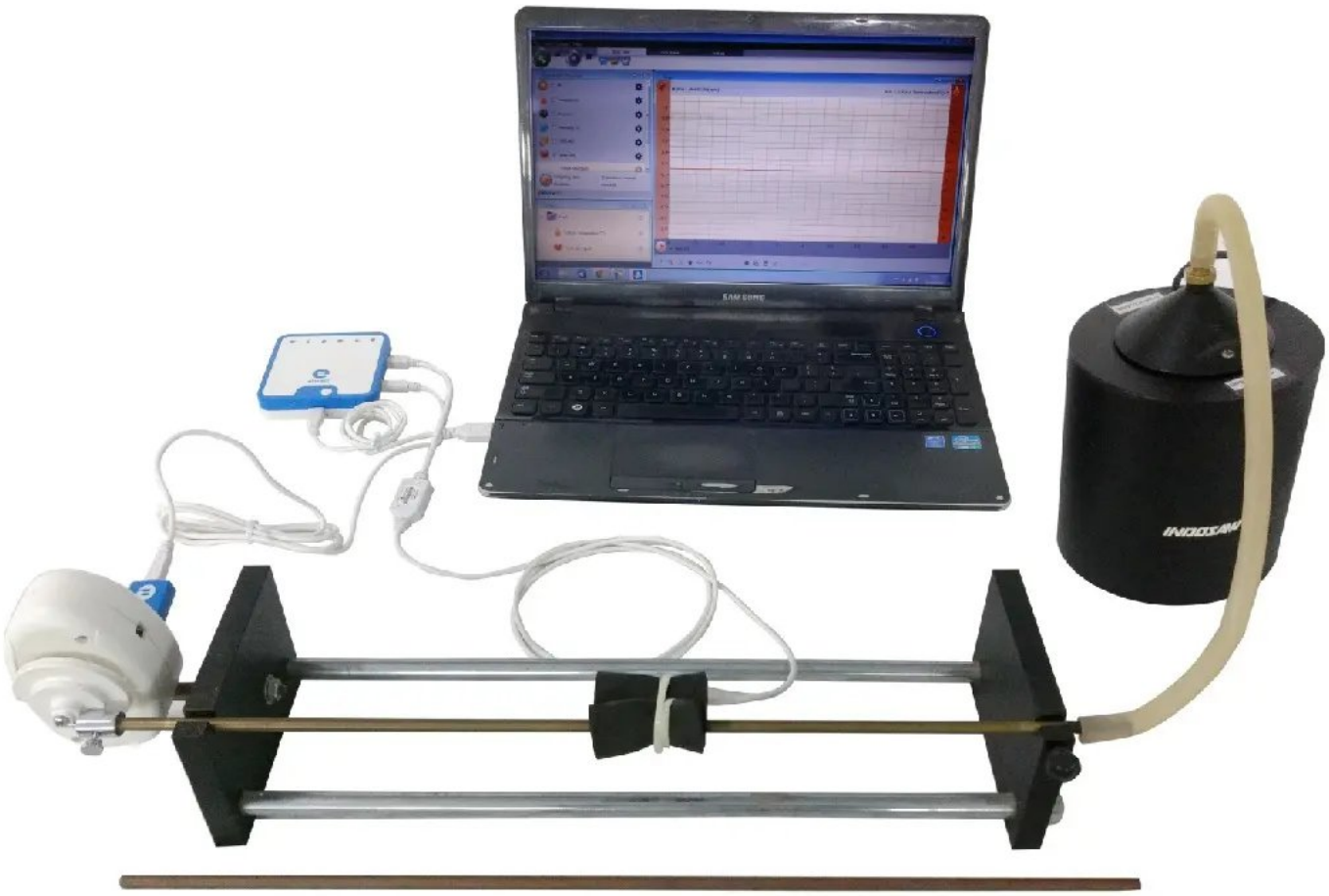
Cat No.	Item Name	Qty
C9818	''A' shaped base	1
SV190	Three finger clamp	1
C13061	Dewar Flask	1
SW092	Bosshead	1
C9812	Rod (0-50cm)	1
C9822	Steam Chamber	1
SC227	Beaker	1
C9823	Copper sample	1
R8211	Lead sample	1
R8222	Glass sample	1
R8216	Rubber cork	1
R8212	Digital Thermometer	1
R8213	Digital weighing scale	1
R8214	Silicone Tubing,1.5m	1
C12091	Steam generator	1

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THERMAL EXPANSION SK101

Experiments:
Exp-1 To find coefficient of thermal expansion of copper, aluminum and brass using their pipes.



Principle and Working:
The Data Logger based Thermal Expansion Apparatus provides easy and accurate measurements for the coefficient of linear expansion for brass, copper, and aluminum. With this thermal expansion model, students no longer have to convert resistance readings to temperature values using a conversion table. Data Logger provides immediate temperature feedback in either degrees Celsius (C) or Fahrenheit (F). A software setup CD comes with the apparatus, which includes the predefined variables and equations for measuring temperature in degrees Celsius. For the length measurement, the brass, copper, or aluminum tube is placed on the expansion base. The length of the tube is measured at room temperature, then steam is passed through it. The expansion of the length of the metal rod is measured with 0.06 degree resolution using the Rotary Motion Sensor. Temperatures are measured to within +0.1 °C using a surface temperature sensor attached to the centre of the tube. To investigate the expansion of the metals at additional temperatures, hot or cold water can be passed through the metal tubes.

Contents :

Cat. No.	Item Name	Qty
CD1058	Base unit	1
CD1065	Copper pipe	1
CD1063	Brass pipe	1
CD1064	Aluminium pipe	1
CD1061	6:1 ratio pinion	1
IMC177	Rotary motion sensor	1
CD1067	Foam wrap	1
IMC179	Surface temperature sensor	1
IMC170	Data Logger	1
IMC188	Sensor cable (mini USB)	2
C13049	Software CD	1
R10212	Silicone Tubing, 1m	1
C12091	Steam Generator	1

Additionally Required
Computer (not supplied with this setup)

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STUDY OF RESISTANCE, DIODE AND TRANSISTOR WITH DEEP S0589

Experiments:

Exp-1	To study ohm's law.
Exp-2	V-I characteristics of Incandescent Lamp.
Exp-3	Study of Rectifier Diode & its applications.
Exp-4	V-I characteristics of a Light Emitting Diode.
Exp-5	Study of Zener Diode & its applications.
Exp-6	Study of NPN transistor characteristics

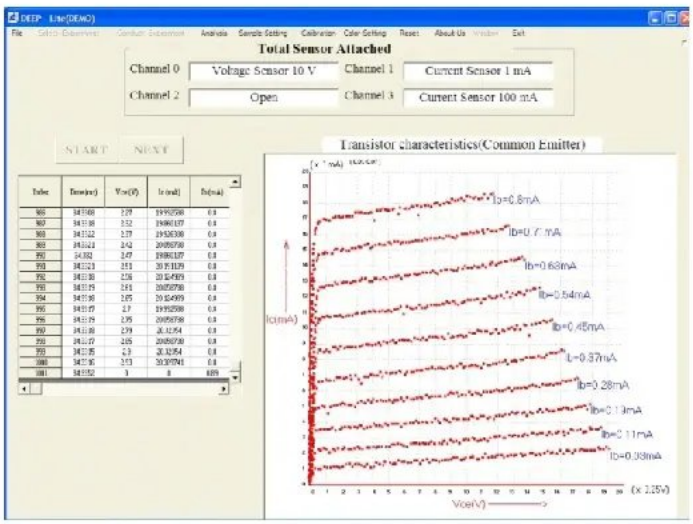
Salient Features:

- **Auto identification** of sensors
- **High speed** data transfer
- **Programmable** delay in data acquisition
- **Programmable** sampling frequency
- **Graphical Analysis**
- **Automatic & manual mode** of data acquisition



Key Topics:

- Ohm's law.
- Charging and discharging.
- Rectifier circuits.
- Zener diode characteristics.
- LED characteristics.
- Clipper and clamper circuit.
- Transistor characteristics.
- Forward biasing.
- Reverse biasing.
- Voltage regulation.



Transistor Characteristics

Contents:

Cat No.	Item Name	Qty.
CK095	Circuit Board	1
LP18	Lead (100cm)	8set
C1710	Data Logger with Current Booster	1
C7993	Power Unit	1
SEB24	Diode Module	1
SEB59	Zener Diode 3.9V Module	1
SEB13	Zener Diode 5.1V Module	1
SEB30	LED Module	1
SEB41	Resistor Module 100Ω	1
SZ040	Resistor Module 10Ω, 10W	1
SEB46	Resistor Module 1kΩ	1
SEB44	Resistor Module 10kΩ	1
SEB66	Transistor Module	1
CK242	Voltage Sensor ± 1V	1
CK241	Voltage Sensor ± 10V	1
CK246	Current Sensor ± 1mA	1
CK245	Current Sensor ± 10mA	1
CK244	Current Sensor ± 100mA	1
CK243	Current Sensor ± 1A	1
C1741	Software	1

Additionally Required
Computer (not supplied with this setup)

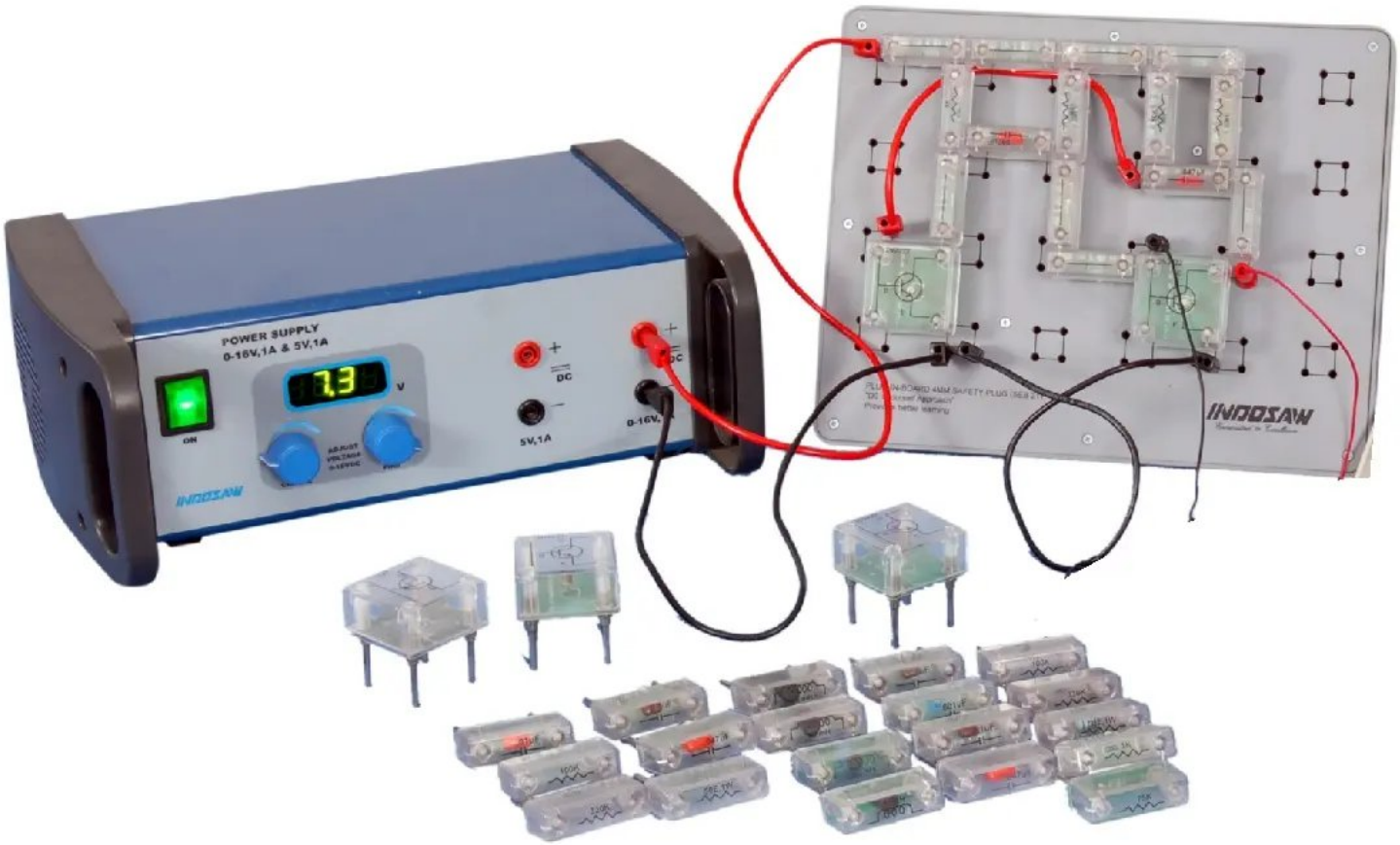
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Fax:+91-171-2699102, 2699222, E-mail:deducation@indosaw.com (Indian Customer), eenquiry@indosaw.com (Foreign Customer)

ELECTRONIC PLUG IN KIT SK023

Experiments:

Exp-1 Recording the I-V & I-R characteristics of solar cell.
Exp-2 Diode characteristics of transistor junctions.
Exp-3 Recording the characteristics of a transistor.
Exp-4 Recording the characteristics of a field-effect transistor.
Exp-5 To study half wave and full wave (bridge) rectifier.
Exp-6 To study capacitor filter effect in power supply.
Exp-7 To study unregulated and regulated power supply.
Exp-8 To study CE amplifier frequency response .
Exp-9 To study RC-coupled amplifier (multistage amplifier).
Exp-10 To study differential amplifier circuits.
Exp-11 To study Astable multivibrator circuit using transistor.
Exp-12 To study Colpitt's oscillator.
Exp-13 To study Hartley oscillator.
Exp-14 To study UJT as relaxation oscillator.
Exp-15 To study half adder and full adder circuit.
Exp-16 To study half Subtractor.
Exp-17 To study BCD to 7-segment decoder using 7segment display.
Exp-18 To study decade counter.
Exp-19 To study RS flip flop.
Exp-20 To study D flip flop.
Exp-21 To study JK flip flop.
Exp-22 To study shift registers.
Exp-23 Recording the current-voltage characteristics of diodes.
Exp-24 Recording the current-voltage characteristics of zener diodes.
Exp-25 Recording the current-voltage characteristics of LED.
Exp-26 AND, OR, XOR, NOT, NAND and NOR operations.
Exp-27 De Morgan's laws.
Exp-28 Logic operation using three and four variables.
Exp-29 To Study RC Phase Shift Oscillator Using Op-Amp.
Exp-30 To Study Wein Bridge Oscillator Using Op-Amp.
Exp-31 To Study Astable Generators Using IC555 Timer.
Exp-32 To Study Monostable Generators Using IC555 Timer.
Exp-33 Op-Amp as Inverting/Non Inverting Amplifier.
Exp-34 Op-Amp as Adder/Subtractor.
Exp-35 Op-Amp as Integrator/ Differentiator.
Exp-36 Op-Amp as a Comparator.
Exp-37 To study MOSFET characteristics.
Exp-38 To study characteristics of SCR.
Exp-39 To study characteristics of TRIAC.
Exp-40 To Study Ohm's Law.
Exp-41 To Study Kirchoff's Law.
Exp-42 To Study Series & Parallel Effect of Resistance.
Exp-43 To Study Resistances As A Voltage Divider.
Exp-45 To Study LDR Characteristics.
Exp-46 To Study Thermistor Characteristics.
Exp-47 To study ADC/DAC circuits.
Exp-48 To study the R-C Circuit.
Exp-49 To study the L-R Circuit.
Exp-50 To study the L-C-R Circuit.
Exp-51 To study the Clipper and Clamper Circuit.
Exp-52 To study the Charging and Discharging of a Capacitor.

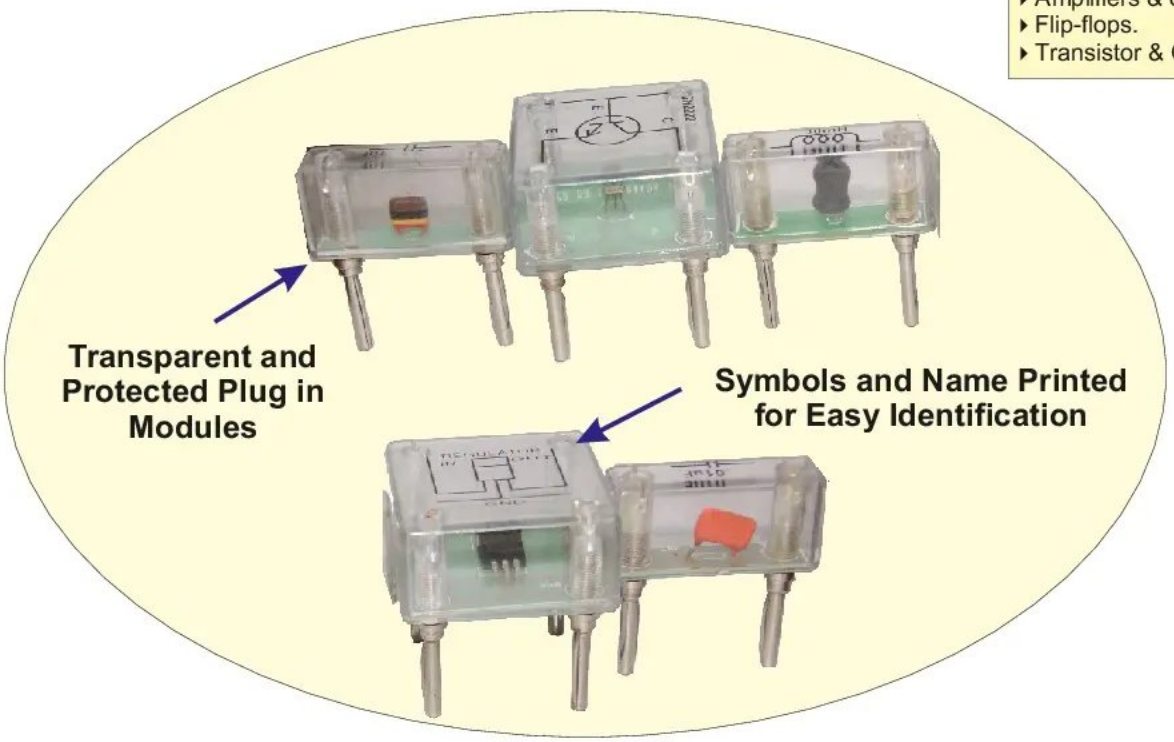


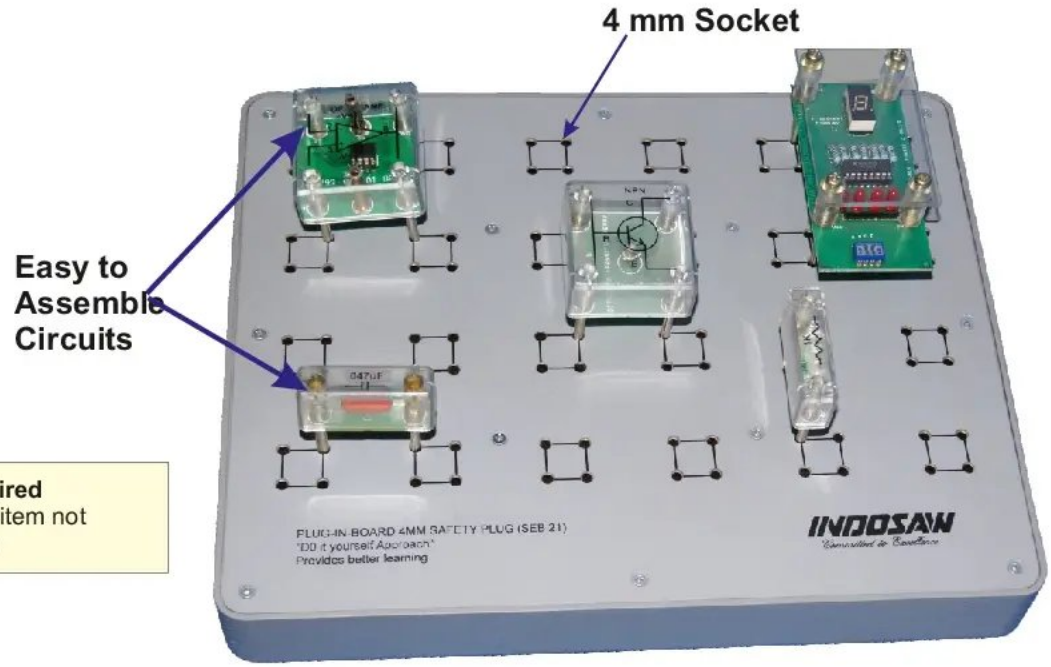
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ELECTRONIC PLUG IN KIT SK023

Salient Features:
- Student uses **Plug- in Modules** for circuit design.
- This 'Do It Yourself Approach' provides better learning.
- The plug-in modules are design in **transparent housing for visibility** of the components.
- The **symbols and name of the components printed** for easy identification.
- Very convenient & **easy to use 4mm sockets** provided to Plug the modules in circuit board.
- **Economical & Flexible method** of performing all experiment on one circuit board in case you buy a complete set.
- Safety as per **European standard**.

Key Topics:
- Ohm's law.
- Charging and discharging.
- Rectifier circuits.
- Zener diode characteristics.
- LED characteristics.
- Clipper and clamper circuit.
- Transistor characteristics.
- Analog & digital circuits.
- Logic gates.
- Amplifiers & oscillators.
- Flip-flops.
- Transistor & Op-Amp.





*** Additionally Required**
CRO is an optional item not supplied with SK023

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CONTENTS OF SK023:

Cat. No.	Item Name	Qty.
SEC02	ADC Module	1
SEB11	AND Gate Module	1
CB530	AND Gate Module (Single Gate)	2
SEB12	BRIDGE Rectifier Module	1
SEB71	Capacitor Module 0.001µF	2
SEB14	Capacitor Module 0.01µF	3
SEC03	Capacitor Module 0.022µF	2
SEB72	Capacitor Module 0.047µF	2
SEB15	Capacitor Module 0.1µF	3
SEB16	Capacitor Module 0.47µF	3
SEB73	Capacitor Module 10µF	3
SEB74	Capacitor Module 100µF	1
SEB17	Capacitor Module 1000µF	1
SEC05	Choke Module	1
SEB21	Circuit Board	1
SEB92	D-Flip Flop	1
SEB22	DAC Module	1
SEB89	Decade Counter Module	1
C4160	Decade Resistance Box	1
SE067	Digital Multimeter	3
SEB24	Diode Module	2
SEC07	Ex-OR Gate Module	2
CB534	Ex-OR Gate Module (Single Gate)	2
SW938	Fixed Power Supply +/- 15 V	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	8
LP18	Flexible lead Set (100cm)	5
SEC04	FND+7 Segment Decoder	1
C8077	Full Adder Module	1
C8076	Half Adder Module	1
SEC13	Half Substractor Module	1
SEB48	IC555 timer Module	1
SEB26	Inductor Module 30mH	2
SEB75	Inductor Module 60mH	1
SEB28	JFET Module	1
SEB91	JK Flip Flop Module	1
R5740	LAMP Source	1
SEB30	LED Module	1
CB539	Light Sensor (LDR) Module	1
SEB31	MOSFET Module	1
SEB32	NAND Gate Module	1
CB531	NAND Gate Module (Single Gate)	1
SEC08	NOR Gate Module	1

Cat. No.	Item Name	Qty.
CB535	NOR Gate Module (Single Gate)	1
SEB34	NOT Gate Module	1
CB532	NOT Gate Module (Single Gate)	2
SEB87	OP-AMP Module	1
SEB35	OR Gate Module	1
CB533	OR Gate Module (Single Gate)	1
SEB38	Push Button Module	1
SEC06	Regulator Module	1
SEB41	Resistor Module 100Ω	1
SEB43	Resistor Module 330Ω	1
SEB46	Resistor Module 1kΩ	2
SEB47	Resistor Module 3.3kΩ	3
SEB76	Resistor Module 4.7kΩ	1
SEB44	Resistor Module 10kΩ	5
SEB45	Resistor Module 15kΩ	2
SEB78	Resistor Module 27kΩ	2
SEB88	Resistor Module 33kΩ	2
SEB79	Resistor Module 75kΩ	1
SEB40	Resistor Module 100kΩ	1
SEB42	Resistor Module 330kΩ	1
SEB80	Resistor Module 470kΩ	1
SEC10	Resistor Module 1kΩ, 1W	1
SEC11	Resistor Module 100Ω, 1W	1
SEC12	Resistor Module 50Ω, 1W	2
SEB90	RS Flip Flop	1
SEB50	SCR Module	1
SEB82	Shift Register Module	1
SW925	Signal Generator	2
SEC14	Solar Module	1
SEB53	Switch Module	2
CB538	Thermistor Module	1
SEB54	Transformer Module	1
SEB84	Transistor Module 2N2222	2
SEB85	Transistor Module BC107	2
SEB86	Transistor Module BC109	2
SEB57	Triac Module	1
SEB83	UJT Module	1
SW926	Variable Power Supply	2
CB536	Variable Resistor 1kΩ	1
CB537	Variable Resistor 10kΩ	1
SEB81	Variable Resistor 1MΩ	1
SEB13	Zener Diode Module	1

Additionally required:
CRO is an optional item not supplied with SK023

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CURRENT AND VOLTAGE SOURCES SJ250

Experiments:
Exp-1 V-I characteristics of a solar cell.
Exp-2 I-R characteristics of a solar cell as a function of the irradiance.



Contents of SJ250:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
C4160	Decade Resistance Box	1
SE067	Digital Multimeter	2
LP17	Flexible Lead Set (50cm)	6
R5740	Lamp Source	1
SEC14	Solar Module	1
SEB53	Switch Module	1
SE080	Power Supply	1
SG110	Cylindrical Base	1

TRANSISTORS CHARACTERSTICS SJ251

Experiments:
Exp-1 Diode characteristics of transistor junctions.
Exp-2 To study the characteristics of a transistor.
Exp-3 To study the characteristics of a field-effect transistor.



Contents of SJ251:

Cat No.	Item Name	Qty.
SEB21	Circuit Board	1
SE067	Digital Multimeter	3
LP17	Flexible Lead Set (50cm)	6
LP18	Flexible lead Set (100cm)	4
SEB46	Resistor Module 1kΩ	1
SEB44	Resistor Module 10kΩ	1
SEB40	Resistor Module 100kΩ	1
SEB84	Transistor Module 2N2222	1
SEB28	JFET Module	1
SEB24	Diode Module	1
SW926	Variable Power Supply	2

DIODE CIRCUIT AND POWER SUPPLY SJ252

Experiments:
Exp-1 To study half wave and full wave rectifier.
Exp-2 To study full wave (bridge) rectifier.
Exp-2 To study capacitor filter effect in power supply.
Exp-3 To study unregulated and regulated power supply.



Contents of SJ252:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SEB12	BRIDGE Rectifier Module	1
SEB73	Capacitor Module 10 µF	1
SEB74	Capacitor Module 100 µF	1
SEB17	Capacitor Module 1000 µF	1
SE067	Digital Multimeter	2
SEB24	Diode Module	2
LP16	Flexible Lead Set (25cm)	4
LP17	Flexible Lead Set (50cm)	6
SEB43	Resistor Module 330Ω	1
SEB46	Resistor Module 1kΩ	1
SEB30	LED Module	1
SEC06	Regulator Module	1
SEB54	Transformer Module	1
SEA94	CRO 20 MHz (Optional)	1

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TRANSISTORS AS AMPLIFIER SJ253

Experiments:
Exp-1 To study CE amplifier frequency response.
Exp-2 To study RC-coupled amplifier (multistage amplifier).
Exp-3 To study differential amplifier circuits.

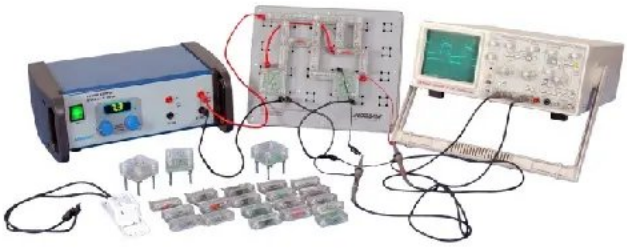


Contents of SJ253:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SEB71	Capacitor Module 0.001µF	1
SEB16	Capacitor Module 0.47µF	3
SEB15	Capacitor Module 0.1µF	2
SE067	Digital Multimeter	2
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	4
LP18	Flexible lead Set (100cm)	3
SEB46	Resistor Module 1kΩ	2
SEB47	Resistor Module 3.3kΩ	2
SEB44	Resistor Module 10kΩ	5
SEB45	Resistor Module 15kΩ	2
SEB88	Resistor Module 33kΩ	2
SW925	Signal Generator	2
SEB85	Transistor Module BC107	2
SEB86	Transistor Module BC109	2
SEB84	Transistor Module 2N2222	1
SW938	Power Supply +/- 15V	1
SW926	Variable Power Supply	1
SEA94	CRO 20MHz(Optional)	1

TRANSISTORS AS OSCILLATOR SJ254

Experiments:
Exp-1 To study Astable multivibrator using transistor
Exp-2 To study Colpitt's oscillator
Exp-3 To study Hartley oscillator
Exp-4 To study UJT as relaxation oscillator

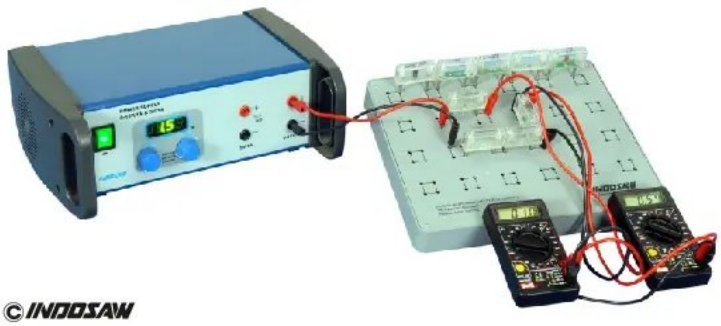


Contents of SJ254:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SEB72	Capacitor Module 0.047µF	2
SEB71	Capacitor Module 0.001µF	1
SEB14	Capacitor Module 0.01µF	2
SEB15	Capacitor Module 0.1µF	2
SEC05	Choke Module	1
SEB26	Inductor Module 30mH	2
SEB75	Inductor Module 60mH	1
SEB41	Resistor Module 100Ω	1
SEB46	Resistor Module 1kΩ	2
SEB44	Resistor Module 10kΩ	2
SEB79	Resistor Module 75kΩ	1
SEB40	Resistor Module 100kΩ	1
SEB42	Resistor Module 330kΩ	1
SEB80	Resistor Module 470kΩ	1
SEB84	Transistor Module 2N2222	2
SEB83	UJT Module	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	2
LP18	Flexible lead Set (100cm)	2
SW926	Variable Power Supply	1
SEA94	CRO 20 Mhz (Optional)	1

DIODES CHARACTERISTICS SJ256

Experiments:
Exp-1 To study the V-I characteristics of diodes.
Exp-2 To study the V-I characteristics of zener diodes.
Exp-3 To study the V-I characteristics of light-emitting diodes.



Contents of SJSJ256:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SE067	Digital Multimeter	2
SEB24	Diode Module	1
LP17	Flexible Lead Set (50cm)	4
LP18	Flexible lead Set (100cm)	2
SEB46	Resistor Module 1kΩ	1
SEB30	LED Module (red)	1
SEB43	Resistor Module 330Ω	1
SEB13	Zener Diode Module	1
SW926	Variable Power Supply	1

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COMBINATORIAL & SEQUENTIAL CIRCUITS SJ255

Experiments:

Exp-1 To study half adder and full adder circuit.
Exp-2 To study half Subtractor.
Exp-3 To study BCD to 7-segment decoder.
Exp-4 To study decade counter.
Exp-5 To study RS flip flop.
Exp-6 To study D flip flop.
Exp-7 To study JK flip flop.
Exp-8 To study shift registers.



Contents of SJ255:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
CB530	AND Gate Module	2
CB534	Ex-OR Gate Module	2
LP16	Flexible Lead Set (25cm)	10
LP17	Flexible Lead Set (50cm)	6
LP18	Flexible lead Set (100cm)	5
C8077	Full Adder Module	1*
C8076	Half Adder Module	1*
SEC13	Half Substractor Module	1*
CB533	OR Gate Module	1
SEC04	FND+7 Segment Decoder	1
SEB89	Decade Counter Module	1
SEB90	RS Flip Flop	1
SEB92	D-Flip Flop	1
SEB91	JK Flip Flop Module	1
SEB82	Shift Register Module	1
SEB53	Switch Module	3
SEB38	Push Button Module	1
SE067	Digital Multimeter	1
SW925	Signal Generator	1
SW926	Variable Power Supply	1

DIGITAL CONTROL SJ263

Experiments:

Exp-1 To study ADC/DAC circuits



BASIC LOGICAL OPERATIONS SJ257

Experiments:

Exp-1 AND, OR, XOR, NOT, NAND and NOR operations using single logic gate modules.
Exp-2 De Morgan's laws
Exp-3 AND, OR, XOR, NOT, NAND and NOR operations using quad logic gate modules.



Contents of SJ257:

Cat No.	Item Name	Qty
CB530	AND Gate Module	1
SEB21	Circuit Board	1
CB534	Ex-OR Gate Module	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	8
LP18	Flexible lead set (100cm)	2
CB531	NAND Gate Module	1
CB535	NOR Gate Module	1
CB532	NOT Gate Module	1
CB533	OR Gate Module	1
SEB53	Switch Module	2
SW926	Variable Power Supply	1
SEB11	AND Gate Module	1*
SEC07	Ex-OR Gate Module	1*
SEB32	NAND Gate Module	1*
SEC08	NOR Gate Module	1*
SEB34	NOT Gate Module	1*
SEB35	OR Gate Module	1*

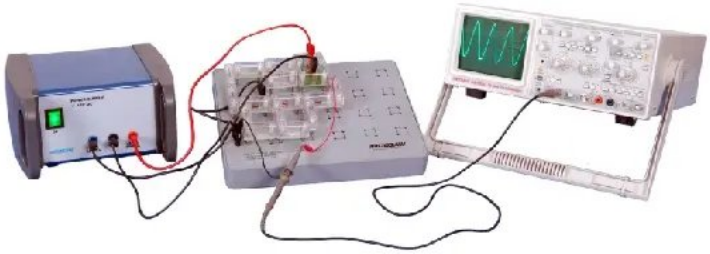
Contents of SJ263:

Cat No.	Item Name	Qty
SEC02	ADC Module	1
SEB21	Circuit Board	1
SEB22	DAC Module	1
SE067	Digital Multimeter	1
LP16	Flexible Lead Set (25cm)	1
LP17	Flexible Lead Set (50cm)	4
LP18	Flexible lead Set (100cm)	5
SEB38	Push Button Module	1
SW925	Signal Generator	1
SW926	Variable Power Supply	1

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OP-AMP AS OSCILLATOR SJ258

Experiments:
Exp-1 To Study RC Phase Shift Oscillator Using Op-Amp.
Exp-2 To Study Wein Bridge Oscillator Using Op-Amp.



Contents of SJ258:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SW938	Power Supply +/- 15V	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	4
LP18	Flexible lead Set (100cm)	3
SEB87	OP-AMP Module	1
SEB47	Resistor Module 3.3kΩ	3
SEB44	Resistor Module 10kΩ	3
SEB45	Resistor Module 15kΩ	2
SEB78	Resistor Module 27kΩ	2
SEB40	Resistor Module 100kΩ	1
SEB81	Variable Resistor 1MΩ	1
SEB14	Capacitor Module 0.01µF	3
SEC03	Capacitor Module 0.022µF	2
SEB15	Capacitor Module 0.1µF	3
SEA94	CRO 20 MHz (Optional)	1

IC 555 TIMER SJ259

Experiments:
Exp-1 To Study Astable Generators Using IC555 Timer
Exp-2 To Study Monostable Generators Using IC555Timer

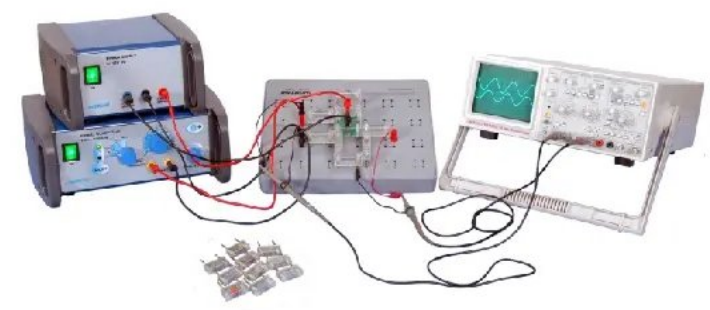


Contents of SJ259:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SEB15	Capacitor Module 0.1µF	1
SEB73	Capacitor Module 10µF	1
SEB74	Capacitor Module 100µF	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	4
SEB48	IC555 timer Module	1
SEB46	Resistor Module 1kΩ	1
SEB44	Resistor Module 10kΩ	1
SEB40	Resistor Module 100kΩ	1
SEB47	Resistor Module 3.3kΩ	1
SEB76	Resistor Module 4.7kΩ	1
SEB30	LED Module	1
SEB38	Push Button Module	1
SW926	Variable Power Supply	1
SEA94	CRO 20 MHz (Optional)	1

OPERATIONAL AMPLIFIER SJ260

Experiments:
Exp-1 Op-Amp as Inverting/Non Inverting Amplifier
Exp-2 Op-Amp as Adder/Subtractor
Exp-3 Op-Amp as Integrator/ Differentiator
Exp-4 Op-Amp as a Comparator



Contents of SJ260:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SE067	Digital Multimeter	3
SW938	Power Supply +/- 15V	1
LP16	Flexible Lead Set (25cm)	6
LP17	Flexible Lead Set (50cm)	10
LP18	Flexible lead Set (100cm)	5
SEB87	OP-AMP Module	1
SEB41	Resistor Module 100Ω	2
SEB46	Resistor Module 1kΩ	1
SEB76	Resistor Module 4.7kΩ	1
SEB44	Resistor Module 10kΩ	5
SEB40	Resistor Module 100kΩ	1
SEB14	Capacitor Module 0.01µF	1
SEB15	Capacitor Module 0.1µF	1
SW925	Signal Generator	2
SW926	Variable Power Supply	2
SEA94	CRO 20 Mhz (Optional)	1

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SPECIAL DIODE CHARACTERISTICS SJ261

Experiments:

Exp-1 To study MOSFET characteristics.
Exp-2 To study characteristics of SCR.
Exp-3 To study characteristics of TRIAC.



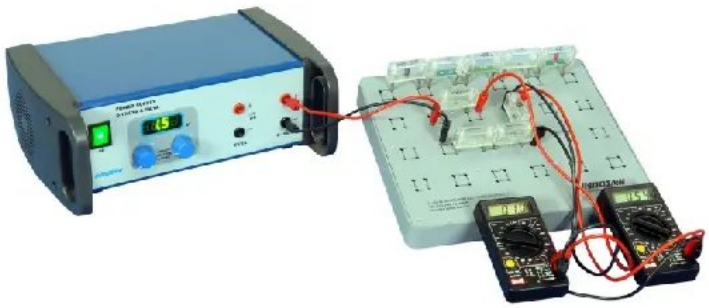
Contents of SJ261:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SE067	Digital Multimeter	3
LP17	Flexible Lead Set (50cm)	6
LP18	Flexible lead Set (100cm)	4
SEB31	MOSFET Module	1
SEB50	SCR Module	1
SEB57	Traic Module	1
SEC10	Resistor Module 1kΩ, 1W	1
SEC11	Resistor Module 100Ω,1W	1
SEC12	Resistor Module 50Ω, 1W	2
SW926	Variable Power Supply	2

BASIC ELECTRONICS SJ262

Experiments:

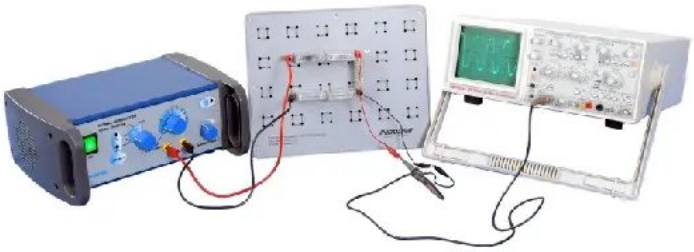
Exp-1 To Study Ohm's Law
Exp-2 To Study Kirchoff's Law
Exp-3 To Study Series & Parallel Effect Of Resistances
Exp-4 To Study Resistances As A Voltage Divider
Exp-5 To Study LDR Characteristics
Exp-6 To Study Thermistor Characteristics



ALTERNATING CURRENT SJ264

Experiments:

Exp-1 To study the R-C Circuit.
Exp-2 To study the L-R Circuit.
Exp-3 To study the L-C-R Circuit.
Exp-4 To study the Clipper and Clamper Circuit.
Exp-5 To study the Charging & Discharging of a capacitor.



Contents of SJ264:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SE067	Digital Multimeter	2
LP16	Flexible Lead Set (25cm)	4
LP17	Flexible Lead Set (50cm)	2
LP18	Flexible lead Set (100cm)	2
SEB16	Capacitor Module 0.47 µF	1
SEB15	Capacitor Module 0.1 µF	1
SEB14	Capacitor Module 0.01 µF	1
SEB17	Capacitor Module 1000 µF	1
SEB26	Inductor Module 30mH	1
SEB75	Inductor Module 60mH	1
SEB46	Resistor Module 1kΩ	2
SEB44	Resistor Module 10kΩ	1
SEB76	Resistor Module 4.7kΩ	1
SEB40	Resistor Module 100kΩ	1
SEB24	Diode Module	1
SW925	Signal Generator	1
SEA94	CRO 20 MHz (Optional)	1

Contents of SJ262:

Cat No.	Item Name	Qty
SEB21	Circuit Board	1
SE067	Digital Multimeter	3
LP16	Flexible Lead Set (25cm)	2
LP17	Flexible Lead Set (50cm)	6
LP18	Flexible lead Set (100cm)	2
SEB46	Resistor Module 1kΩ	1
SEB47	Resistor Module 3.3kΩ	1
SEB76	Resistor Module 4.7kΩ	1
SEC10	Resistor Module 1kΩ, 1W	1
R5740	LAMP Source	1
CB538	Thermistor Module	1
CB539	LDR Module	1
SW926	Variable Power Supply	1

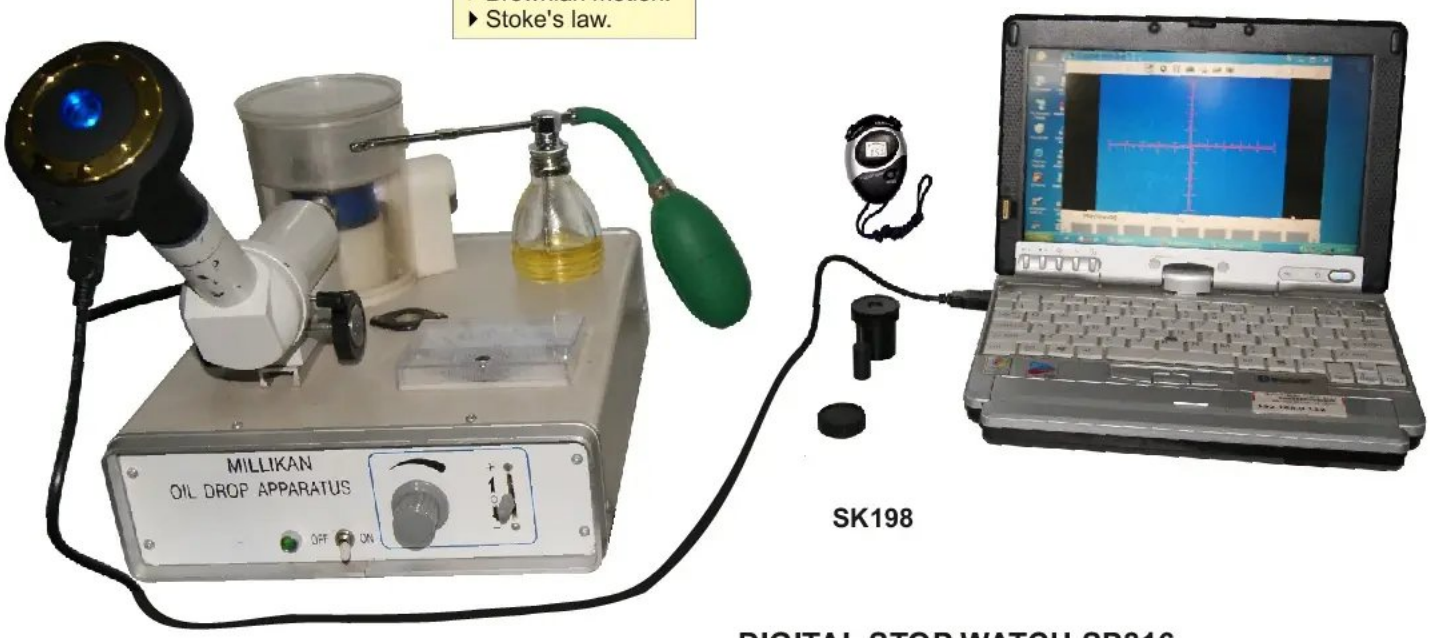
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MILLIKAN OIL DROP APPARATUS SK052/SK198

Experiments:
Exp-1 To observe brownian movement in charged oil droplets.
Exp-2 To determine the quantum nature of charge.

Salient features
- Quick and accurate measurement.
- Clarity of drops for measurements.
- Stability of drops during measurements.
- Inbuilt power supply.
- USB Camera.

Key Topics:
- Electron charge.
- Terminal velocity.
- Electric field.
- Brownian motion.
- Stoke's law.



SK198

MILLIKAN'S APPARATUS J2438

SPECIFICATIONS

Input voltage	: AC 220V, 50Hz
Output power	: 5W.
Plate voltage	: 0~500V DC
Change over switch	: Between +ve, -ve and 0 field
Plate distance	: 5±0.2mm.
Total Magnification	: 30X
Linear field of vision	: ≥3mm.
Scale division	: 2±0.01mm.
Objective lens	: 100 lines/mm.

USB CAMERA R9448

SPECIFICATIONS

Sensor	: 1.2 MP
Eyepiece	: 10X with adaptor ring
Connectivity	: USB
System Requirement	
CPU	: PIV 2.0GHz or above
RAM	: 1GB or above
O.S	: Win2K/WinXP/Vista/Win7
Display	: 32Bit, 1024x768

DIGITAL STOP WATCH SP816

SPECIFICATIONS

Display	: 6 Digit
Accuracy	: 0.01sec
Digit size	: 5mm
Mode	: Start, Stop & Reset
Necklace length	: 2 feet

Millikan oil drop experiment can test and verify the quantum nature of charges, measure the elemental charges and observe the brownian movement.
In the setup SK052 the oil drops are viewed through the eyepiece while in SK052A the motion of oil drops is viewed by USB camera on PC which makes it easier to observe the experiment.

Contents:

Cat. No.	Item Name	SK052	SK198
CD931	Millikan's apparatus	1	1
SP816	Digital stop watch	1	1
SN289	Oil atomizer	1	1
R9448	USB camera		1

Additionally Required
Computer (not supplied with this setup)

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MILLIKAN'S OIL DROP EXPERIMENT SN1060

Experiments:
Exp-1 To measure the charge on an electron.
Exp-2 To demonstrate the quantum nature of electric charge.
Exp-3 To didactic observation on camera.

Key Topics:
- Measuring electron electric charge
- Demonstrating electron quantum nature
- Implementing a sighting device
- Didactic observation on webcam



With an atomiser, spray oil drops in a capacitor made of two light alloy plates. As they pass through two small holes drilled in the plastic holder of the capacitor, some drops will be charged by electrostatic friction. Once they have penetrated between the two flat capacitor plates, these oil drops are observed through a sighting device. The latter is equipped with a long focus lens to single out the oil drops falling along the capacitor axis and standing out as shiny dots against a dark background. Its eyepiece is engraved to a tenth of a millimetre. A camera supplied with a dedicated software, directly placed behind the sighting device, allows real-time display of the phenomenon on the computer.
Oil drop electric charge is determined by calculating its fall velocity. We observe that, according to oil drop size and velocity, this is always a multiple of the electric charge e, the elementary electron charge.

Contents:

S. No.	Item Name	Qty.
1	Plane condenser	1
2	Display microscope	1
3	Vaporiser	1
4	Lighting system	1
5	Adjustable high stand	1
6	Camera	1
7	Software CD	1

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BALMER SERIES AND EMISSION SPECTRA SK071

Experiments:

Exp-1 Observing the Balmer series of hydrogen using Bunsen-kirchoff spectroscope.

Exp-2 Qualitative investigation of emission spectra.

Salient Features:

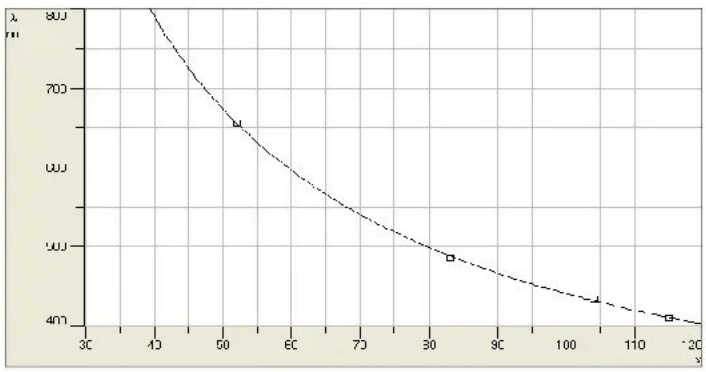
- Electrical safety tested power supply with overload current protection.
- Tube filed with research-grade gasses & vapors.



Key Topics:

- Bohr atomic model.
- Visible spectrum.
- Energy level.
- Rydberg atom.
- Rydberg's constant.

Bunsen-Kirchoff spectroscope is ideal for observation and measurement of emission and absorption spectra.
In the present setup, the Balmer series of hydrogen and wavelengths of unknown gases can be studied using this spectroscope. The scale tube of the spectrometer is initially calibrated with the help of mercury light source so that the marked numbers on the scale tube correspond to the particular wavelength of light. Subsequently the emission spectrum of hydrogen and nitrogen can be investigated.



Scale division vs wavelength

Contents:

Cat No.	Item Name	Qty.
SL807	Spectroscope (Bunsen-Kirchoff)	1
SW281	Spectrum Tube Power Supply	1
SN631	Hydrogen Tube	1
SW440	Mercury Light Source	1

Additionally Required
Other tubes like Helium, Neon, Argon, Oxygen, Nirtogen etc.

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BALMER SERIES AND RYDBERG CONSTANT SK043

Experiments:

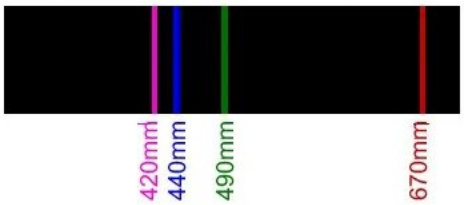
Exp-1 To determine the wavelengths of Balmer series in the visible region from hydrogen emission.

Exp-2 To determine the Rydberg constant.

Salient Features:

- High quality imported grating (100,300,600 line/mm).
- Electrical safety tested high voltage power supply with overload current protection.
- Tube filed with research-grade gasses & vapors.

Hydrogen Emission Spectrum



Key Topics:

- Bohr atomic model.
- Visible spectrum.
- Energy level.
- Diffraction.
- Rydberg atom.
- Rydberg's constant.

Principle and Working:

Hydrogen atoms in a discharge lamp emit a series of lines in the visible part of the spectrum. This series is called the Balmer series which continues into the ultraviolet range. Rydberg generalized the Balmer's formula in terms of wave numbers to describe wavelengths of spectral lines of many chemical elements. For hydrogen the Balmer's formula becomes a special case of Rydberg's formula and is given by

$$1/\lambda = R(1/2^2 - 1/n^2)$$

where n are integers, 3, 4, 5, … up to infinity and
R is Rydberg constant (R = 4/B where B is the Balmer's constant).
In the present setup, the spectral lines of hydrogen is observed by means of diffraction grating. The wavelength of the visible lines of Balmer series of hydrogen are measured by spectrometry.

Contents:

Cat No.	Item Name	SK043
SL806	Spectrometer (L.C. = 20 sec)	1
SL745	Diffraction grating	1
SW281	Spectrum tube power supply	1
SN631	Hydrogen tube	1
R1437	Allen key	1
SL1048	Magnifier with LED	1
SW915	Prism EDF	1

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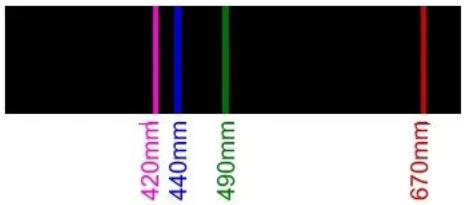
de BALMER-RYDBERG SN1061

Experiments:

Exp-1 To determine the wavelengths of Balmer series in the visible region from hydrogen emission, spectrum.

Exp-2 To determine the Rydberg constant.

Hydrogen Emission Spectrum



Key Topics:

- Bohr atomic model.
- Visible spectrum.
- Energy level.
- Diffraction.
- Rydberg atom.
- Rydberg's constant.



Hydrogen Tube





Principle and Working:

Hydrogen atoms in a discharge lamp emit a series of lines in the visible part of the spectrum. This series is called the Balmer series which continues into the ultraviolet range. Rydberg generalized the Balmer's formula in terms of wave numbers to describe wavelengths of spectral lines of many chemical elements. For hydrogen the Balmer's formula becomes a special case of Rydberg's formula and is given by

$$1/\lambda = R(1/2^2 - 1/n^2)$$

where n are integers, 3, 4, 5, … up to infinity and
R is Rydberg constant (R = 4/B where B is the Balmer's constant).

Contents:

S. No.	Item Name	Qty.
1	Spectrometer	1
2	Software CD	1
3	USB Cable	1
4	Optical Fibre 2m-50µm	1
5	Spectrum tube Power supply	1
6	Hydrogen tube	1
7	Power cord	1

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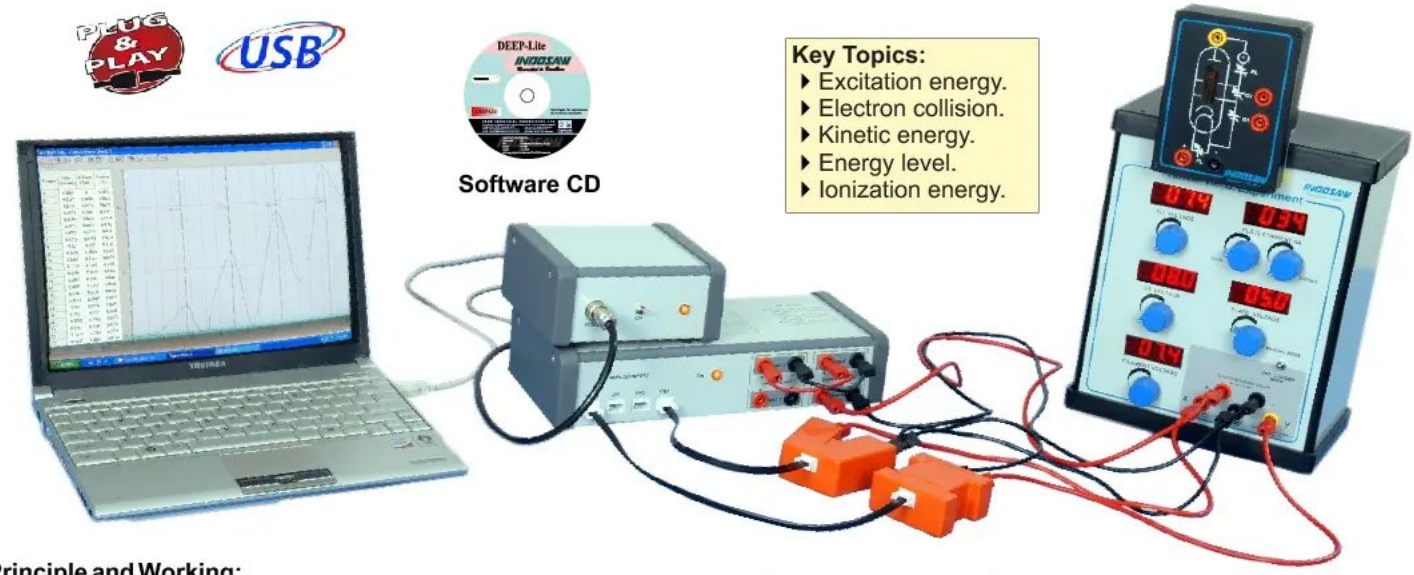
FRANCK HERTZ EXPERIMENT SK087/SK090

Experiments:

Exp-1 To observe the neon spectral bands formation in Franck-Hertz tube.
Exp-2 To record the Franck-Hertz characteristic curve for neon.
Exp-3 To study the effect of filament voltage and anode plate voltage on the characteristic curve.

Salient Features :

- **Manual & automatic experiment mode.**
- Neon bands formation in frank-hertz tube can be visually observed.
- Easy experiment setup.
- **Auto identification** of sensors and graphical analysis in automatic mode with data logger.



Software CD

Key Topics:

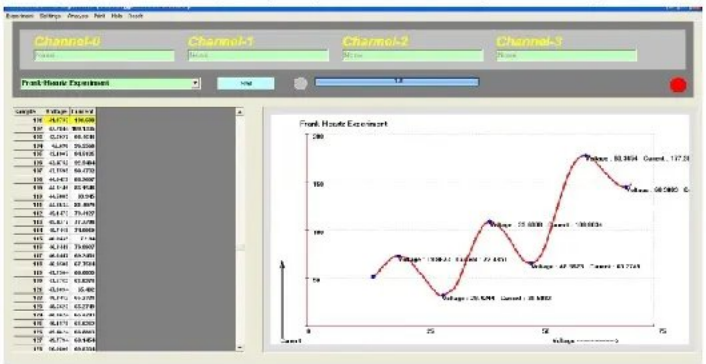
- Excitation energy.
- Electron collision.
- Kinetic energy.
- Energy level.
- Ionization energy.

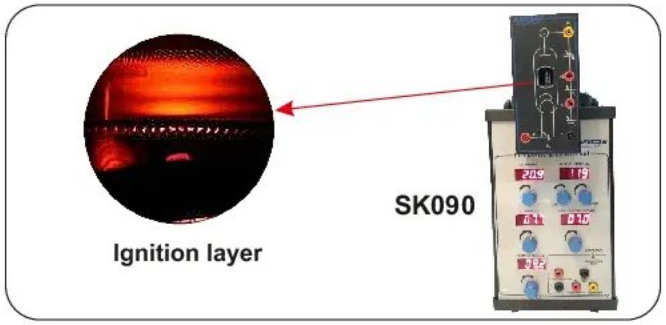
Principle and Working:

The Franck-hertz tube consists of an electron-emitting cathode, two mesh grids for accelerating electrons and an anode plate for collecting electrons. It is filled with a low pressure gas. The mesh grids provide the accelerating potential to electrons and the anode is held at slightly negative potential to provide braking. At low accelerating potential, the electrons gain kinetic energy and reach the anode plate with purely elastic collisions with the gas atoms. As accelerating potential is increased the gas atoms absorb energy as they are excited due to in-elastic collision by the energized electrons. Thus fewer electrons reach the anode plate and there is a dip in the plate current. These dips in current is observed at approximately fixed intervals of accelerating potential which demonstrate the presence of discreet or quantum energy levels in the Bohr's model of atom.

In the present Franck-Hertz experiment with neon gas, the absorbed energy by neon atoms is released through photons having red-orange wavelength, which can be visually observed in band formations. The experiment can be performed in manual mode where the accelerating voltage and the plate braking voltage can be manually controlled in SK090. Also with sensors and data logger in Sk087 the accelerating voltage can be automatically varied and plate current measured & displayed graphically on PC.

Graphical Analysis (Easy and Fast Analysis on PC)





Contents:

Cat No.	Item Name	SK087	SK090
CD133	Franck-Hertz unit	1	1
CD433	Data logger	1	
C7994	Power supply for data logger	1	
CD152	Neon tube with mount	1	1
CD435	Current sensor (± 100mA)	1	
CD434	Voltage sensor ± 10V)	1	
SN204	Flexible plug lead red	2	
SN201	Flexible plug lead black	3	
SN207	Flexible plug lead yellow	1	
R9964	USB cable	1	
C13049	Software CD disc	1	
R0696	Power Cord	2	1

* ***Additionally Required***
Computer (not supplied with this setup)

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ZEEMAN EFFECT SK075

Experiments:

Exp-1 To observe the Zeeman splitting of the green (546.1nm) mercury line using Fabry-Perot etalon for normal transverse and longitudinal configuration.

Exp-2 Determining the polarization state of the triplet components in transverse configuration.

Exp-3 Determining the polarization state of the doublet components in longitudinal configuration.

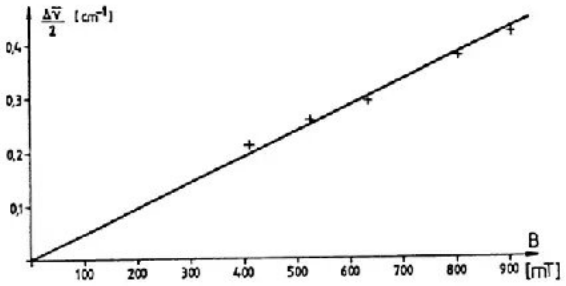
Salient Features:

- Compact electromagnet can be placed in transverse/ longitudinal direction.
- High resolution Fabri-Perot etalon to detect wavelength change of 0.002nm.
- Central wavelength of interference filter is 546.1nm.
- Safety tested multipurpose power supply
- Clear orbital splitting is observed on microscopic camera.
- Gaussmeter with axial hall probe.



Key topics:

- Bohr's atomic model.
- Quantization of energy levels.
- Fabry Perot interferometer.
- Electron spin.
- Bohr's magneton.



Zeeman splitting of spectra line λ=546.1nm as function of flux density B.

Principle and Working:

The Zeeman effect is the splitting of atomic energy levels, under application of external magnetic field, which are additionally characterized by the orbital and spin angular momentum or Bohr's Magneton.

In this set up the normal Zeeman effect is investigated which characterizes the splitting of energy levels observed by the spectral lines of corresponding electron transitions. A line triplet perpendicular to the magnetic field and a line doublet parallel to the magnetic field having very small difference in wavelengh is observed instead of a single line without magnetic field. The splitting of 546.1 nm wavelength from Mercury light source under strong magnetic field in transverse and longitudinal direction is observed through CCD camera on computer. The Bohr's Magneton can be calculated from the measurements in experiment.

Contents:

Cat. No	Item Name	Qty.
C13018	Optical Bench triangular	1
C11829	Transverse slider	2
SL754	Convex lens in holder 10cm	1
SL752	Convex lens 5cm	1
SL801	Polarizer filter	1
CD499	Quarter wave filter	1
CD541	Electromagnet	1
SE1044	Power supply for electromagnet	1
SN1023	Mercury lamp with supply	1
CD502	Mercury lamp holder	1
CD935	Fabry-Perot etalon	1
R9448	Microscopic camera	1
SEA20	Digital Gauss meter	1
CD936	Color filter with holder	1
SL233	Micrometer Eyepiece	1
C11837	Fixed slider	5

Additionally Required
Computer (not supplied with this setup)

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PLANCK'S CONSTANT BY Cs PHOTOCELL SK054

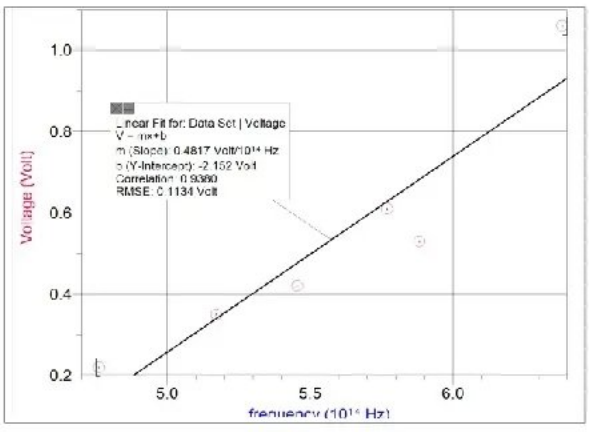
Experiment:
Exp-1 To determine Planck's Constant by Cs Photocell.

Salient features
- Multipurpose electrometer amplifier.
- Cs photo cell.
- Multipurpose power supply.
- Monochromatic light source may be used in many other experiments also.
- Hexagonal optical bench .

Key topics:
- Photoelectric effect.
- Photo cell.
- Work function.
- Planck's constant.
- Photoelectric voltage.
- Photon energy.



Principle and Working:
Einstein postulated that light consists of a quantum of particles, called photon whose energy E is proportioned to the frequency ν, by an equation, $E = h\nu$, where h is planck's constant.
In this experiment, narrow band interference filters are used to select wave length. Each filter selects precisely one spectral line from the light of a high pressure mercury lamp. The monochromatic light falls on the cathode of the photocell. A capacitor, connected between cathode and anode of photocell, charged by anode, is used. Electrometer amplifier is used to measure the voltage at capacitor without current.



Contents:

Cat. No.	Item Name	Qty.
SE080	Power Supply 12V AC/DC 5Amp	1
SZ010A	Photocell	1
SW440	Mercury Light Source	1
SL754	Convex lens in holder	1
SW752	Iris Diaphragm	1
SLA65	Set of Color Filters	1
C0449A	Set of Interference filter (optional)	1
SD003	Electrometer Amplifier	1
SEB15	Capacitor, 100 pF , 630 V	1
SEB38	Push Switch module	1
SE067	Digital multimeter	1
C13018	Optical bench triangular	1
C11837	Fixed slider	2
C11829	Transversal slider	1
SN203	Flexible plug lead red (50 cm)	1
SN200	Flexible plug lead black(50 cm)	1
SN207	Flexible plug lead Yellow (100 cm)	1
SN206	Flexible plug lead Yellow (50 cm)	2
SN201	Flexible plug lead black(100 cm)	1
SN204	Flexible plug lead Red(100 cm)	1
C4342	Earthing Lead	1

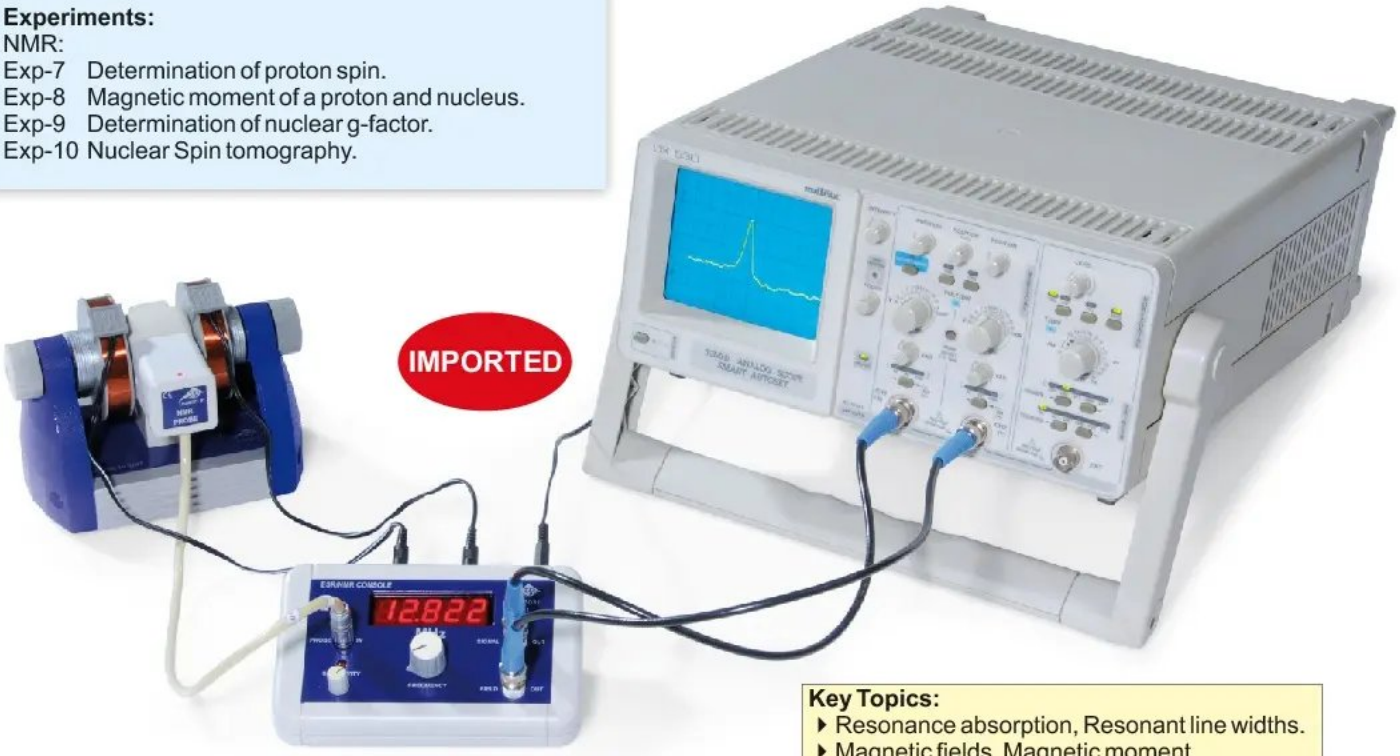
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ELECTRON SPIN RESONANCE AND NUCLEAR MAGNETIC RESONANCE (ESR-NMR) SN1029

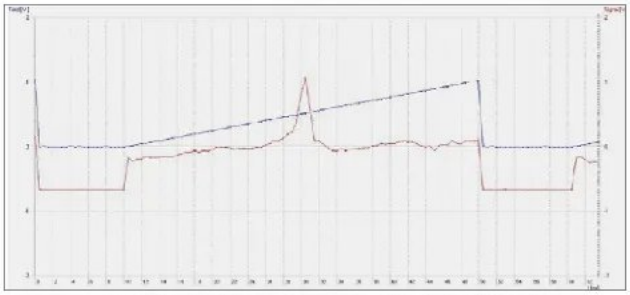
Experiments:
ESR:
Exp-1 Line width.
Exp-2 Electron Spin.
Exp-3 Magnetic moment of an electron.
Exp-4 Determination of electron g factor.
Exp-5 Resonance Absorption of a high frequency oscillating circuit.
Exp-6 Dependence of resonance frequency on magnetic field.

Salient features
- Modular set for ESR/NMR
- Table top experiment.
- Easy to setup.
- Glycerin, Teflon, and polystyrene sample for NMR
- DPPH sample for ESR

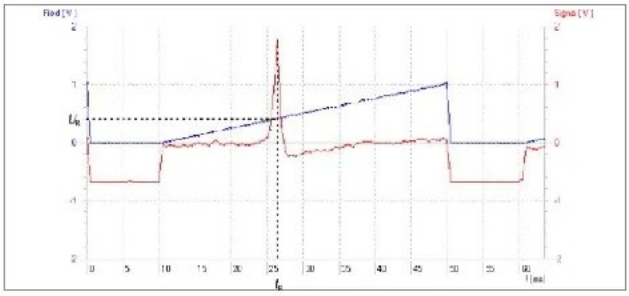
Experiments:
NMR:
Exp-7 Determination of proton spin.
Exp-8 Magnetic moment of a proton and nucleus.
Exp-9 Determination of nuclear g-factor.
Exp-10 Nuclear Spin tomography.



Key Topics:
- Resonance absorption, Resonant line widths.
- Magnetic fields, Magnetic moment.
- Electron and proton spin.
- Nuclear g-factors, Nuclear-spin tomography.



NMR of Glycerine v = 12,854 MHz)



ESR of DPPH v = 40 MHz)

In this set-up, the ESR of an unpaired electron of DPPH is studied. Study of NMR is carried out by using samples such as glycerine, teflon and polystyrene. The applied magnetic field is varied to determine the frequency at which the resonance occurs. Included 1coil pair is used here to obtain the variable magnetic field. The control panel provides the voltage-control, power to the ESR/NMR probes and coil pair and processes the signal to be obtained in the oscilloscope. ESR Basic Set, ESR Supplementary Sheet, Analogue Oscilloscope & HF Patch Chord are required to conduct the experiments listed under the heading of ESR. NMR Basic Set, NMR Supplementary Sheet, Analogue Oscilloscope & HF Patch Chord are required to conduct the experiments listed under the heading of ESR.

Contents:

Cat. No.	Item Name	ESR	NMR
U189021	ESR/NMR Basic Set	1	1
U189021	NMR Supplementary Set		1
U188501	ESR Supplementary Set	1	
U11255	HF Patch Cord	2	2
U11175	Dual Channel Oscilloscope (Optional)	1	1

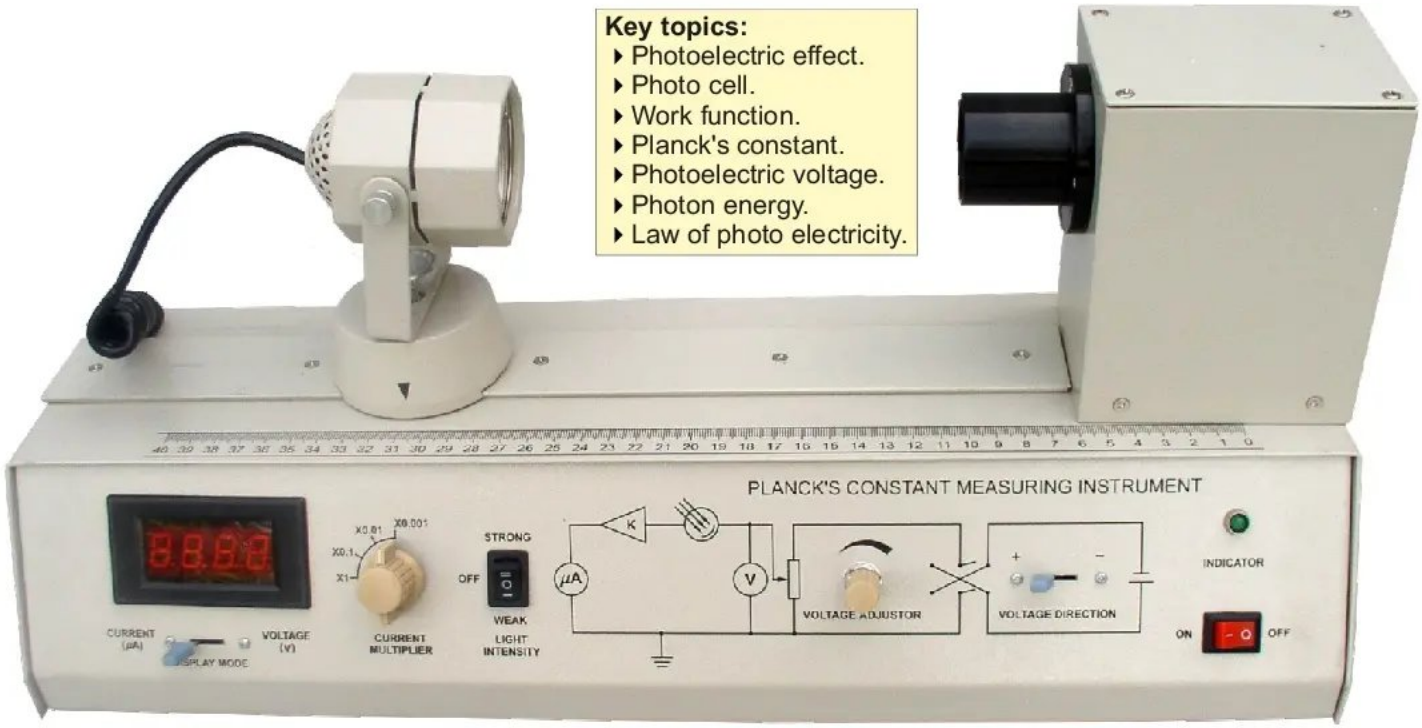
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PLANCK'S CONSTANT SN627

Experiments:
Exp-1 To determine planck's constant.
Exp-2 To verify the inverse square law.

Salient Features:
- Inbuilt power supply & photocell.
- Different types of filters and LED.
- Different types of wave length of filters and LED.

Key topics:
- Photoelectric effect.
- Photo cell.
- Work function.
- Planck's constant.
- Photoelectric voltage.
- Photon energy.
- Law of photo electricity.

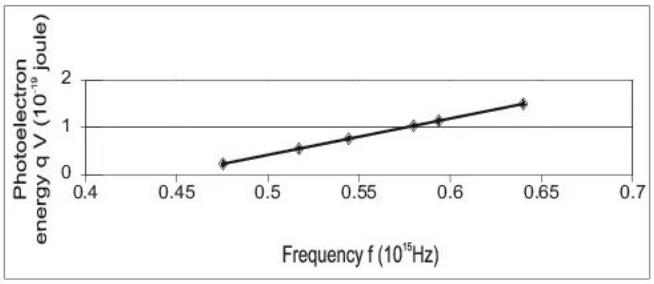




PLANCK'S CONSTANT APPARATUS

SPECIFICATIONS

Light source	: Tungsten-halogen 12V / 35W
Scale	: Length 400mm
Photocell	: Cs Vacuum Phototube
Dark-current	: < 0.003 μA
Display mode switch	: Displays current (μ A) or voltage (V)
Current multiplier	: X1, X0.1, X0.01 & X0.001
Accelerate Voltage	: -15V to 0V & 0 to15V, < ±2%
Power supply	: 220V / 50Hz
Measuring error	: < ± 15% compared with the recognized value (h=6.62619x 10^{-34}J.S)



Principle and Working:
The photon energy by Einstein equation E=hν is equal to energy gap E_g between the valence and conduction bands. The energy E_g is equal to the energy barrier eV_0, that electron have to overcome in going from n-doped side of diode junction to p-doped side when no external voltage V is applied to the diode.
In the p-doped side, electron recombine with holes releasing the energy E_g in the form of photon emit given by equation

$$E_g = eV_0$$

Contents:

S. No.	Item Name	Qty.
1	Planck's constant apparatus	1
2	Set of color filters	1

SET OF COLOR FILTERS

SPECIFICATIONS

Red	: 635nm
Orange	: 570nm
Yellow	: 540nm
Green	: 500nm
Blue	: 460nm

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PLANCK'S CONSTANT BY LED SK014

Experiments:

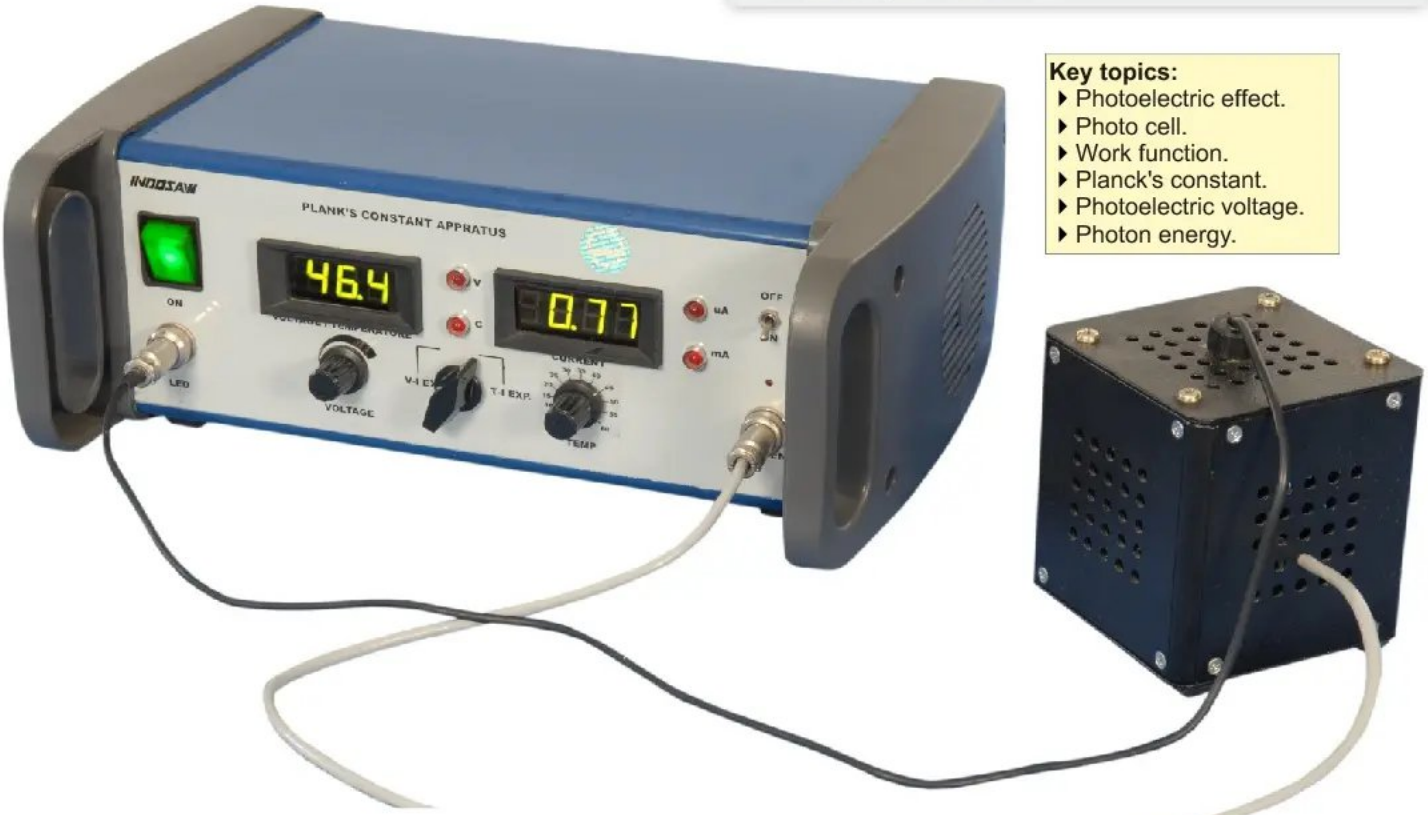
Exp-1 Determination of material Constant h.
Exp-2 Determination of Temperature Coefficient of Current.
Exp-3 Determination of Planck's Constant by LED method.

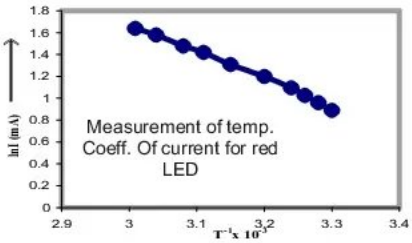
Salient features:

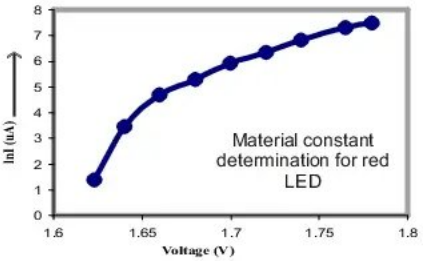
- It is a self contained unit.
- Using LED method instead of photocell & monochromatic light source reduces cost.
- Built - in power supply for Oven (oven ambient to 60°C, resolution 0.1°C).
- Variable voltage source 0 - 2V DC, resolution 1mV.
- Current meter 0-20mA / 2000mA.
- In - built temperature sensor.

Key topics:

- Photoelectric effect.
- Photo cell.
- Work function.
- Planck's constant.
- Photoelectric voltage.
- Photon energy.







Principle and Working:

The photon energy calculated by Einstein equation $E=h\nu$ is equal to energy gap E_g between the valence and conduction bands. The energy E_g is equal to the energy barrier eV_0, that electron have to overcome in going from n-doped side of diode junction to p-doped side when no external voltage V is applied to the diode.

In the p-doped side, electron recombine with holes releasing the energy E_g in the form of photon is given by equation

$$E_g = eV_0$$

In the present setup ,the Planck Constant is given by

$$h = \frac{eV_0\lambda}{c} \qquad \text{Where,} \qquad V_0 = V - \left[\frac{\Delta \ln I}{\Delta T^{-1}} \text{X} \frac{k}{e} \text{X} \eta\right]$$

Contents:

Cat No.	Item Name	Qty.
SEA95	Planck's constant apparatus	1
SEB06	Oven	1
SEB09	LED red	1
SEB10	LED yellow	1
R0696	Power cord	1

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PLANCK'S CONSTANT EXPERIMENTS SN1068

Experiments:

Exp-1 To measure the current voltage characteristic of the photoelectric cell.

Exp-2 To determine the value of Planck's constant h.

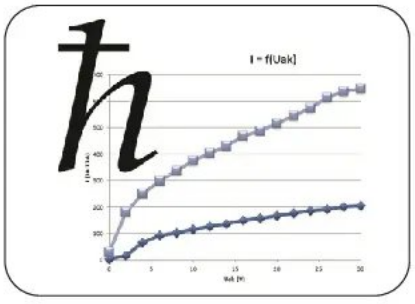
Key Topics:

- Determining h
- Implementing a protocol
- Measuring the current-voltage characteristic of the photoelectric cell



Principle and Working:

The emission of electrons by a metal material when the latter is exposed to electromagnetic radiation of a sufficiently high frequency, is a means of approaching and better understanding the particulate aspect of light. The experiment proposed, using our photoelectric cell, a HP mercury spectral lamp and a micro-ammeter, aims at showing the photoelectric effect, verifying Einstein's equation and experimentally measuring Planck's constant. To do this, the photoelectric cell, with a spectral range from approx. 340 to 700 nm, is installed in a metal box ensuring its light insulation and safety. A drum secured on the front of this box allows a variety of filters and diaphragms to be placed in front of the cell to perform a set of measurements. Last but not least, one device only is used to supply both the cell anode and cathode with two voltage ranges (-2/2 V and -2/30 V) and as micro- ammeters to measure photo-current (with a number of measurement ranges: 10-8 to 10-13 A).



Contents:

S.No.	Item Name	Qty.
1	Planck's constant power supply	1
2	Photocell in holder with stand	1
3	Colour filter	1
4	Light source with stand	1

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RADIATION COUNTER SN615

Experiments:

Exp- 1 Plotting a Geiger Plateau characteristics curve.
Exp- 2 To calculate the Statistics of Counting.
Exp- 3 To study the Background radiation.
Exp- 4 To measure the Resolving Time **(RSS2 is required)**.
Exp- 5 To verify the Inverse Square Law.
Exp- 6 To calculate the Range of Alpha Particles.
Exp- 7 To study the Absorption of Beta Particles.
Exp- 8 To calculate the Beta Decay Energy.
Exp- 9 To calculate the Absorption of Gamma Rays.
Exp-10 To calculate the Geiger Tube Efficiency.
Exp-11 To calculate the Shelf Ratios.
Exp-12 To study the Backscattering.

Salient features

- Preset Time
- Digital Ratemeter
- Preset Audio Alarm
- Adjustable High Voltage
- Volume Control
- Operate both manual and software mode.

Key Topics:

- G.M. counter.
- G.M. tube efficiency.
- Alpha, Beta & Gamma radiation.
- Decay energy.

IMPORTED



Radiation Measurement System is built around the Radiation Counter and GM tube along with different types of radioactive sources and absorbers to study the characteristics of radiation, background radiation, Gm's operation and the interaction of radiation with matter. The radiation counter includes the features of a preset time function, a digital rate-meter with audible beeper and alarm and digitally controlled high voltage supply and computer interfacing via USB cable.

Operation may be as a stand-alone station or directly from the computer when used. Data files are saved in spreadsheet compatible format for importing in most common spreadsheets allowing the student to perform calculations and graph the results for printing.

The Radiation Counter is equipped with upgraded high voltage and an internal pre-amplier allowing operation with optional scintillation detectors for gross gamma counting.

Contents:

Cat No.	Item Name	Qty	Exp. No.
ST360	Radiation Counter	1	1 - 13
GP35	GM-35 Tube with stand	1	1 - 13
RAS20	Set of 20 absorbers	1	7,8,9,12
LSDISK50	Lead shield for radioactive source	1	1 - 13
USB6	USB cable	1	1 - 13
LM5	Manual CD	1	1 - 13
RSS5	Set of five radioactive source	1	1,2,3,5,6,7, 8,10,11,12
RSS8	Set of 8 gamma sources (optional)	1	9
RSS2	Set of three half disks	1	4

Additionally Required :
Computer (not supplied with the setup).
Isotope generator for Gamma Rays experiment .

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GAMMA SPECTROSCOPY & COMPTON EFFECT SN1038

Experiments:

Exp-1 Detecting Gamma Radiation with a scintillation counter.
Exp-2 Recording and calibrating Gamma Spectrum.
Exp-3 Identifying & determining activity of radioactive samples.
Exp-4 Qualitative observation of the Compton Effect.
Exp-5 Energy calibration.
Exp-6 Detector Energy Resolution.
Exp-7 Pair Production and Annihilation.
Exp-8 Counting Statistics.
Exp-9 Absorption of Gamma radiation.
Exp-10 Multichannel scaling and Half Life.

Salient Features

- An external MCA interfacing through the computer USB port.
- USB Support
- Powerful System Software for Analyzing data.
- Connects to a USB port eliminating the need to install cards inside the computer.

Key Topics:

- Scintillation detector.
- Gamma radiation.
- Energy resolution.
- Multichannel analyser.
- Compton effect.
- Pair production and annihilation.
- Half life.

IMPORTED



This setup with internal pre-amplifier allows direct connection to scintillation detectors. The bipolar amplifier includes polarity selection and multiple shaping times when using different types of detectors with external pre-amplifiers. Upper and lower level discriminators may be set for rejection of unwanted signals. The high voltage supply is rated to +2048V for use with scintillation or proportional detectors. Optional polarity selection is available for use with detectors requiring negative bias. A pre-amplifier power connector (±12V) is included for use with our model PA-1 external pre-amplifier. A 10µsec fixed conversion ADC allows high throughput with dead-time correction. Input selection for pre-amplifier, amplifier or ADC is controlled through computer. A background buffer is included for storing a spectrum when background subtraction, factional spectrum stripping or overlay is required. Presets include real time, live time and ROI integral. UCS30 may be operated as a multichannel scaler for time correlated studies e.g. half-life decay. A special mossbauer mode is included with MSB output for synchronization of the drive circuit. X-ray mapping may be performed with the optional ROI output. An auto-calibrate mode is provided that automatically sets the HV and amplifier gain to 1 keV/channel using a Cs-137 source.

Additionally Required :
Computer (not supplied with the setup).
Isotope generator for half life experiment .

Contents:

Cat No.	Item Name	Qty.
UCS30-XK	Universal Computer Spectrometer	1
SPA 38	Scintillation probe with stand	1
RSS 8	Set of 8 gamma sources	1
RAS20	Set of 20 Absorbers	1
LSDISK 50	Lead Shield for radioactive sources	1
USB 6	USB cable	1
LM5	Manual CD	1

Computer Spectrometer Options
UCS301K - 1024 channel .
UCS302K - 2048 channel .
UCS304K - 4096 channel

Note:
RAS20 is required only for Exp-9.
Isotope generator is required only for Exp-10.

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X-RAY APPARATUS SN1028

Experiments:

Exp-1 Diffraction of X-Ray:
- Bragg's Law.
- Laue's Method.
- Debye Scherrer's Method.
- To determine Planck's constant by using Duane-Hunt's displacement law.

Exp-2 Mosley's Law.
Exp-3 Distance Law.
Exp-4 Absorption Experiment.
Exp-5 Dosimetry and Radiation Protection.
Exp-6 Properties of X-rays:
- Transmission.
- Linear Propagation.
- Ionization.
- X- Ray Photography.

Exp-7 Fluorescent radiation.
Exp-8 Shielding of X-Rays.







IMPORTED







Contents:

Cat No.	Item Name	Qty.
1000665	X-Ray Apparatus	1
1000666	Basic Equipment Set	1
1000667	Crystallographic	1
1000661	Radiography Accessories	1
1012871	Geiger Muller Tube	1
1000669	Bragg Driver	1
1000670	Filmpack 2	1
1008508	Filmpack 4	1

The experiment chamber is contained in a closed, radiation-proof housing with a transparent synthetic-glass shield. The high vacuum X-Ray tube with the directly heated tungsten cathode and copper anode is positioned in a borosilicate glass chamber with a thin walled, concave ray emission window. A lead glass hood with a collimator causes X-rays to emerge in parallel with the experiment plane and provides a shield against scattered radiation. The horizontal counter tube goniometer consists of a central sample holder and the swiveling arm. In the form of a slight ray, this arms serves as a mount for the GM Tube, ionization chamber as well as experimental devices in slide format or on a 5cm X 5cm base plate. This swiveling arm can be rotated manually independently of the sample holder or at a fixed mutual angle with the ratio of 2:1, for instant, for experiments involving Bragg's refection. The devices equipped with angle and mm scale, position marking for experimental devices, as well as radiation proof bushings for cables and houses.

Additional Items:

Cat No.	Item Name	Qty.
1008629	X-Ray Energy Detector	1
1012868	Set of Fluorescence Sample	1

*** Note:**
- All the experiments(except Experiment No. 2 &7) can be performed using primary items.
- X-Ray energy detector and Set of Fluorescence Samples are required to perform the experiment for Fluorescent Radiation in addition to X-Ray apparatus.
- X-Ray Energy Detector is needed to perform Mosley's Law experiment in addition to X-Ray apparatus, Basic Equipment Set and Crystallographic Accessories.
- Bragg's reflection can also be studied by using X-Ray apparatus, Bragg Driver and Basic Set Bragg only.

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ELECTRON DIFFRACTION SN1030

Experiments:

Exp-1 Measuring the diameters of the two diffraction rings for different accelerator voltages.

Exp-2 Determining the wavelength of the electrons for different accelerator voltages by applying the Bragg condition.

Exp-3 Confirming the de Broglie equation for the wavelength.

Salient Features

- Electron Diffraction Tube with built-in graphite foil and fluorescent screen.
- Adjustable Anode voltage from 0V to 5000V range.
- Diffraction Patterns are noticed in fluorescent screen.



Key Topics:

- De-Broglie Wavelength.
- Wave nature of electron.
- Diffraction of Wave.
- Bragg's Law.

POWER SUPPLY U33010-230

SPECIFICATIONS

High voltage output	: 0-5000 V DC, max. 2 mA, max. 5 W
Heater voltage output	: 6.3 V AC, max. 3 A
Overload protection	: Primary: fuse
Secondary	: current-limiting resistors
Connections	: 4 mm safety sockets
High-voltage display	: Analogue
Dimensions	: 235x130x155 mm³ approx.
Weight	: 3.5 kg approx.
High voltage resistant up to 6 kV	

TUBE HOLDER U185001

SPECIFICATIONS

Terminals	: 4 mm safety sockets
Dimensions	: approx. 130x190x250 mm³
Weight	: approx. 570 g

When a polycrystalline graphite foil is illuminated by electron, it is diffracted by the various lattice plane within the crystal. This wave property of electron thus proves the de-Broglie's principle i.e. electrons are waves. In the fluorescent screen, the diffraction pattern is observed around a central bright spot. The diffraction patterns formed here satisfy Bragg's law.

SAFETY EXPERIMENT LEADS U138021

SPECIFICATIONS

Wire cross-section	: 2.5 mm²
Continuous current	: max. 32 A
Plug and jack	: 4 mm (nickel-plated)
No. of cords	: 15
Length	: 75cm
It comes in 3 different color like: red, black and blue.	

ELECTRON DIFFRACTION TUBE U18571

SPECIFICATIONS

Max. filament voltage	: 6.3 V AC
Max. anode voltage	: 5 kV
Anode current: approx. 0.1 mA at 4 kV	
Lattice constant of graphite: d10 = 0.213 nm; d11 = 0.123 nm	

Contents:

Cat No.	Item Name	Qty.
U18571	Electron diffraction tube S	1
U185001	Tube holder S	1
U33010-230	High voltage power supply 5kV (230V)	1
U138021	Set of 15 safety experiment leads	1

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THOMSON TUBE SN1031

Experiments:

Exp-1 Investigate the deflection of an electron beam by a magnetic field.
Exp-2 Estimate the specific charge of an electron.
Exp-3 Investigate the deflection of an electron beam by an electric field.
Exp-4 Construct a velocity filter using orthogonal electric and magnetic fields.

Salient Features

- Four experiment in one setup.
- Thompson Tube with built-in capacitor and fluorescent screen.
- Helmholtz Coil for production of magnetic field.

Key Topics:

- Thompson Tube, Electric Field, Magnetic Field, Helmholtz coil, e/m ratio
- Effect of the electric and magnetic field on electron.



TELTRON THOMPSON TUBE U18555

SPECIFICATIONS

Max. filament voltage	: 6.3 V AC
Max. anode voltage	: 5 kV
Max. capacitor voltage	: 500 V
Anode current	: approx. 0.1 mA at 4 kV (anode)
.008m between tick marks on screen	

HELMHOLTZ COIL PAIR U185051

SPECIFICATIONS

Number of turns	: 320
Coil diameter	: 138 mm
Load rating	: 1.0 A (Continuous operation) 1.5 A (Short-term operation)
Effective Impedance	: approx. 6.5 Ω
Terminals	: 4 mm safety sockets
Max. field strength	: approx. 9 mT

Thompson Tube is used to study the effect of electric and magnetic field on electron. A high voltage is applied between anode and cathode. Electrons are therefore emitted from cathode and accelerated towards anode. Cathode is maintained at ground potential. So electrons are emitted from cathode with a kinetic energy proportional to the anode voltage. These emitted electrons from cathode are then accelerated towards anode and pass horizontally through a slit behind the anode. These energetic electrons then impinge upon fluorescent screen where they are observed. A plate capacitor is used to displace the electrons vertically upward or downward in fluorescent screen. Helmholtz's coils are used to produce a horizontal magnetic field which moves the electrons in the vertical directions.

POWER SUPPLY U33010-230

SPECIFICATIONS

500 V output	: Voltage: 0 – 500 V DC, max. 50 mA
Stability at full load	: ≤0.01% ± 100 mV
Residual ripple	: ≤20 mV
50 V output	: Voltage: 0 – 50 V DC, max. 50 mA
Stability at full load	: ≤0.1% ± 30 mV
Residual ripple	: ≤50 mV
12 V output	: Voltage: 0 – -12 V DC, max. 4 A
Stability at full load	: ≤0.1% ± 30 mV
8 V output	: Voltage: 0 – 8 V DC, max. 3 A
Stability at full load	: ≤0.1% ± 30 mV
Displays	: Analogue, class 2
Connections	: 4 mm safety sockets
Power consumption	: 50 VA

TUBE HOLDER U185001

SPECIFICATIONS

Terminals	: 4 mm safety sockets
Dimensions	: approx. 130x190x250 mm³
Weight	: approx. 570 g

Contents:

Cat No.	Item Name	Qty.
U18555	Teltron Thompson Tube S	1
U185001	Tube Holder S	1
U185051	Helmholtz Pair of Coils S	1
U33010-230	Power Supply 5 kV (230 V, 50/60 Hz)	1
U33000-230	Power Supply 0 - 500 V (230 V, 50/60 Hz)	1
U138021	Set of 15 Safety Experiment Leads, 75 cm	1

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FOUR PROBE- RESISTIVITY MEASUREMENT SK012

Experiments:

Exp-1 Measurement of resistivity of semiconductor by four probe method.

Exp-2 Determination of Energy Band Gap.

Salient Features

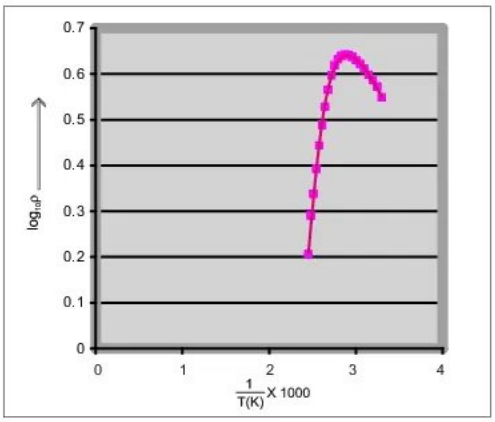
- Built-in constant current source, dual range millivoltmeter & power supply for oven.
- Pointed **spring loaded probes** ensure good electrical contacts with the sample.
- Sample crystal (Germanium).
- Digital Temperature Sensor

Key Topics:

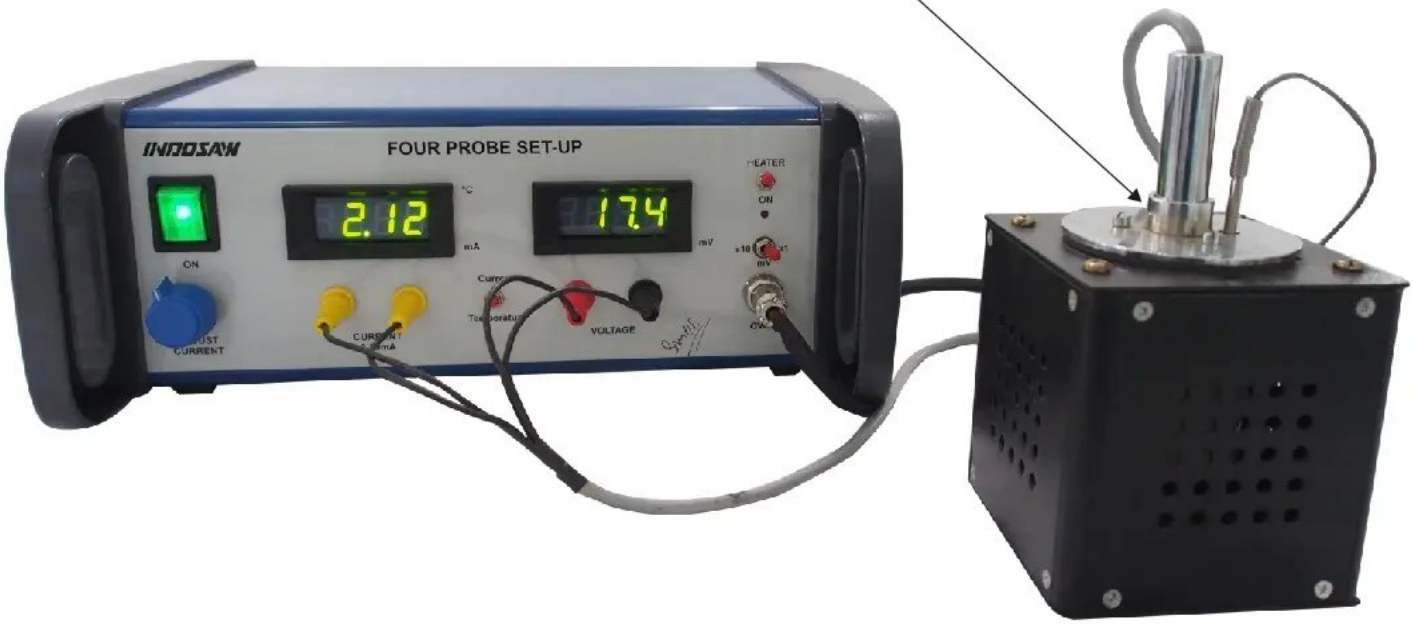
- Resistivity.
- Energy band gap.
- Electrical conductivity.
- Semiconductor.
- Four probe.
- Extrinsic semiconductor.
- Intrinsic semiconductor.



Contact Points



Plot for energy band gap determination of germanium



Principle and Working:

The resistivity of Ge crystal is given by $\rho=(V/I).2\pi s$,
Where V is voltage, I is current (mA) and s is spacing between two point electrode.
While the energy band gap is given by $Eg=(2k \log_e \rho)/T$
Where T is absolute temperature & k is Boltzmann constant.
In the present setup, the four probes are placed collinearly with equal spacing between them on the sample. The current is passed through the two outer probes and the potential is measured between the two inner probes. The errors due to electrical contacts are absent because the current and voltage leads are separate.

Contents:

Cat No.	Item Name	Qty.
SN168	Four probe power supply	1
CK135	Oven	1
C4192	Four probe arrangement	1
R4636	Sample crystal (Ge)	1
R9624	PT 100, Temperature sensor	1
R11023	Screw driver	1
R0696	Power cord	1

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PHOTOCONDUCTIVITY SK007

Experiment:

Exp-1 To study the current vs voltage characteristics of CdS photo-resistor at constant irradiance.

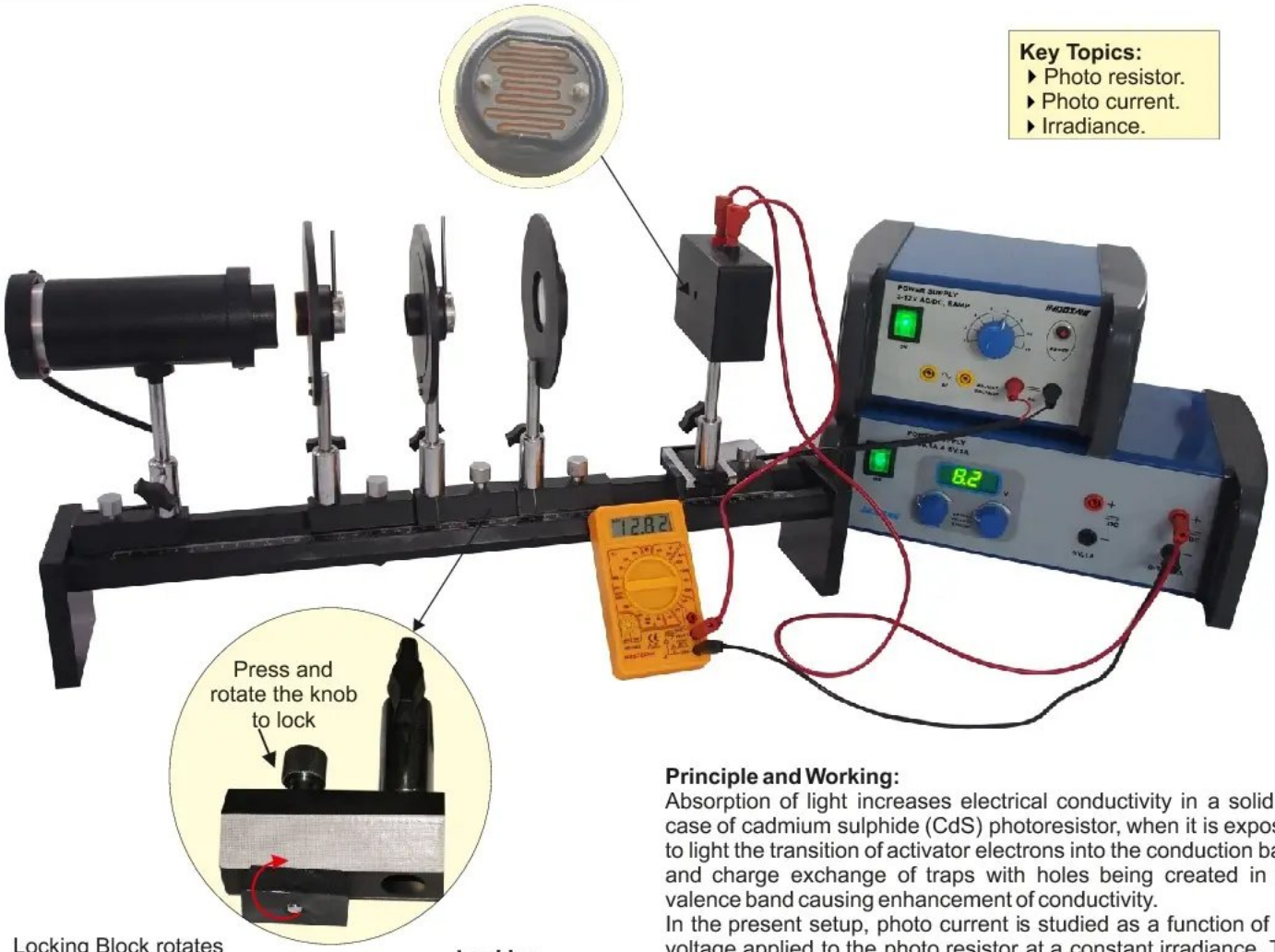
Exp-2 To measure the photo-current as a function of the irradiance at constant voltage.

Salient features:

- Multipurpose power supply.
- Electrical safety tested.
- Adjustable slit self centering.
- Marked analyzer & polarizer for angle measurement.

Key Topics:

- Photo resistor.
- Photo current.
- Irradiance.



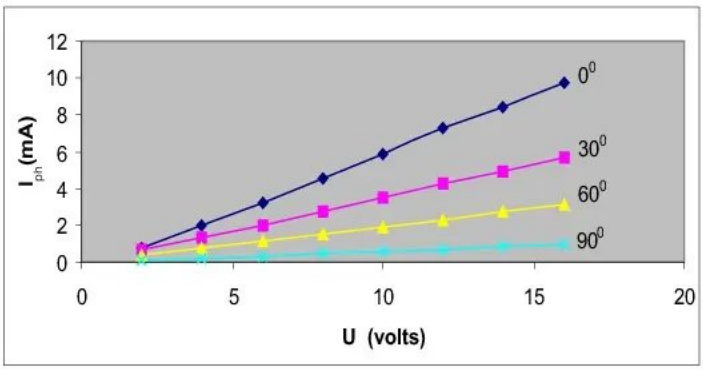
Locking Block rotates through knob & locks in channel from below

Locking arrangement

Principle and Working:

Absorption of light increases electrical conductivity in a solid. In case of cadmium sulphide (CdS) photoresistor, when it is exposed to light the transition of activator electrons into the conduction band and charge exchange of traps with holes being created in the valence band causing enhancement of conductivity.

In the present setup, photo current is studied as a function of the voltage applied to the photo resistor at a constant irradiance. The angle of polarization is changed by polarizer filter.



Current - Voltage Characteristics of CdS Photoresistor

Contents:

Cat.No.	Item Name	Qty.
SL804	Photoresistor in holder (CdS)	1
SE080	Power supply 12V AC/DC 5 Amp.	1
SL803	Lamp housing	1
SL754	Convex lens in holder	1
SL801	Polarizer/Analyzer (pair)	1
SL214	Optical bench(1mtr.)	1
SL802	Adjustable slit self centering	1
SW926	Power supply, 0-16V DC, 1A	1
SE067	Digital multimeter	1
SN203	Flexible plug lead, 50 cm (Red)	2
SN201	Flexible plug lead, 1m (Black)	1
SL436	Transversal saddle	1

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SOLID STATE PHYSICS HALL EFFECT

HALL EFFECT IN METAL SK199/SK200

Experiments:
Exp-1 To determine the proportionality of Hall Voltage and magnetic flux density.
Exp-2 To determine the polarity of Charge carrier.
Exp-3 To calculate the Hall constant R_H and the charge carrier concentration n.



Principle and Working:
If a current-carrying metallic conductor strip is located in a magnetic field B perpendicular to the direction of the current flow I, a transverse electrical field E_H and a potential difference is produced (Hall effect).
The following equation holds for the Hall voltage U_H

$$U_H = \frac{1}{n \cdot e} \frac{B \cdot I}{d}$$

B: magnetic flux density
I: current through the metallic conductor
d: thickness of the band-shaped conductor
n: concentration of charge carriers
e = 1.602-10^{-9}C: elementary charge
The Hall voltage U_H is caused by the deflection of the moving charge carriers in the magnetic field due to the Lorentz force, whose direction may predicted by the right hand rule. The factor

$\frac{1}{n \cdot e}$ is called Hall constant R_H:

$$R_H = \frac{1}{n \cdot e}$$

The sign of the Hall constant R_H is determined by the polarity of the charge carriers, predominantly responsible for the current.

Key Topics:
- Hall coefficient.
- Conductivity.
- Mobility.
- Conduction band.
- Charge density.
- Types of charge carriers.

Salient Features:
- **Modular and Compact** set up as compared to others which are too bulky.
- **Compact Electromagnet** made of U-core with yoke having low loss lamination.
- **Power Supply for all general purpose applications.**
- **Stackable** power supply, current source and gauss meter
- Electrical safety tested.

Contents :

Cat. No.	Item Name	SK200	SK199
C0610	"U" core	1	1
C5194	Pair of pole pieces	1	1
CD1154	Coils with 500 turns	2	2
C8534	Clamp arrangement	2	2
SE1004	Power Supply(30V, 10A)	1	1
SEA58	Constant current source	1	1
SEA20	Digital Gauss meter	1	1
SR010	Digital micro volt meter	1	1
C13062	Hall effect apparatus (tungsten)		1
C13063	Hall effect apparatus (silver)	1	
SN201	Flexible Plug leads 100cm, Black	3	3
SN204	Flexible Plug leads 100cm, Red	3	3
SN206	Flexible Plug leads 50cm, Yellow	1	1
R0696	Power Cord	3	3

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HALL EFFECT SK006

Experiments:

Exp-1 To determine Hall Voltage (p or n type).
Exp-2 To determine Hall Coefficient.
Exp-3 To determine the type of Charge carrier .
Exp-4 To determine Charge Density of carriers.
Exp-5 To determine the Resistivity of a given sample.
Exp-6 To determine the mobility of charge carriers.
Exp-7 To determine the Hall angle .

Salient Features:

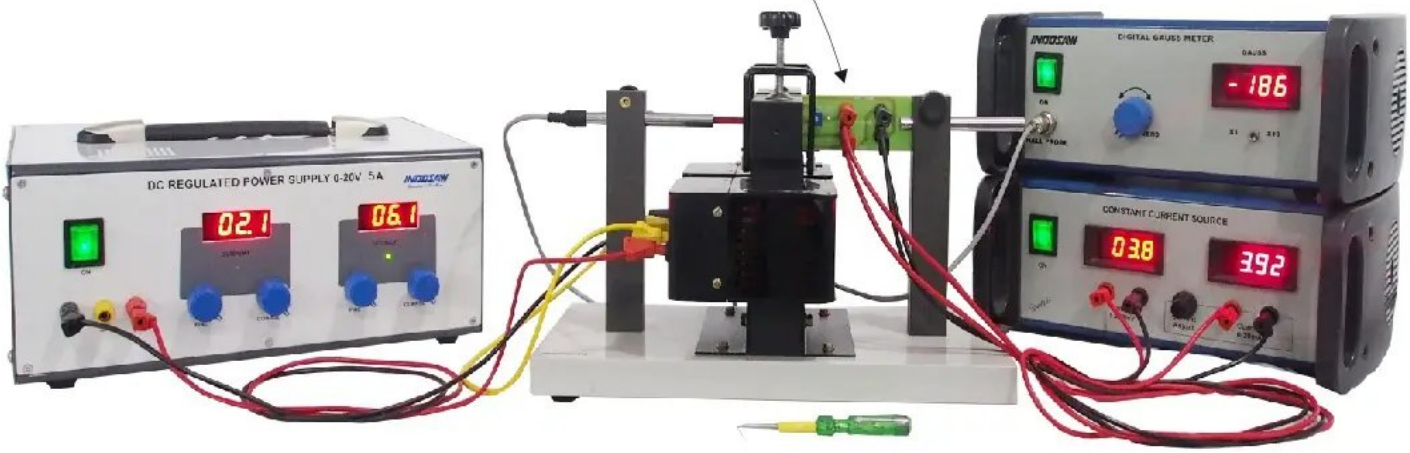
- **Modular and Compact** set up as compared to others which are too bulky.
- **Compact Electromagnet** made of U-core with yoke having low loss lamination.
- **Power Supply for all general purpose applications.**
- **Stackable** power supply, current source and gauss meter
- Electrical safety tested.

Key Topics:

- Hall coefficient.
- Conductivity.
- Mobility.
- Conduction band.
- Charge density.
- Hall angle.
- Resistivity.
- Types of charge carriers.



Crystal mount



Principle and Working:

When a conductor through which current is flowing, is placed in the magnetic field, a potential difference is generated between two opposite edges of the conductor in the direction mutually perpendicular to both the field and the conductor. This potential developed is Hall voltage & the phenomenon is called Hall effect.

In the present setup, the crystal mount on PCB is placed perpendicular to the pole pieces. Magnetic field is produced by electromagnet operated by 0-16V, 5A power supply. Field intensity measured by gauss meter with radial gauss probe. A constant current is passed through the crystal and hall voltage is measured by multimeter.

Contents :

Cat. No.	Item Name	Qty.
SR021	Hall Effect apparatus	1
SE079	Power Supply(20V, 5A)	1
SEA58	Constant current source	1
SEA20	Digital Gauss meter	1
R11023	Liner(Screw Driver)	1
SN201	Flexible Plug leads 100cm, Black	3
SN204	Flexible Plug leads 100cm, Red	3
SN206	Flexible Plug leads 50cm, Yellow	1
R0696	Power Cord	3
SEB01	GE crystal PCB	1

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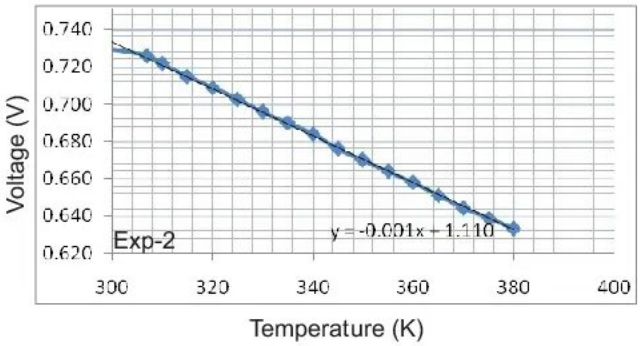
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STUDY OF P-N JUNCTION & ENERGY BAND GAP SK013

Experiments:
Exp-1 Determination of reverse saturation current.
Exp-2 Study of Energy Band Gap of p-n Junction.
Exp-3 Study of Junction capacitance.

Salient Features:
- Suitable for Diodes, Transistors.
- **Built - in** current source, bias voltage generator.
- **Built - in** power supply for oven.

Key Topics:
- Saturation current.
- Energy band gap.
- Temperature coefficient.
- Junction capacitance.



Temp vs V characteristic curve (Transistor BC109)



Principle and Working:
The slope of V-T curve used to measure the temperature coefficient of the junction voltage and the energy band gap is given by

$$V_{G0} = V(T) - T.\frac{dV}{dT} - \frac{m\eta kT}{q}$$

Where V(T) - Voltage at given temperature, dV/dT - Slope of curve, for Si, m = 1.5, η=2 at 300K and for Ge, m = 2, η=1 at 300K, η - Material constant and q - charge of electron = 1.6×10^{-19}C

Contents:

Cat. No.	Item Name	Qty.
SN170	P-N junction setup	1
CK142	Oven with temperature sensor	1
R4536	Junction transistor	1
R0322	Diode 1N5402	1
R8087	CRO probe	1

Additionally Required :
**CRO is an optional item, not supplied with the setup.*

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PIN DIODE CHARACTERISTICS SK060

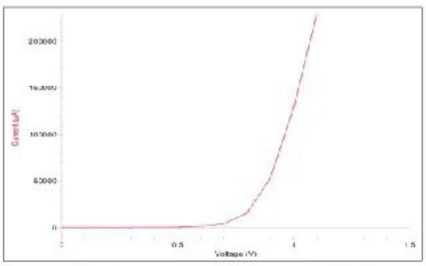
Experiments:

Exp-1 BPW34 PIN Photodiode forward and reverse bias characteristics for fixed irradiation.

Exp-2 Dependence of photocurrent on light intensity.

Salient Features:

- Highly sensitive photo-diode.
- Easy set-up.
- Multipurpose power supply with digital display.



Key topics:

- Dark current.
- Photo-diode.
- Photo current.
- Forward bias.
- Reverse bias.



The BPW34 is a high speed and high sensitive PIN photodiode in a miniature flat plastic package. Due to its water clear epoxy the device is sensitive to visible and infrared radiation. The large active area combined with a flat case gives a high sensitivity at a wide viewing angle.

In the present setup, the photo-diode characteristics in forward bias and reverses bias configuration for fixed irradiation is measured. Also, the dependency of photo-current on different irradiation will be measured.

Contents :

Cat No.	Item Name	Qty.
SW926	Power Supply0-16V, 1Amp	1
SN1016	Photo Detector	1
SL803	Lamp housing	1
SE067	Digital multimeter	2
LP17	Connecting Lead Pair	3
SZ039	Resistance Module	1
SE080	Power supply 2-12V AC/DC	1
C13056	Optical bench	1
SL216	Fixed saddle	2

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SUPERCONDUCTIVITY EXPERIMENT KIT SK053

Experiments:

Exp-1 To measure the transition temperature of a high temperature superconductor.

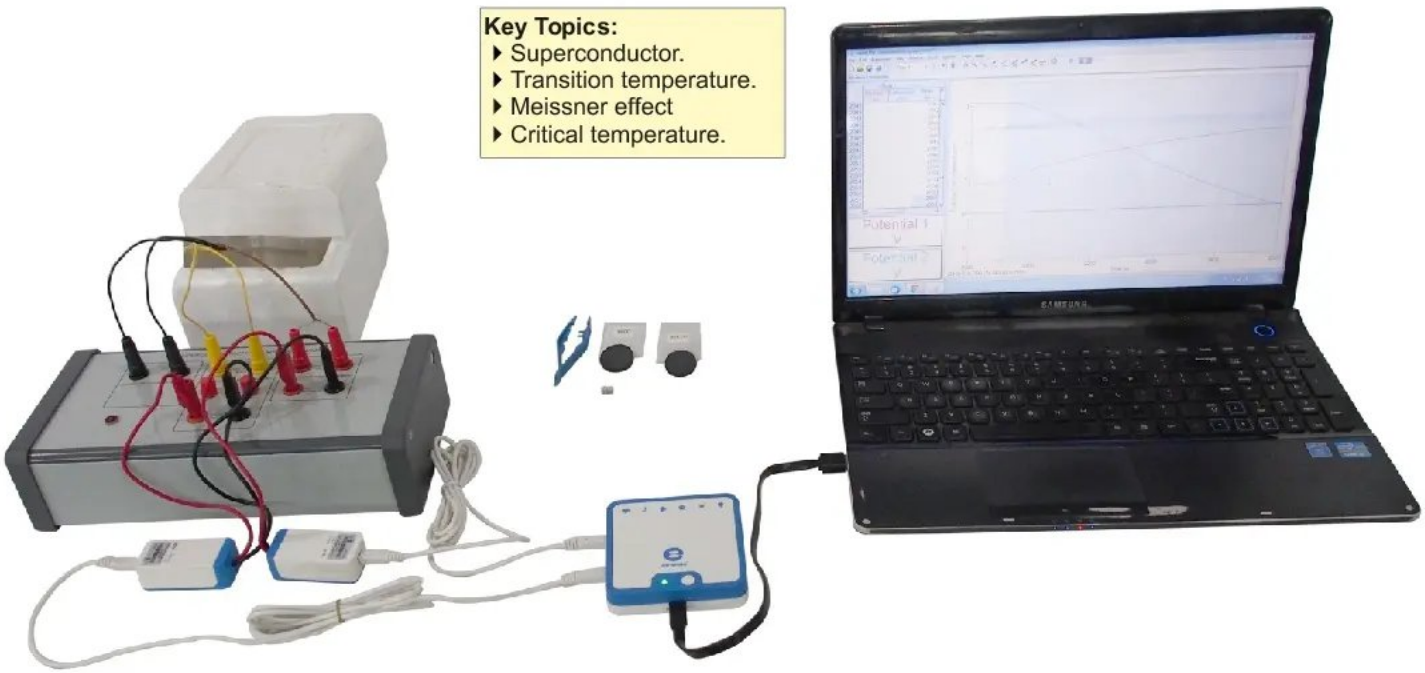
Exp-2 To demonstrate the Meissner-Ochsenfeld effect.

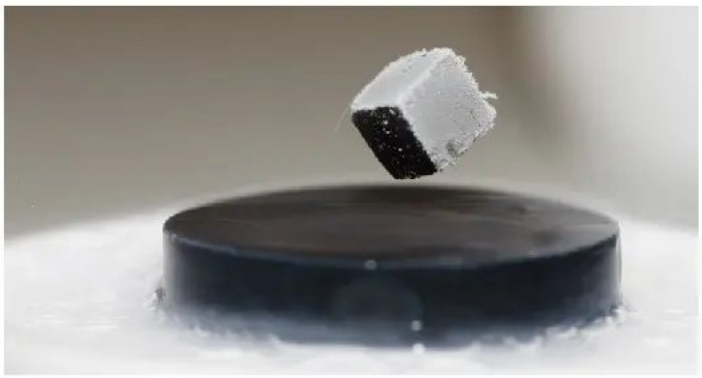
Salient Features:

- High quality superconductor with **in-built four probe & surface temperature sensor.**
- **Voltage probes** for temperature & voltage measurement.
- Data Logger may be used in other experiments also.
- Graphical display of the data.

Key Topics:

- Superconductor.
- Transition temperature.
- Meissner effect
- Critical temperature.





Superconductivity was discovered in 1911, when Kamerlingh Onnes found that the electric resistance of mercury dropped to zero at cryogenic temperatures. The so called transition temperature at which a conductor becomes superconducting depends on the material used. For the past 75 years, the transition temperatures were just in the 10 to 20 K range.

In the present setup, the transition temperature of high temperature superconductor YBCO or BSCCO is measured. A probe chamber is used for liquid nitrogen in which the superconducting probe (sample) is cooled to below its critical temperature of approximately 93 K or -180 °C. The superconductivity probe so designed precisely is based on four- point measurement for resistivity, the end points of which are for fixed current and middle points for voltage drop. A temperature sensor is also attached on the surface of the sample. The voltage drop across the sample is measured as a function of the sample temperature using the voltage sensor.

Additionally Required
Computer (not supplied with this setup)

Contents :

Cat No.	Item Name	Qty.
SU001	Superconductivity measurement unit	1
SU002	Superconductor with Probe arrangement	2
SU004	Meissner Effect Samples	2
SU003	Liquid nitrogen Chamber	1
IMC170	Data logger	1
C13049	Software CD	1
IMC171	Voltage sensor	2
SC402	Petri dish	1

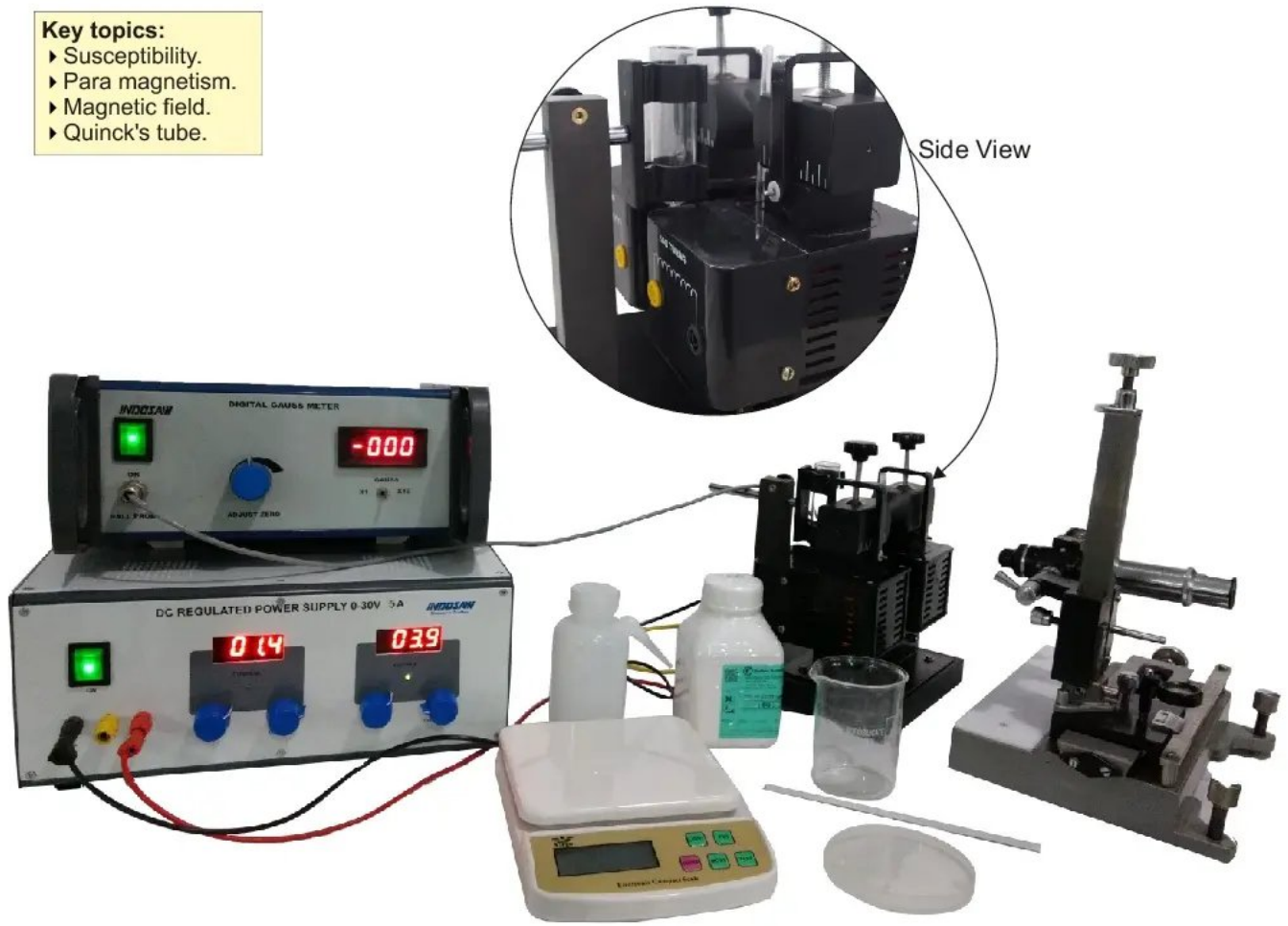
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QUINCK'S TUBE METHOD SK069

Experiment:
Exp-1 Susceptibility of paramagnetic sample by using quinck's tube method.

Salient Features:
- Compact electro magnet.
- Electrical safety tested.
- High magnetic field.

Key topics:
- Susceptibility.
- Para magnetism.
- Magnetic field.
- Quinck's tube.



Principle and Working:

Quinck's method is based on the force experienced by a magnetised material in a non-uniform magnetic field and is a version of Gouy's method. It is specially adapted for liquids. On the basis of susceptibility, a substance can be classified as diamagnetic, paramagnetic and ferromagnetic, which is an important observation in material science.

In the present setup, the liquid moves under the action of the total force F until it is balanced by the pressure exerted over the area A due to a height difference 2h between the liquid surfaces in the two arms of the U-tube. Allowing for the susceptibility χ_a and density ρ_a of the air which the liquid displaces, it follows that,

$$A\,(X-X_a).(B^2-B_0^2)/2\,\mu_0=2Ah\,(\rho-\rho_a)g$$

where g is the acceleration due to gravity, ρ density of liquid, so that

$$(X-X_a)\,(B^2-B_0^2)=4\,\mu_0 h\,(\rho-\rho_a)g$$

by plotting h as a function of B^2, the susceptibility χ can be determined directly from the slope of the graph.

Contents :

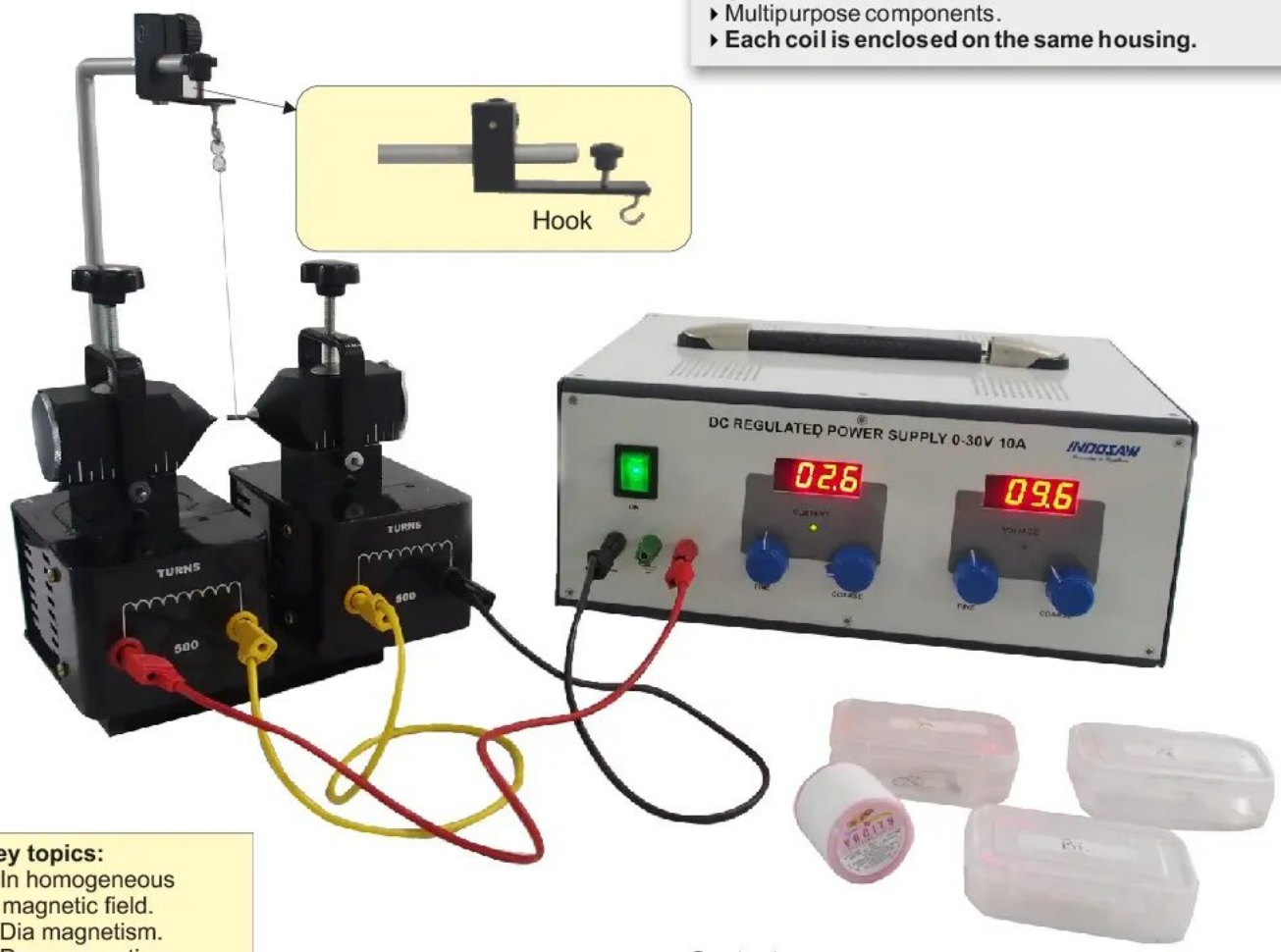
Cat. No.	Item Name	Qty.
CD541	Electromagnet	1
SE079	Power Supply for Electromagnet	1
C0994	U Tube with Stand	1
SF908	Traveling Microscope	1
SEA20	Digital Gauss Meter	1
SN204	Connecting Lead Red	1
SN201	Connecting lead Black	1
SN206	Connecting Lead Yellow	1
R8213	Electronic Balance	1
SC1049	Manganous sulphate	1
SC211	Measuring Cylinder 100ml	1
SF055	Pipette 10ml	1
SC379	Funnel	1
SJ015	Dropper	1

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DIA-, PARA-, AND FERROMAGNETISM SK048

Experiment:
Exp-1 To demonstrate dia-para-ferro magnetism in an inhomogeneous magnetic field.

Salient features:
- **Reversible pole pieces for centric and homogenous magnetic field.**
- **Coils** are enamelled Cu wire wound round on high impact plastic moulded bobbins.
- Multipurpose components.
- **Each coil is enclosed on the same housing.**



Key topics:
- In homogeneous magnetic field.
- Dia magnetism.
- Para magnetism.
- Ferro magnetism.
- Magnetic dipole.

Diamagnetism is the property of material which causes it to create a magnetic field in opposition of an externally applied magnetic field, thus causing a repulsive effect.

Paramagnetism is a form of magnetism which occurs in the same direction presence of an externally applied magnetic field. Paramagnetic materials are attracted to by external magnetic fields.

Ferromagnetism is the basic mechanism by which certain materials (such as iron) become permanent magnets and/or exhibit strong interactions with magnets. They are also magnetized strongly in the direction of external field.

The present setup demonstrates the magnetic behavior of Bismuth, Nickel and Aluminium samples when suspended freely in an inhomogeneous magnetic field. These metals are attracted or repelled by magnetic field depending upon the magnetic property of the metal under investigation.

Contents :

Cat No.	Item Name	Qty
SE1004	Power supply 0-30V DC,10 A	1
C0609	U-Core	1
C7553	Pole piece with hole(pair)	1
C8112	Pointed attachment for pole pieces(pair)	1
CD1154	Coil 500 turns (Left)	1
CD1155	Coil 500 turns (Right)	1
SG110	Cylindrical base	1
C7758	Rod 'L' shaped	1
C7759	Attachment assembly	1
SN203	Flexible plug lead, red	1
SN200	Flexible plug lead, black	1
SN206	Flexible plug lead, yellow	1
C7761	Bi sample	1
C7762	Ni sample	1
C7763	Al sample	1
R4514	Cotton Reel	1
CD891	'S' Shape Hook	1

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STUDY OF BH-CURVE WITH DEEP S1010

Experiments:
Exp-1 To study BH-Curve.
Exp-2 To study permeability curve

Salient Features
- **Auto identification** of sensors
- **High speed** data transfer
- **Programmable** delay in data acquisition
- **Programmable** sampling frequency
- **Graphical Analysis**
- **Automatic & manual** mode of demagnetization

Key topics:
- Magnetic induction.
- Magnetic flux.
- Magnetic field strength.
- Hysteresis.
- Remanence.
- Coercivity.
- Hysterisis loss.


Automatic Core Demagnetization



Principle and Working:
A Magnetic field is generated in a U & I shape iron core by continuous (Sin or Triangular) wave to primary coil which generates the magnetic field strength H as

$$H=(N_1/L).I_1$$

where L: Effective length of iron core, N_1: Number of turns.
The corresponding magnetic induction B is obtained through integration of the voltage V induced in second coil as:

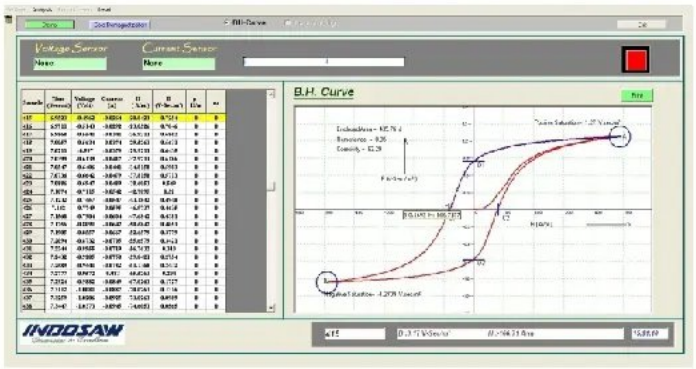
$$B=(1/N_2.A).\int V.dt$$

where A: Cross-section of iron core, N_2: Number of turns.
In the present setup, the magnetization curve and Hysteresis curve as function of the magnetic field strength H is plotted.



No need of Expensive Oscilloscope

Graphical Analysis (Easy and Fast Analysis on PC)



Automatic collection of data and plotting of graph

Contents :

Cat No.	Item Name	Qty.
C1713	DEEP_ BH Software	1
CD433	Data Logger with Current Booster	1
C7994	Power Unit	1
CD861	Voltage Sensor ± 1V	1
CD860	Current Sensor ± 1A	1
C0608	I Core	1
SW178	Coil 300 turns(pair)	1
CD511	Resistance Module 10Ω , 10 W	1
C0610	U Core	1
LP18	Flexible lead (100 cm)	4 Set
R9964	USB Cable	1

Additionally Required
Computer is required with this setup.

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BH-CURVE SK182

Experiments:

Exp-1 To find hysteresis loop of an iron core.
Exp-2 To find corrosivity and retentivity of an iron core.
Exp-3 To show the effect of varying voltage and frequency on hysteresis loop.

Salient Features

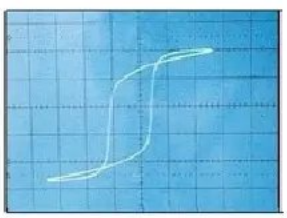
- No need of external current and voltage sensor's
- Input Frequency changeable 5 to 500Hz
- Input Voltage changeable 0 to 10V
- Modular approach
- Easy to use

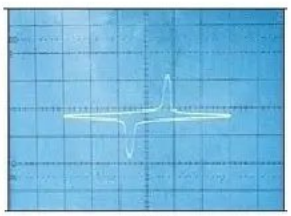
Key topics:

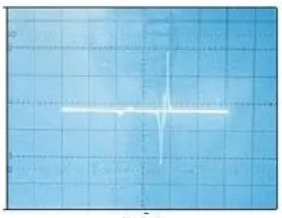
- Magnetic induction.
- Magnetic flux.
- Magnetic field strength.
- Hysteresis.
- Remanence.
- Coercivity.
- Hysterisis loss.



*** Additionally Required**
CRO (not supplied with this setup)


FIG-1


FIG-2


FIG-3

Principle and Working:

When a cylindrical sample is placed coaxially in a periodically varying magnetic field the magnetisation in the sample also undergoes periodic variation. This variation is packed up by a coil placed coaxially with the sample.

For the uniform field Ha produced, the effective field H acting in the cylindrical sample will be

$H = Ha - NM$ or

where M is magnetisation, N is normalised demagnetisation factor including 4p and J is the magnetic polarisation defined by

$B = m\,0H + J$

with B = m H or m 0(H+M) as magnetic induction. The signal corresponding to the applied field, Ha can be written as

$e1 = C1Ha$

where C1 is a constant

Contents :

Cat No.	Item Name	Qty.
CD1277	BH Curve Power Supply	1
C0608	I Core	1
SW178	Coil 300 turns	2
C0610	U Core	1
LP18	Flexible lead Yellow (100 cm)	4
R9931	BNC to BNC Cable	2
R0696	Power cord	1

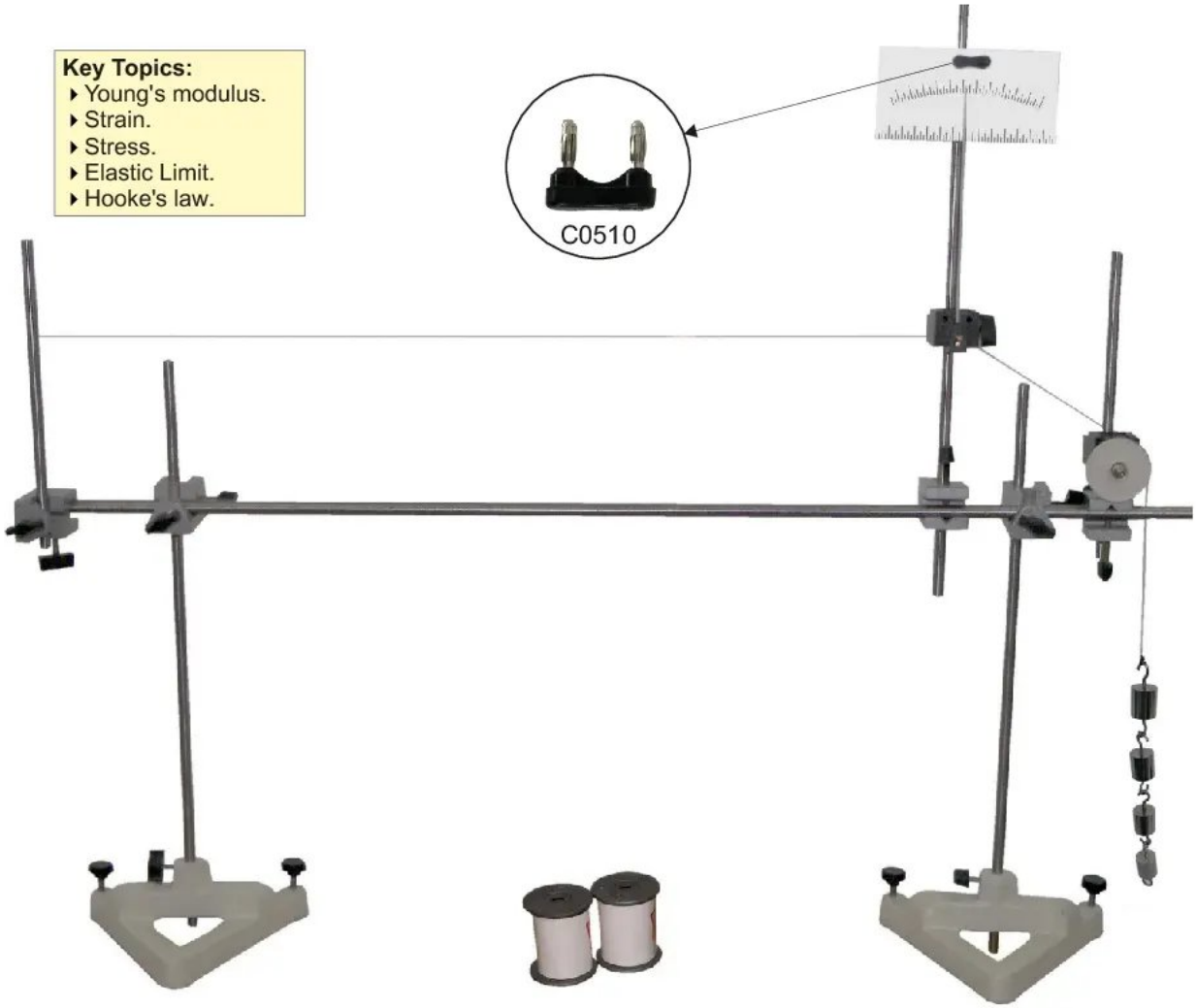
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ELASTIC AND PLASTIC DEFORMATION SK050

Experiment:
Exp-1 To investigate the elastic and plastic extension of metal wires.

Salient features:
- Easy setup.
- Modular approach.

Key Topics:
- Young's modulus.
- Strain.
- Stress.
- Elastic Limit.
- Hooke's law.

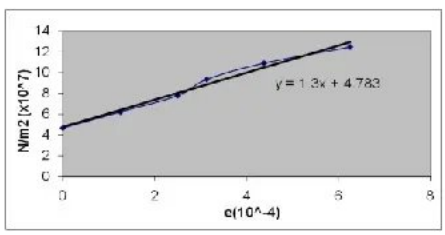


Principle and Working:
The ratio of the normal stress to the longitudinal strain is called Young's modulus of elasticity. If a wire of length 's' and area of cross section 'a' be stretched by a force F and if a change (Increase) of length Δs is produced , then

Normal stress =F/a, Longitudinal strain, ε= Δs /s

Modulus of elasticity, E= Normal stress/ longitudinal strain.

In the present setup the extension produced is magnified by 40 times for easy observation on a pointer scale.



Modulus of Elasticity of Cu

Contents:

Cat No.	Item Name	Qty.
C9807	Rod 1m	1
C9812	Rod, 50 cm	3
C9808	Rod, 25 cm	2
C2942	A' shaped base, small	2
Sw092	Bosshead	5
C9809	Clamp block	3
SP640	Cu wire, 34 SWG	1
SG436	Constantan wire, 34 SWG	1
C9810	Pulley	1
C9816	Pointer	1
C8228	Acrylic Scale Screen	1
C0510	Support clip	1
Sw088	Double hooked mass 50g	24

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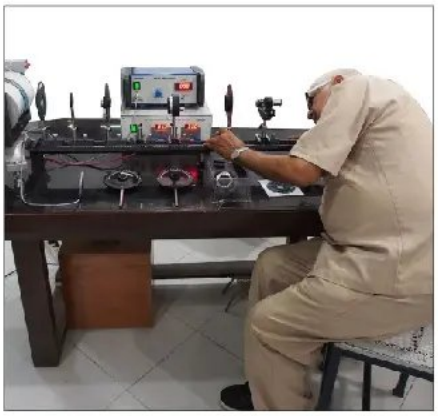


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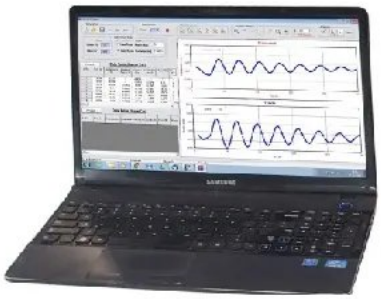


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