Learning Science by doing experiments

We know that science must be learnt by doing experiments to understand the concepts. Prof. M.S. Hegde at TDC conceived a large set of experiment from the text books of high school and PU science –physics, chemistry and biology for this purpose. Following advantages emerge when these experiments are performed. For example, an activity on density in 8th class subject, needs a digital balance. By measuring l, b and h of a metal cuboid with a digital calliper one gets volume. Mass/volume = density gm/cc. We have devised a method to find density by Archimedes principle with the same balance and a beaker with water. This can be shown in the class room in 30 min and the students will never forget what density is. NCERT and ICSC prescribe activity based teaching. But there is no proper experimental kit to implement in the class rooms. We specialize in equipping the schools with kits prescribed under the activities in books. Advantages are:

- Experiments are designed to show a concept the teacher teaches from the text book.
- The teachers perform experiment in the class room and explain the science behind it.
- Make the subjects easy for the students using experimental kits. No need for a separate laboratory. In the class room itself students can practice.
- The students get excited by experiments as seeing is believing.
- The students will have correct knowledge within the text book domain and syllabus.
- The students will be clear on the basic concepts in the science subjects.
- The students will be able to relate the results obtained from experiments to the theory they learn in the class and construct problems based on the experiments in front.
- The knowledge level becomes higher after experiments done in the class room.
- The students will be able to construct new problems and solve when an experimental setup is available in the school.
- The school can command respect of students by imparting higher knowledge of the subject within the same text book.
- The standard and status of the school goes higher with experiment facility in the schools.
- Teaches knowledge also goes up because most of the teachers have not performed these essential experiments themselves

Characteristics of good Experimental kits and their availability

For doing good experiments, we need quality experimental kits. The basic requirements are: these experimental kits must be mechanically sturdy, portable and easy to setup. On the technical part, they should be modern, reliable, accurate and routinely working. The results produced using these kits must be repeatable. Also the failure rate must be minimal. However there is the big mismatch between the need and the availability. Many concepts have to be taught only on theory as there is no experimental setup available. Fortunately, we at Techno Science Instruments have been able to design and fabricate instruments for

such concepts so that the desired results are obtained. Experiments such as Boyle's law, Charle's Law, Avegadro number determination, vapour pressure measurement, thermal expansion of metal, etc. are some examples. Though there are many scientific instruments companies who are selling these kits, the quality is very sub standard, according to TDC. Therefore, we designed and developed these instruments as per the specifications given by **TDC, IISc.** Thus these instruments can give results that can be compared with the reported values in literature.

Salient features of our high school / college physics experiment kits

Our experimental kits for high school and colleges have better technical specifications and contain improvements over competitors. Some of the features are listed below.

1. **Resistance Experiment:** We integrated three experiments into one box to carryout Series circuit, Parallel circuit, Ohm's Law verification. In-built digital Voltmeter and Ammeter facilitated series current measurement, Voltage across individual resistors and applied potential. A continuously variable dc power supply with a ten turn potentiometer was provided to adjust any voltage from zero to maximum. Old method of using rheostat, analog ammeter, and fixed voltage dc power supply has been entirely replaced with this setup.
2. **Determination of earth magnetic field:** In this experiment, a dc power source, rheostat, commutator, galvanometer, multimeter to read current and tangent galvanometer are wired to do the experiment. We have replaced the whole set by an adjustable constant current source with digital ammeter and a toggle switch to connect to the tangent galvanometer. This reduces inconsistencies in the experiment due to wrong wiring or loose connections and also reduced number of parts.
3. **Measurement of Atmospheric pressure:** The older experiment involved mercury, graduated glass capillary, stand, etc to measure the atmospheric pressure. We replaced it with a sensor (Absolute pressure sensor) with a digital meter.
4. **Charge-Discharge study of capacitor:** This experiment is taught only in theory as an independent experimental setup is seldom available. We have made a setup with digital timer and a digital voltmeter integrated in one box which will freeze the reading every 5 second to allow the user to record the readings of Time and Voltage.
5. **Digital Timer with start-stop IR sensors:** This instrument is most needed for doing Newton's law study and conservation of energy study. Many available instruments in market have having only **1ms** resolution. We have made a better timer from 0-9999 second with **0.1ms** resolution, housed in a very compact box. These timers are integrated (the competitors have external connection arrangement) into the inclined planes which removes the hastle of connecting timers to IR sensors every time. Also the increased timer resolution aids in accurate calculations.
6. **Projectile Motion study setup:** This setup comprises a compact, adjustable height projectile motion study setup. We made a simple setup with a spring loaded launcher by using a de-soldering pump at very low cost that worked exactly how the experiment demands.

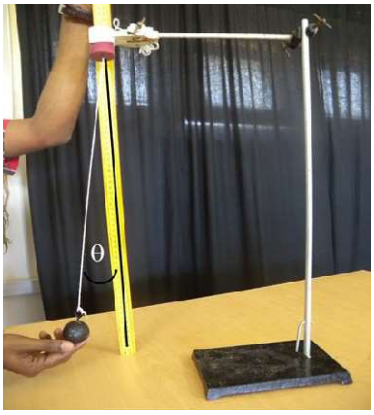
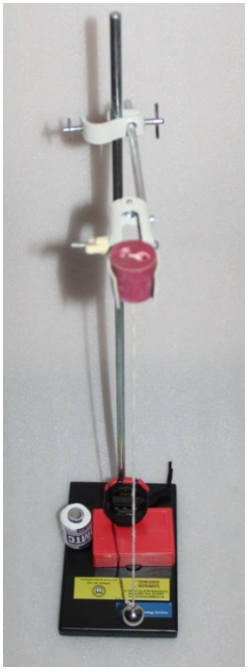
7. **Transistor characteristics study setup:** This setup needs no wiring as everything has been internally wired. Only the transistor is required to be mounted. All the readings such as VCE, VBE, IB and IC are simultaneously displayed on a LCD display. The competitors system requires wiring and operating toggle switches to read voltage and current. Our system greatly reduces experiment time and switching inconsistencies.
8. **Resistivity of metals using Meter Bridge:** This experiment generally comes with individual galvanometer, dc power supply, decade resistance box which need to be connected to meter bridge board. We have used high precision resistors with a rotary switch to replace the decade resistance box and integrated the galvanometer and an SMPS into a single box making it a compact setup. It is very easy to use and do the experiment.
9. **Optical Bench:** Many companies supply a wooden board with measurement scale fitted. There is no sliding guide to slide the lens holder and image screen. We have made a sturdy metal channel with sliding arrangement for lens holder with tilting facility. The image screen can either be mounted on the slide or removed. Also the CFL light source (which is put conventionally) is replaced with bright LED lamp for better image formation.
10. **Digital Thermometer:** This uses a Pt100 temperature sensor which is easily available and cheaper compared to a K-Type thermocouple. Also it is sturdy and long lasting as well as more accurate. We have implemented the entire Pt100 temperatue Vs resistance curve in our electronics to give a temperature reading from -200°C to +600°C with a 0.1 degree resolution.
11. Most of our instruments are AC230V operated. We have eliminated the battery operation because most of the schools do not have tools to remove the back cover to replace the battery in the instruments. It is also a recurring expense to change the battery. Many times though the instruments show Low Battery indication, people don't change the battery leading to inaccurate readings. Additionally our instruments are long lasting, sturdy and ergonomically easy to operate. Since ours is Bangalore based company, it is easy to approach for any service related query or request for modifications in the existing setup.

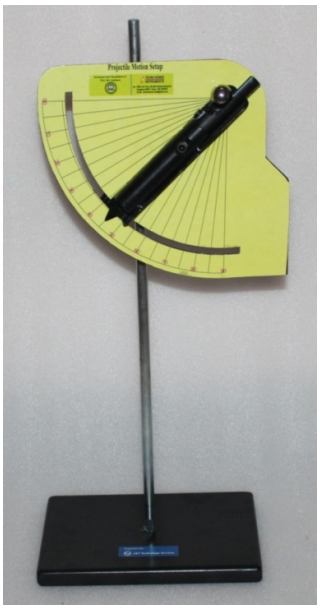
These experimental sets have been found very practical, affordable, elegant and standalone systems which gave reproducible results that could be compared to the values reported in the literature. In 2018, TDC, IISc, Challakere came forward to associate with us to put a joint logo on all our instruments mentioning **"Guidance from TDC, IISc"** on the label. Thus the quality of our products is conforming to IISc quality standard as they have tested and verified our instruments.

According to an analysis conducted by TDC, it has been found that the percentage of students who scored more than 70% has doubled from the schools which used these experimental kits in their schools.

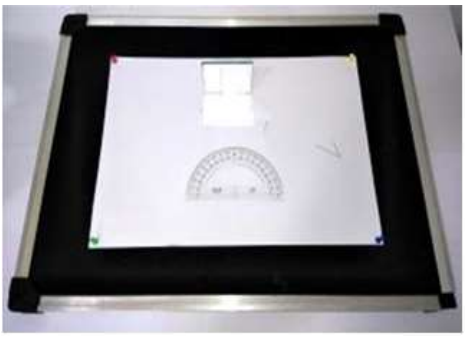
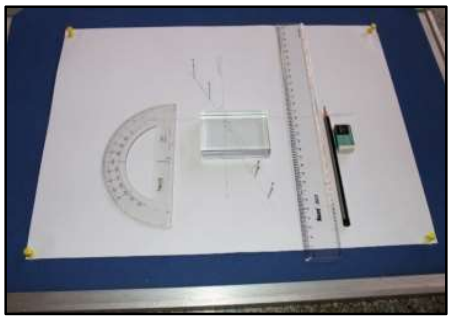
This more than proves the point that teaching science by doing experiments brings a great benefit in both knowledge enhancement as well as good result in examination.

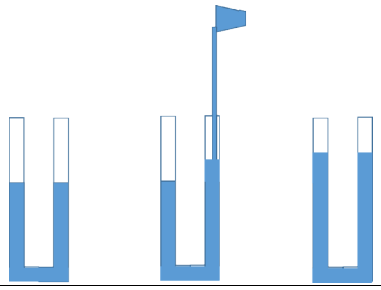
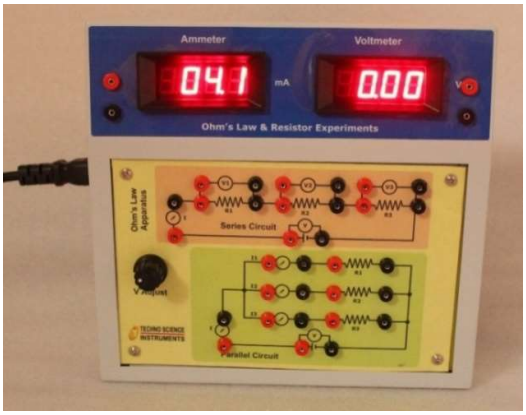
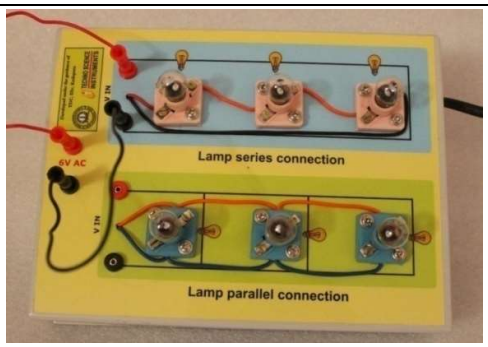
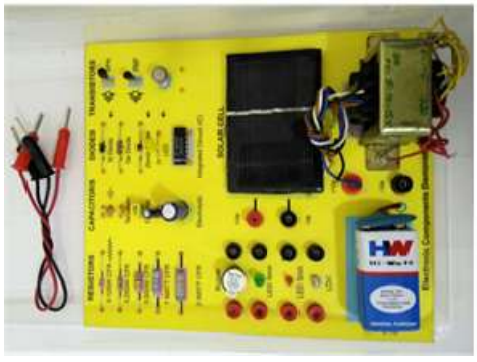
List of High school Physics experiments

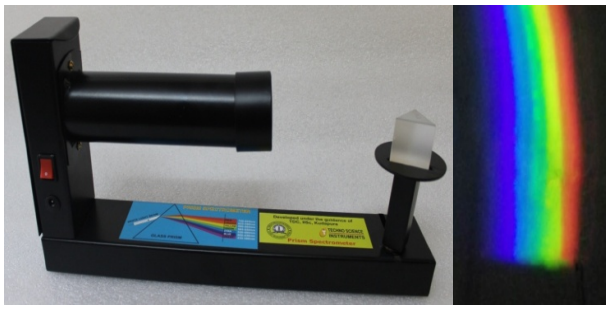
Sl No.	Description of Experiment	Picture
1	**Determination of linear dimensions and density of solids and liquids** (a) Use of digital calliper for measurement of dimension of regular shaped metal objects (b) Use of Digital weighing balance to measure mass of objects (c) Density calculation for solids and liquids (d) Buoyancy method **Items Supplied:** Digital weighing balance (10mg resolution, Dual display, battery backup, with shield), digital Vernier caliper (SS type, 0.01mm LC, 150mm length), pipette 10ml (with rubber squeezer), thread 2 m, 50 ml beaker, metal pieces cuboids 12x12,x30mm; rods 10mm dia x 30mm length) of Al, Cu, Fe, Brass metal	 
2	**Determination of G, acceleration due to gravity** **Items Supplied:** Metallic bob with hook (2 Nos), clamp stand 75cm height, split halves of a cork with plane faces, fine cotton thread about 2 m in length, digital stop watch with 0.01s resolution, wooden 1 meter scale. 	
3	**Verification of conservation of energy and determination of frictional loss** (a) Determination of kinetic energy and potential energy (b) Determination of frictional loss **Items Supplied:** Height adjustable metal plane 50cm length; solid SS sphere 16mm, with two IR sensor and digital Timer with 100µs resolution	

4	. **Determination of spring constant** **Items Supplied:** Two types of springs 10cm and 12cm; Weight hanger 50g x 5; Weight hanger 20g x 5metal stand 70cm height with cm ruler.	
5	**Projectile motion** **To determine the angle of projection for which range is maximum.** **Items Supplied:** • Adjustable height metal stand • adjustable angle 0-90° • spring loaded launcher • measuring tape (metal).	
6	**Determination of velocity of sound – Resonance column** **Items Supplied:** • Metal stand with 75cm height • 60mm and 30mm length of open ended brass pipes with graduation • Two aluminium tuning forks (480Hz & 512Hz), rubber pad • tall 1litre measuring cylinder.	

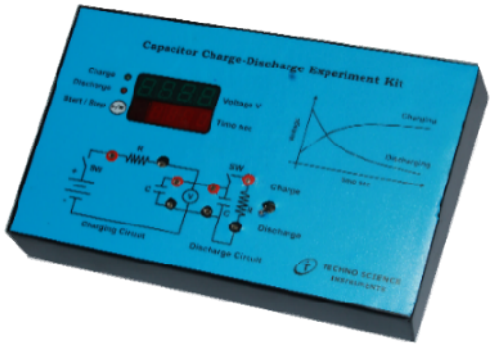
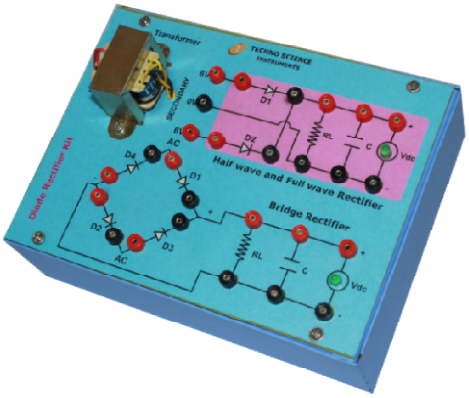
7	**Heat Experiments** **(a) Heat Transfer Experiment** **(b) Determination of Flame Temperature** **Items Supplied:** • CU, Al, Brass and Fe metal rods of 8mm dia and 15cm length • Spirit lamp • Digital Thermometer 0.1 °C resolution with Pt100 sensor, 	
8	**Heat Experiments** **(a) Temperature dependence of resistance of a metal** **(b) Temperature dependence of resistance of a metal** **Items Supplied:** • Digital Multimeter • Digital Temperature meter • Beaker 250ml • Semiconductor (Thermistor) 10Ω • Copper coil 10Ω • Glass Stirrer 6 inch	
9	**Newton's Laws of Motion study experiment** **Verification of $v = u + at$ and Verification of $s = ut + \frac{1}{2}at^2$** **Items Supplied:** • Adjustable angle inclined plane 0 to 30° with adjustable sensor position • Digital timer 100µs resolution with two IR sensors. • SS sphere 16mm dia • pvc scale on the inclined plane	
10	**Magnetism Experiments - Mapping of magnetic lines of force** **Items Supplied:** • Bar Magnet Size: 51 mm x 7.5 mm x 12 mm • 20mm compass • Drawing board Size: 45cm x 60 cm • Drawing board pins • White sheet	

11	**Magnetism Experiments - Deflection magnetometer** **Items Supplied:** • Magnetometer board with 4 inch magnetic compass. • Two bar magnets	
12	**Optics Experiments – Laws of Reflection** **Items Supplied:** • Drawing board 2ft x 1 ½ ft • Plane Mirror with stand • Plastic protractor • Plastic Ruler • Pins	
13	**Optics Experiments – Laws of refraction and determination of lateral shift; Snell's law** **Items Supplied:** • Drawing board 2ft x 1 ½ ft • Glass slab 77x50x20mm size • Plastic Ruler • Pins	
14	**Optics Experiments – Refractive index of prism** **Items Supplied:** • Drawing board 2ft x 1 ½ ft • flint white glass prism 32x32mm size • Plastic Ruler • Pins	
15	**Optics Experiments - Determination of focal length of lens and mirror** **Items Supplied:** • Optical bench metal type with wooden scale on either side; comprising bright LED light source, adjustable position lens holder, object and image screen • Two convex lens • Two concave lens • Two convex mirror • Two concave mirror (all having 10cm and 15cm focal length)	

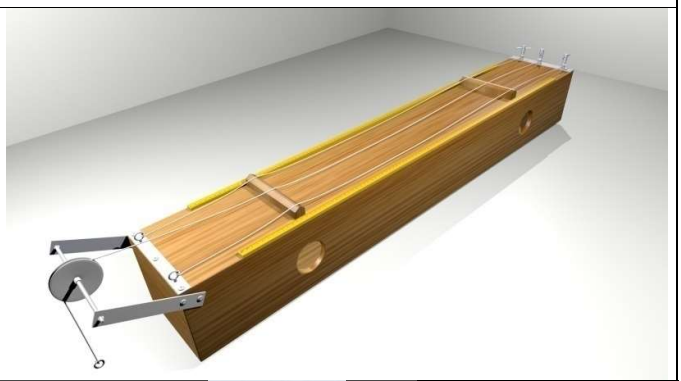
16	**Measurement of atmosphere pressure by digital Barometer** **Item Supplied:** Digital pressure meter 15-115 kPa with power adopter	
17	**Application of atmospheric pressure – Measuring water level using a transparent hose** **Items Supplied:** **5 meter plastic pipe**	
18	**Electricity Experiment set up** 1. Determination of resistance –Series and parallel circuits. 2. Verification of Ohm's law. 3. Digital Multimeter (3½ digit) **Items Supplied:** Easy to connect socket board to insert resistors for series and parallel connection; 10 turn potentiometer to adjust voltage, DC power supply 0-20V, digital voltmeter 10mV resolution, digital ammeter with 0.1mA resolution, spare resistors of different values in multiple quantities. .	
19	**Understanding Series and parallel circuits – Bulb method** Easy to fit or remove bulbs board with holders. Three 6.2 V bulb with series connection. Three 6.2 V bulb with Parallel connection. Voltage measurement across bulbs possible	
20	**Electronics Components Demonstration board** **Items Supplied:** • Printed Circuit Board (PCB) with soldered components (Transistor, Diode, LED, Resistor, Capacitor, Transformer) • Patch Cords	

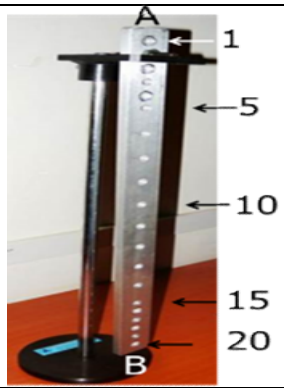
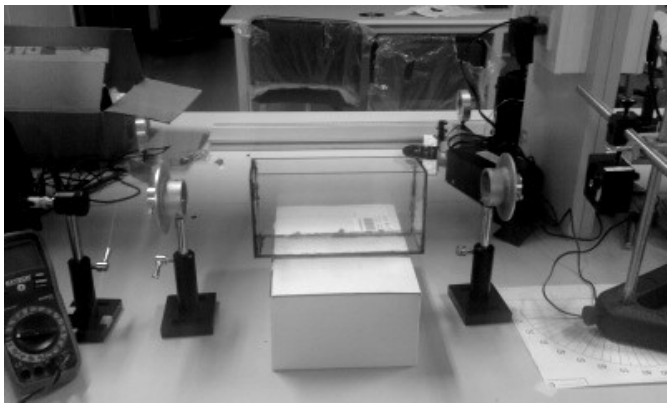
21	**Resistivity of metal – Meter bridge** Meter bridge board with copper strips, metal wires (Cu: 4-6Ω, Fe: 4-5Ω, Kantal wound on bobbins), standard resistance box with precision 1Ω resistors connected to rotary switch, DC power Supply, galvanometer all integrated into one box, Jacky.	
22	**Study of dispersion of light** Adjustable prism table with light source Image screen stand EDF Prism This uses a convex lens to concentrate the white light from LED source on to the prism. A versatile metallic bench is made to mount light source, lens and the prism. The prism can also be rotated, horizontally moved to focus the diffracted light on to a screen.	
23	**Diffraction Spectometer using CD grating** Box with view port and a slit CFL source Mains cable This is a simple **spectrometer** using CD grating plate for demonstating diffraction of light. A CFL lamp is used as a light source. A small slit of 1 mm width allows the light to pass through narrowly to fall on the grating. The view port is bent at 120 degrees to suppress the pure white light being viewed and allows only the diffracted colours pattern to be seen by eyes	 
24	**Energy of a photon** (a) To observed the dispersion of light. (b) To determine the wavelength of different colors of light and calculate the energy of a photon associated with them. **Items Supplied:** Digital Spectrometer with mercury lamp	

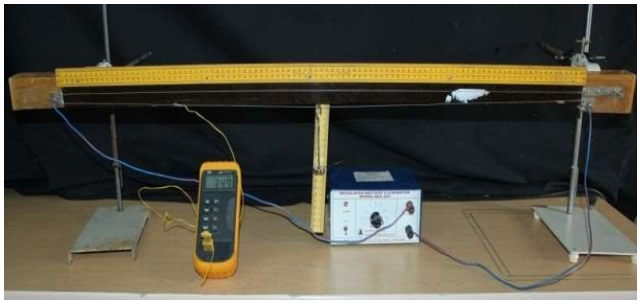
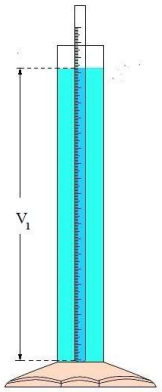
List of PU Physics experiments

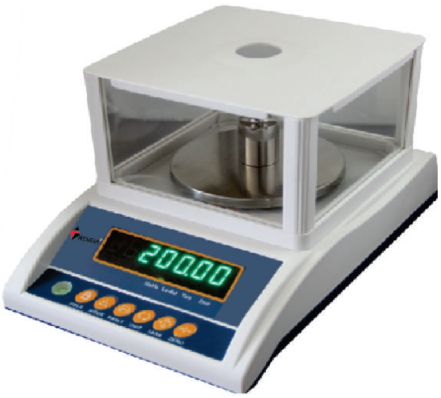
Sl. No.	Description of Experiment	Picture
1	**Capacitors** 1. Charging and discharging of capacitors. 2. Determination of RC time constant. Regulated power supply Timer control counter Electrolytic capacitor 1000 $\mu F, 25V$ and $100k\Omega$ resistor	
2	**Solar Cell Characteristics** 5W solar cell assembly on board Variable load Voltmeter and ammeter provision	
3	**LCR series and parallel resonance circuit** 1. Series connection of LCR (Resonance circuit.) 2. Parallel connection of LCR (Rejection circuit) LCR Kit which includes 1 channel mini Digital Oscilloscope 3 × 4 *inch* display and components	
4	**Rectifier circuit** 1. Half wave rectifier 2. Full wave bridge rectifier 3. RC filter i. Inbuilt 6-0-6V ac power supply ii. Connecting ports for half wave and full wave rectifier iii. Rectifier diode: 1N4007, 2W10 iv. Digital Multimeter: V830A v. Resistor 1000 Ω (¼ Watt), capacitor 1000uF, patch cords, vi. 1 channel mini DSO with3 × 4 *inch* display and components	

5	**Transistor characteristics** **1. CE Transistor input characteristics** **2. CE Transistor output characteristics** i. BC547 NPN transistor, ii. two variable dc power supply (0-5V, and 0-20V), iii. two dc ammeter (0-200µA; 0-100mA), digital voltmeter, iv. Circuit board with a base resistor of 50kΩ, a collector resistor of 1kΩ .	
6	**Diode Characteristics** **(a) Forward and reversed bias characteristics of rectifier diode** **(b) Forward and reversed bias characteristics of Zener diode** **(c) Operating voltage of LEDs** • Rectifier diode-1N4007, • Zener diode- 1N750, • Inbuilt 0-20Volt DC power supply, • Inbuilt digital voltmeter: 0-20V (10mVResolution), digital ammeter: 0-200mA(100µA Resolution), • LEDs: Red, yellow, green and blue color • 6. Resistor: 1000 Ω (¼ Watt).	
7	**Photoelectric effect** **1. Verification of photoelectric effect** **2. Determination of planks constant** (i) Photoelectric measurement unit (ii) Photocell of work function of 1.5 eV (iii) 12W white light source (iv) Color filters (680nm, 580 nm, 520nm, 480nm, 435nm) (v) connecting wires	
8	**Spectroscopy** **1. Hydrogen spectroscopy** **2. Dispersion of light** **3. Energy of a Photon** 1. Constant deviation based digital spectrometer with display (provision for measuring wavelength from 380 to 720 nm) ii. hydrogen lamp with power supply iii. 12W LED white light bulb with support stand	

9	**Tangent Galvanometer** Horizontal component of earth's magnetic field 1. Tangent Galvanometer kit which includes (i) variable constant current source (ii) copper coil frame and coils of different number of turns (iii) 10 cm diameter magnetic compass	
10	**Diffraction of light experiment** 1.Grating constant 2. Wavelength of monochromatic light 3. Speed of light in water i. 10 mW,650 nm Laser light with power supply ii. Height adjustable laser light stand iii. 3 window grating plate (100 lines/mm, 300 lines/mm, 600 lines/mm) and its stand iv.Metal screen($20 \times 15 \times 0.1\ cm$) v.Meter scale (1 m wooden) vi.Acrylic tank ($30 \times 25 \times 7cm$)with water drain option	
11	**Sonometer – Verification of Laws of Transverse Vibrations of Stretched String** first and second laws of transverse vibrations of a stretched string using sonometer, i.e., to show (i) nl = constant and (ii) $\frac{\sqrt{T}}{l}$ = constant.	
12	**Verification of Boyle's Law** 1meter metal stand Transparent silicone tube for water column Meter scale for height measurement Glass bulb with hose	

13	**Verification of Charle's Law** 2 meter foldable metal stand Transparent silicone tube for water column Meter scale for height measurement 1 llitre Glass bulb with hose Metal enclosure for the glass bulb	
14	**Compound pendulum** 1. Time period of Compound pendulum and g 2. Moment of inertia Parallel axis theorem 1. Compound pendulum kit (i) 31-hole Al bar (60 cm × 5cm × 8mm) (ii) Support for oscillation (iii) Digital timer	
15	**Coplanar force** 1. Triangle law of force 2. Lami's theorem 2. Parallelogram law of force (i) Vertical stand coplanar force board with pulley: board size($60cm \times 41\ cm$), 15 cm base stand (ii) 20g calibrated mass = 12 nos. (iii) 50 g calibrated mass = 12 nos	
16	**Specific rotation** 1. Plane of rotation – sugar solution 2. Malu's law i. 10 mW 650 nm Laser light with power supply ii. adjustable stand for laser light iii. Highly transparent 3mm thick acrylic water tank ($20 \times 6 \times 10$) iv. Tank base adjustable to laser light v. $0 = 360°$ rotatable and measurable polarizer and analyzer with proper height base stand vi. 1 litre calibrated measuring plastic jar, vii. Beaker (500 ml)	

17	**Interference of light source** 1.Newton's Ring Travelling microscope base Newton's ring experiment kit should provide i. 5 cm vertical movable and 10 cm horizontal measurement option, × 10 eye piece magnification travelling microscope ii. 9 watt LED Light source with stand iii. light splitter and attached holder iv. Newton's ring reflecting mirrors, one side low curvature transparent disc	
18	**Specific heat of solids** 1. Specific heat of metals 2. Determination of acceleration due to gravity 1. Rectangular blocks (Al, Cu, Fe, Brass, SS) $(15\ mm \times 15mm \times 30mm)$ 2. Digital thermometer ($LC \sim 0.01$ ℃) 3. 50 ml beaker 4. 100W iron rod immersion heater	
19	**Linear thermal expansion of metal** 1 meter manganin wire with metal stand 1meter wooden scale Constant voltage source Temperature meter	
20	. **Volume expansion** Thermal expansion of liquids 1. Calibrated burette 10ml, 30 cm in length. 2. Plastic jar (2.5 $inch\ dia, 30\ cm\ length$) 3. Digital thermometer ($LC \sim 0.01$ ℃)	 

21	**Newton's Law of cooling** 250ml beaker Digital temperature meter Digital timer	
22	**Linear Voltage Regulator Power Supply** 0-30V adjustable voltage 2A /5A current output Single / Dual / Three channel models	
23	**Signal generator** Sine, Triangular, Square wave 0-10MHz with Frequency and amplitude adjust	
24	**Digital / analog Oscilloscope** Digital and analog,20 MHz to 100 MHz bandwidth, Dual channel	
25	**Digital Weighing Balance** Wensar make, PGB630, PGB220 etc Various models are available with weighing capacity 220g to 10kg Resolution: 10mg to 0.1mg	

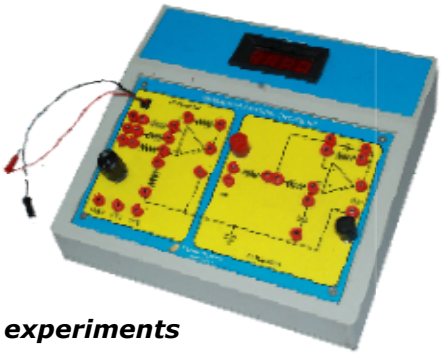
26	**Digital Timer Start – Stop type** Time count: 0-9999.9 sec Resolution: 0.1ms Digital Dissplay Start-Stop-Reset buttons Can be used as a stop clock timer	
27	**Constant Current Source** 0-200mA continuously adjustable 9V compliance output 0.1mA resolution Digital Display AC230V operated	
28	**Digital Multimeter** 3 ½ digit digital LCD Display Voltage – Current – Resistance function Both auto ranging and manual Supplied with probes	

Other small items we can supply		
		
		

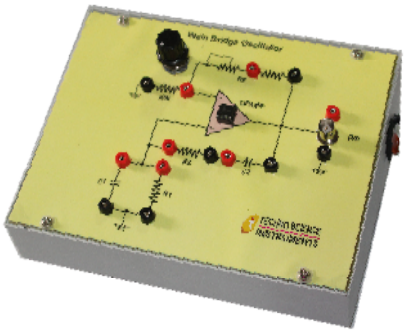
Other Electronics Experiments

FET Characteristics experiment setup

CE Amplifier Characteristics expt setup

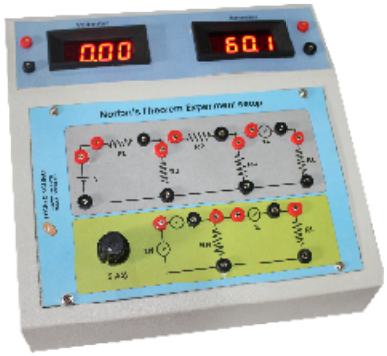


OPAMP experiments
Inverting, Non-inverting, Summing,
Difference amplifier circuits, Active Filters



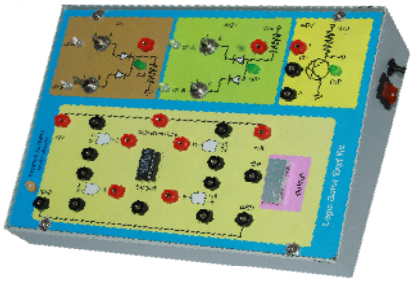
Wein Bridge Oscillator experiment

Thavenin's Theorem verification

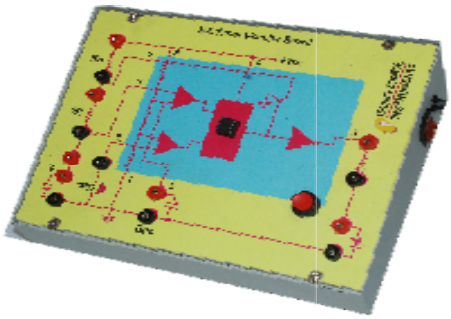
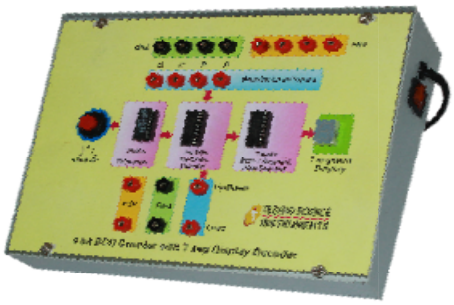
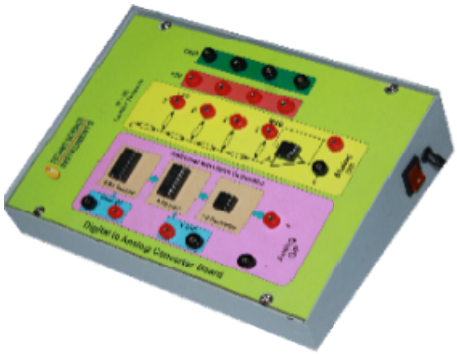
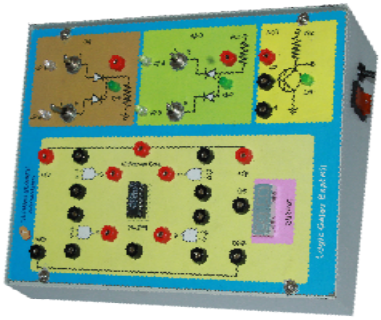


Norton's Theorem verification

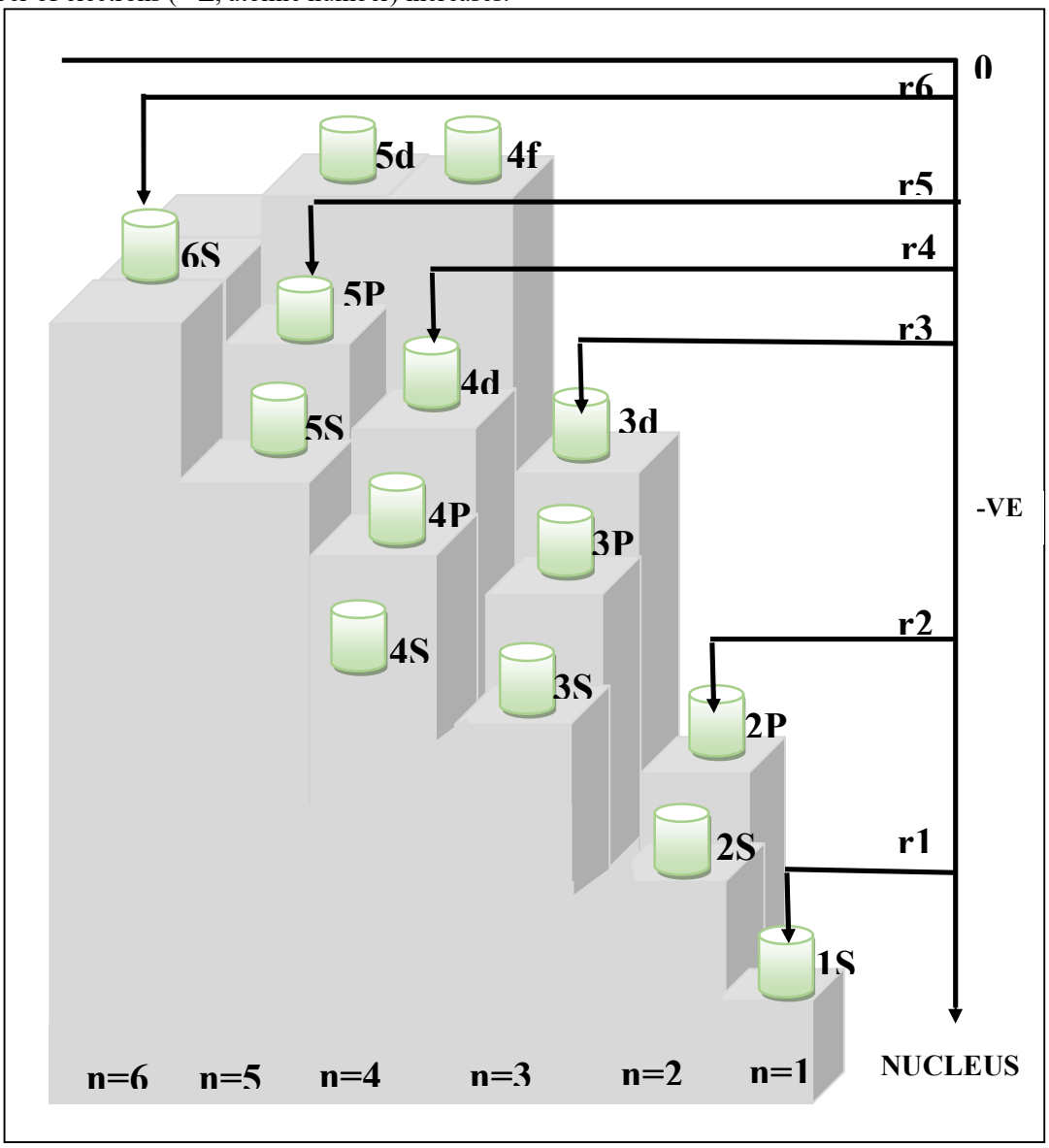
Maximum Power Transform theorem

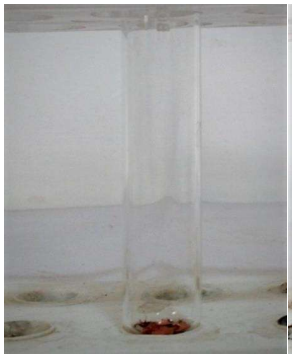
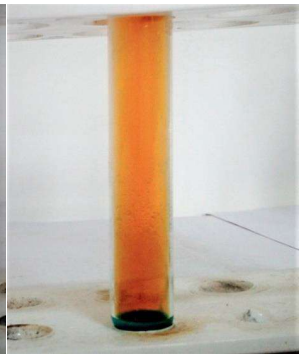


Verification of De Morgon's theorem

 ***Four bit Up-Down Counter with parallel load***	 ***Astable & monostable multivibrator using 555 Timer IC***
 ***Analog to Digital Converter kit***	 ***Digital to Analog Converter kit***
 ***Logic Gates construction*** ***OR, AND, NOT, NAND, NOR, XOR Gates***	 ***Digital Atmospheric pressure meter***

List of Chemistry Experiments – High School

Sl.No.	Experiment	Picture
1	**Detection of elements- Flame test** This test involves introducing a salt of the element to a hot flame and observing the colour of the flame. Sodium — Golden yellow Barium — Apple green Calcium — Orange Potassium — Lilac Lithium — Crimson red	  Normal spirit lamp LiCl + Alcohol in spirit lamp
2	**Electronic configuration and orbital** Customized stand with glass beakers. Electrons in atoms are occupied in 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s, 4d, 5p, 6s, 5d, 4f, 6p order as the number of electrons (= Z, atomic number) increases.	

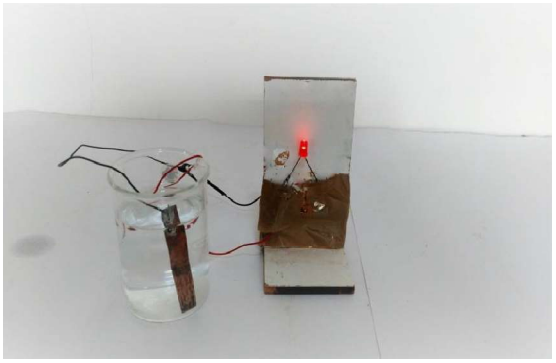
3 **4** **5**	**Preparation of sulphur dioxide** **Chemicals:** Cu turnings, conc. H2SO4, blue litmus paper, acidified K2Cr2O7, acidified KMnO4, sodium sulphite, dil. HCl **Preparation of chlorine** **Chemicals:** MnO2, conc. HCl,KMnO4,KI,KBr, blue litmus paper **Preparation of PCl_5** **Chemicals:** KMnO4, conc. HCl, red phosphorous **Apparatus:** Round bottom flask, adapter, rubber tube, glass tube, retort stand with clamp, test tubes, bunsen burner, tripod stand, wire gauze, beakers	
6	**Preparation of oxides of nitrogen** **Aim:** To prepare NO (Nitric Oxide) and NO2 (Nitrogen dioxide) from the reaction of Cu and HNO3**.** **Apparatus:** Test tubes, test tube holder **Chemicals:** Cu metal turnings, dil. HNO3 and conc. HNO3	  **Cu metal in test tube** **Evolution of NO_2 gas**
7	**Reaction of metals with mineral acids** **Aim:** To study the reactions of mineral acids such as dil. hydrochloric acid and dil. sulphuric acid with metals like magnesium, iron, zinc and aluminium. **Apparatus:** Test tubes, match stick, bunsen burner, test tube holder. **Chemicals:** Zn granules, Mg ribbons, Fe metal powder, Al foils, dil. HCl, dil. H2SO4	
8	**Reactions of sodium hydroxide with aluminium and Zinc** **Aim:** To study the reaction of aluminium metal with NaOH solution. **Apparatus:** Test tubes, match stick, test tube holder **Chemicals:** 15% NaOH solution, Al foil pieces.	
9	**Chemicals:** Na metal, distilled water **Aim:** To study the reaction of metals with water and observing evolution of hydrogen gas. **Apparatus:** Test tube, forceps, test tube holder **Chemicals:** Na metal, distilled water	
10	**Displacement reactions of metals and their salt solutions** **Aim:** To study the competition reactions of metals and arrive at reactivity series of the metals used. **Apparatus:** Spot plate, plastic droppers, spatula **Chemicals:** Mg metal powder, Zn metal powder, Cu turning pieces, MgSO4,ZnSO4,CuSO4	
11	**Exothermic metal displacement reactions – reactivity series** **Aim:** To study the exothermic metal displacement reaction of different metals with CuSO4 solution. **Apparatus:** Test tubes, digital thermometer, spatula, droppers	
12	**Displacement reaction between Iron nail and aqueous copper sulphate solution** **Aim:** To study the reaction of iron nail with aqueous copper sulphate solution. **Aim:** To study the reaction of iron nail with aqueous copper sulphate solution.	

13 **LED Continuity test**

Aim: To distinguish between electrolytes and non-electrolytes using continuity circuit.

Observation

Solution	Does the LED glow?	Electrolyte or non-electrolyte
Common salt		
Distilled water		
Distilled water + a few drops of HCl		
Sugar		
Urea		
Sodium hydroxide		



Apparatus: LED connected continuity circuit, beakers.

Chemicals: Different electrolyte and non-electrolyte solutions.

14 **Measurement of conductivity using a conductivity meter**

Aim: To measure the conductivity of different solution using a conductivity meter

Apparatus: Conductivity meter with cell, beakers

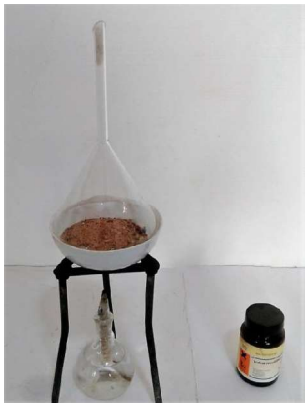
Sample	Conductance (mS/µS)
0.1 M HCl	
0.1 M Acetic acid	
0.1 M NaOH	
0.1 M $CaCl_2$	
0.1 M NH4Cl	
0.1 M NaCl	
0.1 M urea	
0.1 M glucose	
0.1 M Sucrose	

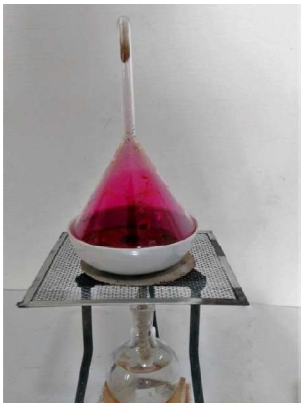
15 **Sublimation of solids and separation of a mixture of solids**

Aim: To study the sublimation of solids and to apply sublimation process in the separation of a mixture of solids

Apparatus: Tripod stand, bunsen burner, 4" dia glass funnel, cotton, sand, 4" dia china dish

Chemicals: Iodine, ammonium chloride

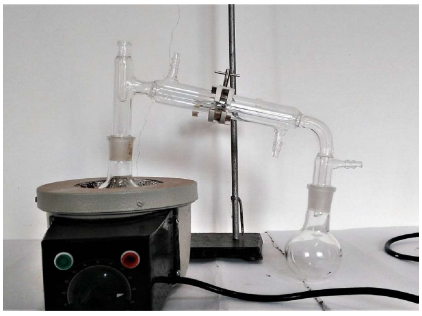


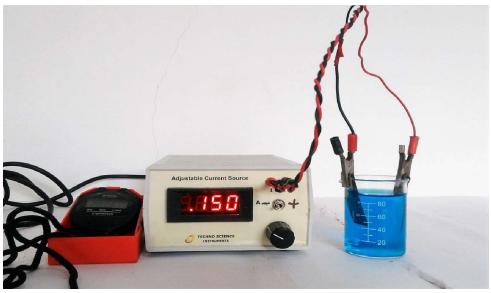
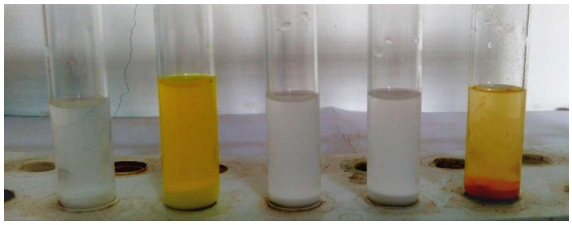


16 **Percentage of oxygen in atmosphere**

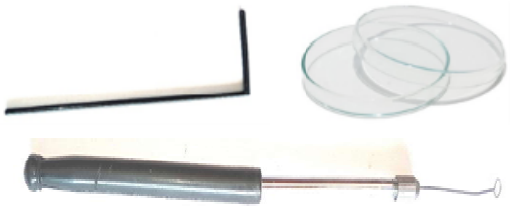
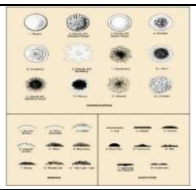
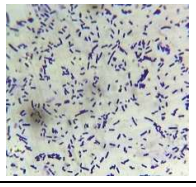
Apparatus: Tray, candle, metal block, glass jar (approx. 100 mL capacity)

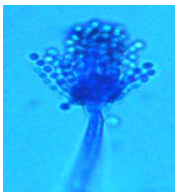
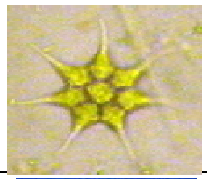
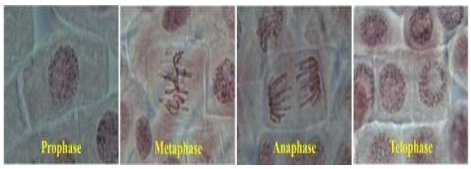
Rise in the level to the total height is about 1:5 indicating oxygen in the air is about 20%.

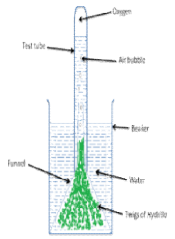
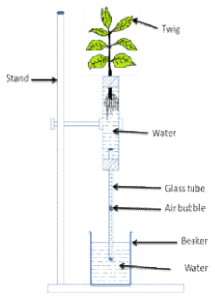
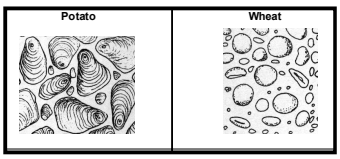
17	**What is iodised salt?** **Aim:** To identify the salts of iodine in common salt **Chemicals:** Common salt, lemon, starch solution	 
18	**Colloids and Tyndall effect** **Apparatus:** Torch, beakers **Chemicals:** Water, potassium chromate solution, sodium thiosulphate (hypo), dil. HCl	
19	**Preparation of a solution of known composition** **Aim:** To prepare a 5% solution of common salt in water. **Chemicals:** NaCl, distilled water	
20	**Determination of Solubility of common salt** **Aim:** To prepare a saturated solution of common salt and determination of solubility by evaporation method. **Apparatus:** Bunsen burner, 100 mL beaker, crucible, tripod stand, wire gauze, glass rod, spatula, weighing balance, tongs, measuring cylinder **Chemicals:** NaCl (common salt), distilled water.	
21	**Separation of two immiscible liquids using a separating funnel** **Aim:** To study the separation of given two immiscible liquids using a separating funnel. **Apparatus:** Separating funnel, measuring cylinder, beaker, glass rod **Chemicals:** Water, any oil.	
22	**Separation of two miscible liquids by distillation** **Aim:** To study the separation of two miscible liquids by distillation method **Apparatus:** Two round bottom flask, Liebig condenser, heating mantle, water circulating pipes, thermometer **Chemicals:** Acetone, water	

26	**Growing crystals** a) Sodium chloride b) Copper Sulphate c) Potassium dichromate	
27	**Determination of Avogadro number** **Aim:** To determine the Avogadro number by electro-deposition method. **Apparatus:** Constant current source, stopwatch, beaker, Cu and Stainless steel strips, connecting wires, dryer **Chemicals:** 1M CuSO4 solution, distilled water	
28	**Double displacement reactions** **Aim:** To study the double displacement reactions of various compounds **Apparatus:** Test tubes **Chemicals:** Na2SO4,BaCl2,K2CrO4,MgSO4,Na2CO3,CaCl2, KI,Pb(NO3)2	
29	**Preparation of carbon dioxide** **Aim:** To prepare carbon dioxide and performing its reactions **Apparatus:** Round bottom flask, adapter, rubber tube, glass tube, stand with clamp, test tubes **Chemicals:** Marble chips, dil. HCl, blue litmus paper, lime water	
30	**Preparation of oxygen by decomposition** **Aim:** To prepare oxygen by decomposition of solid KMnO4 and H2O2 **Apparatus:** Test tube, test tube holder, incense stick, Bunsen burner, spatula **Chemicals:** KMnO4 crystals, H2O2,MnO2	
31	**Electrolysis of water** Acrylic tub 6”x8”x6” size Constant current source 0-200mA Measuring cylinder 25ml borosilicate 2 Nos for collecting oxygen and hydrogen Nickel strips Connecting wires Adjustable lever with handle KOH bottle	
32	**Daniell cell** **Aim:** To construct the Daniell cell and to measure the voltage **Apparatus:** Beakers, multimeter, Cu and Zn plates soldered with wire, salt bridge **Chemicals:** 1 M CuSO4, 1 M ZnSO4	
33	**Measurement of pH using digital pH Meter**	

NOTE: We supply chemicals for all the chemistry experiments lasting for one year. We can setup entire chemistry lab.

Sl. No.	Experiments	Picture
1	**Microbiological Tools** Petri plates used to culture microorganisms. Inoculation loop used to transfer bacteria into the medium. Inoculation needle used to transfer fungi and L-shaped rod used to spread the inoculum on solid medium. Several tools are introduced.	
2	**Compound Microscope** The compound microscope uses lenses and light to enlarge the image. It is also called an optical or microscope**.** The **compound microscope** has two systems of lenses for greater magnification: 1) the ocular or eyepiece lens that the observer looks into and 2) the objective lens, the one closer to the object. The total magnification in this microscope will be 1000x.	
3	**Isolation of Microorganisms From Natural Sources** When the sample from such sources is directly inoculated on to a nutrient medium, microorganisms multiply rapidly and direct plating is a simple technique to isolate microorganisms from different natural source.	
4	**Study of Colony Characteristics Of Bacteria** The colony morphology of an organism depends on type of media used and other growth conditions provided.	
5	**Simple Staining** The use of single stain to colour a bacteria is commonly referred to as simple staining.	

6	**Negative Staining** In negative staining technique a simple stain is used that does not stain the bacteria but stains the background.	
7	**Isolation of Seed Borne Fungi By Blotter Method** In this method, when moisture is provided to seed fungi imbibe water. The fungi present in and on it get expressed as seed itself acts as nutrient source. This technique is simple and easy to perform.	 
8	**Microscopic Observations of Fungi By Tease Mount Preparation** In this technique, fungi are stained using cotton blue stain and mounted in lacto phenol to obtain semi permanent microscopic slides. Many of the fungi are themselves coloured known as 'Dematacеous fungi'.	
9	**Examination of Pond Water Microorganisms** Microscopic examination of a drop of pond water through wet mount preparation provides considerable amount of information on different types of microorganisms and their shape, colour and motility.	 
10	**Antibiotic Sensitivity Test** When the discs impregnated with antibacterial agents come in close contact with the medium, they get diffused into the medium thus inhibiting the growth of bacteria	
11	**Biofertilizers / Bio pesticide** Many bio fertilizers are commercially available in the market such as *Rhizobium, Azotobacter, Azospirillum, Azolla, Bacillus megaterium*, etc. Some organisms like *Trichoderma*, *Pseudomonas*, *Bacillus* sp. and others can kill pathogenic organisms and hence used as a bio pesticides.	
12	**Mitosis In Onion Root Tip** In plants, cell divisions rapidly take place in meristematic tissues of root and shoot where the stages of mitosis can be easily observed. In animals, mitotically dividing cells can be easily viewed in the bone marrow cells.	
13	**Study Of Pollen Germination** To understand the formation of pollen tube.	
14	**Study Of Monocot And Dicot Plants (Stem, Roots And Leaves)** To understand the difference between the monocot and dicot plants based on the cross section of stem, root and leaves.	

15	**Oxygen Liberation During Photosynthesis** To demonstrate the release of oxygen during photosynthesis by inverted funnel method.	
16	**Transpiration Pull** Transpiration is a process of loss of water vapours from aerials parts of the plant. It takes place mainly through stomata. This helps in uptake of water through conducting tissues like xylem. This process is the basic requirement for uptake of water by roots. Transpiration stream is flow of water through plant as a result of loss of water during transpiration.	
17	**Microscopic observation of Starch Granules** There is enormous variation in granule size and shape between plant species. All types of starch have the same physical and chemical properties but under microscope the granules have different sizes and shapes.	
18	**Flower Morphology And Floral Diagrams** . A typical flower has four different kinds of whorls namely calyx, corolla, androecium and gynoecium. They are arranged successively on the swollen end of the pedicel called thalamus or receptacle.	
19	**Effect of Sunlight On Chlorophyll And Plant Growth Hormone Synthesis** If sufficient light is not available plants become yellow, the process is called etiolation. The process of chloroplast development and accumulation of chlorophyll is light dependent	
20	**Blood Group Determination** The human blood types can be separated into four basic groups on the basis of two antigens that are present on the red blood cells. These antigens are designated as 'A' and 'B'	
21	**Qualitative Test For Carbohydrate, Protein And Lipid** To test the presence of carbohydrate, protein and lipid in the given sample.	
22	**Pregnancy Detection** The presence of low level of harmone in urine can be detected by sensitive immune chromatography technique. This test indicates the **presence hCG** in urine based on antigen-antibody reaction and thus detects pregnancy.	
NOTE: All the chemicals, stains, instruments will be given to carryout above experiments.		

Other Instruments supplied by us

LABMAN PRODUCT LIST		
Sl No.	Description	Model
1	UV-VIS Double Beam Spectrophotometer	LMSPUV1900/LMSPUV1900S
2	UV-VIS Single Beam Spectrophotometer	LMSPUV1200/LMSPUV1000B
3	Peltier/Sipper System	PS1565
4	Visible Spectrophotometer	LMSPV325/LMSPV320
5	Online PH Controller	OPH11
6	Gradient Thermal Cycler PCR	PCR9602G
7	Dry Bath Incubator	DBI10/DBI18/DBI20
8	Refrigerated Circulating Bath	RCB620/RCB1220
9	Digital Water Bath	LMWB04/LMWB06
10	Digital Ultrasonic Cleaner	LMUC3/LMUC6/LMUC9/LMUC12/LMUC25
11	Turbidity Meter	LMTB200
12	Bio Chemistry Analyser	BCA80
13	Vortex Mixer	LMVM20
14	Visual Colorimeter	LMCR80F
15	Probe Sonicator	PRO650
16	Ice Flaker	LMIF30/LMIF50/LMIF100
17	Digital Rotational Viscometer	LMDV60/LMDV100/LMDV200
18	Automatic Digital Polari meter	ADP45/ADP90
19	Digital ABBE Refractometer	LMAR1317
20	Automatic Digital Refractometer	RFM950/RFM970
21	Ceramic Hot Plate Magnetic Stirrer	LMMS5LC
22	Hot Plate Magnetic Stirrer	LMMS300
23	Dissolved Oxygen Meter	LMDO50
24	PH Meter	LMPH9/LMPH10/LMPH12
25	PH Meter with Thermal Printer	LMPH15
26	Conductivity/TDS Meter(3 Point)	LMCM20

WENSER PRODUCT LIST		
1	Moisture Analyzer	HPB60H/PGB1MB
2	Analytical Balance-Touch Screen	MAB220T
3	Semi Micro Analytical Balance	MAB220LCD/MAB250
4	Analytical Balance	MAB201/MAB301
5	High Precision Balance	HPB201/HPB501/HPB1001/HPB3000
6	Precision Balance	PGB211M/PGB200/PGB301/PGB220/PGB321

7	Density Balance	PGB201D
8	Precision Gold Balance	PGB600/PGB1000/PGB610/PGB630
9	Platform Balance	PFB101H
10	Density Determination Kit	WDK250
11	Thermal Printer	TP10

OTHER PRODUCT LIST		
1	Hot Air Oven	Various models available
2	autoclave	Various models available
3	Binocular Microscope	Various models available
4	Travelling Microscope	Various models available
5	Muffle Furnace	Various models available
6	Tubular Furnace	Various models available
7	IC Trainer KIT	Various models available
8	Oscilloscopes	Various models available
9	Spectrum Analysers	Various models available
10	Signal Generators	Various models available
11	DC Power supplies	Various models available
12	Digital Multimeters	Various models available
13	LCR Meters	Various models available
14	Digital and Analog Trainer kits	Various models available
15	Centrifuge	Various models available
16	Regulated DC power supply	0-30V / Dual / Single / 2A / 5A

Other Research Products		
1	Potentiostat – Galvanostat	PG11210
2	Spin Coater	SC8k / SC10K/ SC12KTS
3	Dip Coater	DC150TS
4	Four Probe Resistivity measurement setup	FP2050
5	Hydrogen Uptake System	Customizable
6	Digital Pressure Gauges	15-115 kPa / 200 kPa
7	Digital Mass Flow Meters	0-200 sccm
8	Data Acquisition System	Customizable
9	Digital Vacuum Gauges	Pirani / Penning gauges
10	Thermogravimetric Analyser	Customizable