Central Instrumentation Facility (CIF)

at

Thiruvalluvar University

Central Instrumentation Facility

Excellence in teaching and research by Science Departments need state-of-the-art sophisticated equipments, various workshops and support facilities. The Central Instrumentation Facility (CIF) has been established at the Thiruvalluvar University, Vellore that acquires, maintains sophisticated analytical equipments all under one roof and provides service to the R & D projects of academic institutions and industries. These equipments and facilities help the faculty, research scholars and students to carry out globally competitive R & D in basic and applied sciences.

CIF was started in Thiruvalluvar University with a mission to enrich the resources on a shared basis for promoting R and D with the following objectives.

1. To provide guidance for acquisition of data and train personnel in operation and maintenance of Sophisticated Instruments.
2. To strengthen technological infrastructure to carry out advanced research in various science disciplines under one roof and make their services available to academic schools and departments.
3. To organize short-term courses/workshops on the use and application of various spectroscopic and analytical techniques for students, teachers and technical personnel from our University, affiliated institutions, universities and industry in the region.

Central Instrumentation Facility (CIF) at Thiruvalluvar University

Index

High Performance Liquid Chromatography (HPLC)

JASCO UV-4075

Advantages of HPLC

- ✓ Separations fast and efficient (high-resolution power)
- ✓ Continuous monitoring of the column effluent
- ✓ It can be applied to the separation and analysis of very complex mixtures
- ✓ Accurate quantitative measurements.
- ✓ Repetitive and reproducible analysis using the same column.
- ✓ Adsorption, partition, ion exchange and exclusion column separations are excellently made.
- ✓ HPLC is more versatile than GLC in some respects because it has the advantage of not being restricted to volatile and thermally stable solute and the choice of mobile and stationary phases is much wider in HPLC
- ✓ Both aqueous and non-aqueous samples can be analyzed with little or no sample pre-treatment
- ✓ A variety of solvents and column packing are available, providing a high degree of selectivity for specific analyses.
- ✓ It provides a means for the determination of multiple components in a single analysis.

Applications of HPLC

The main purpose of the HPLC technique is to identify, quantify and purify a particular analyte or compound. Both quantitative and qualitative analysis can be done. HPLCs can be used in the following applications:

- **Pharmaceutical Applications**
  To control drug stability.
  Tablet dissolution study of pharmaceutical dosages form.
  Pharmaceutical quality control.

- **Environmental Applications**
  Detection of phenolic compounds in drinking water.
  Bio-monitoring of pollutants.

- **Applications in Forensics**
  Quantification of drugs in biological samples.
  Identification of steroids in blood, urine etc.
  Forensic analysis of textile dyes.

- **Food and Flavour**
  Measurement of Quality of soft drinks and water.
  Sugar analysis in fruit juices.
  Analysis of polycyclic compounds in vegetables.
  Preservative analysis.

- **Applications in Clinical Tests**
  Urine analysis, antibiotics analysis in blood.
  Analysis of bilirubin, biliverdin in hepatic disorders.
  Detection of endogenous Neuropeptides in extracellular fluid of brain etc.

Fourier-transform infrared spectroscopy (FTIR)-JASCO4600

Fourier-transform infrared spectroscopy (FTIR)-ParkinElmer

Fourier-transform infrared spectroscopy (FTIR)-JASCO4600

FTIR

- ✓ The speed of FTIR analysis makes it particularly useful in screening applications, while the sensitivity empowers many advanced research applications.
- ✓ While FTIR is frequently used for polymer testing and pharmaceutical and forensic analysis, the application of the technique is virtually limitless, offering both qualitative and quantitative analysis of a wide range of organic and inorganic samples.
- ✓ FTIR spectra reveal the composition of solids, liquids, and gases. The most common use is in the identification of unknown materials and confirmation of production materials (incoming or outgoing).
- ✓ The information content is very specific in most cases, permitting fine discrimination between like materials.
- ✓ Whether you are a new user or an experienced spectroscopist, you can obtain high-quality spectral data to accelerate your research, routine QA/QC testing, or investigative needs.

Electrochemical analyzer (CH Instrument CHIE-608E)

Established the electrochemical techniques, including: potential sweep, step, pulse, alternating current, stripping, and scanning electrochemical microscopy.

Powerful and intuitive software

- Designed by electrochemists, for electrochemists
- Macro commands for batch experiments
- CV simulation and fitting program
- AC impedance simulation and fitting program
- Interactive 3D graphics

Applications

Battery & intercalation compounds, Battery cycling, Capacitor and supercapacitor, Corrosion & coatings, EIS, Electrochroms, Fundamental electrochemistry, Liquid conductivity, Sensors.

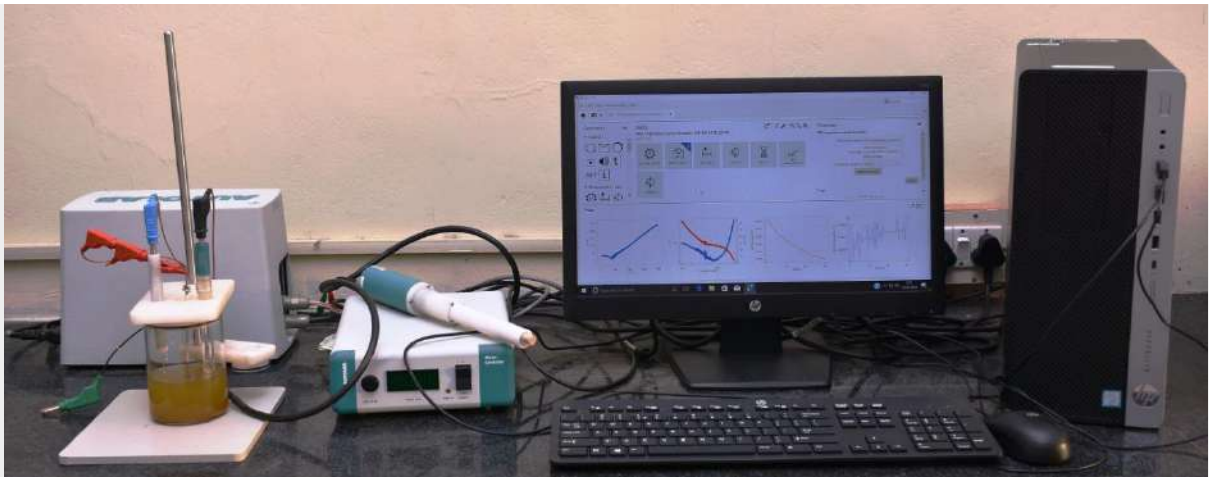
Biologic Science Instruments SP-200

Biologic Science SP-200

- Biological science SP-200 is a 500 mA research grade, value-oriented Potentiostat/Galvanostat. With the 100 fA accuracy ultra low current option, it is the perfect instrument for application in electrochemistry especially corrosion.
- The SP-200 offers a floating mode, analog filtering and a built-in calibration board.
- Additionally, the SP-200 can be purchased with a standard DC potentiostat or an EIS capable one.
- There is also an Ultra Low Current (ULC) option. On-site experiments can be performed thanks to its portable design.

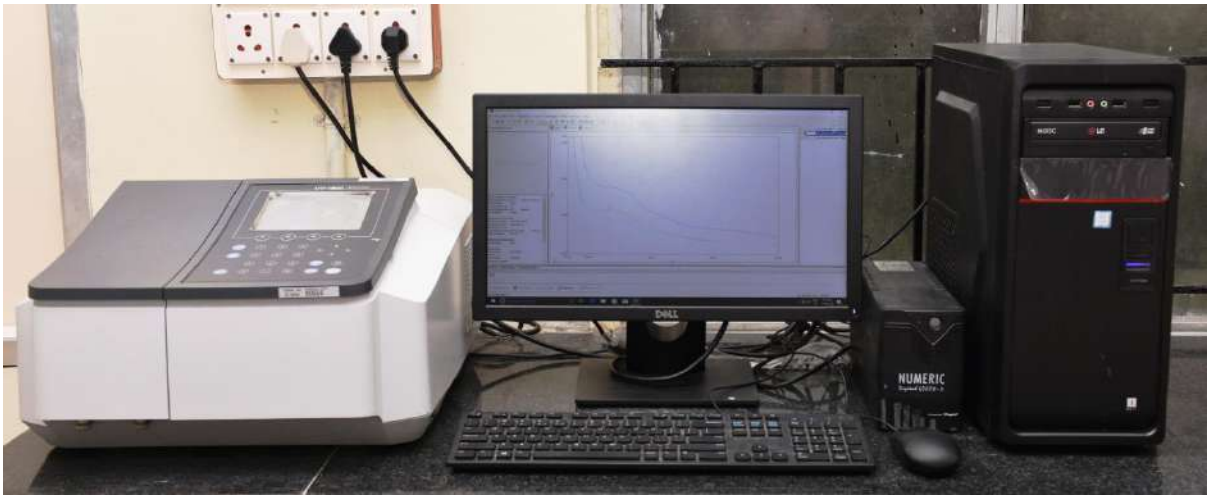
Applications: Battery & intercalation compounds, Battery cycling, Capacitor and supercapacitor, Corrosion & coatings, EIS, Electrochroms, Fuel Cell & Biofuel Cell, Fundamental electrochemistry, Liquid conductivity, Sensors, Topography

Autolab (Potentiostat / Galvanostat with motor controller)



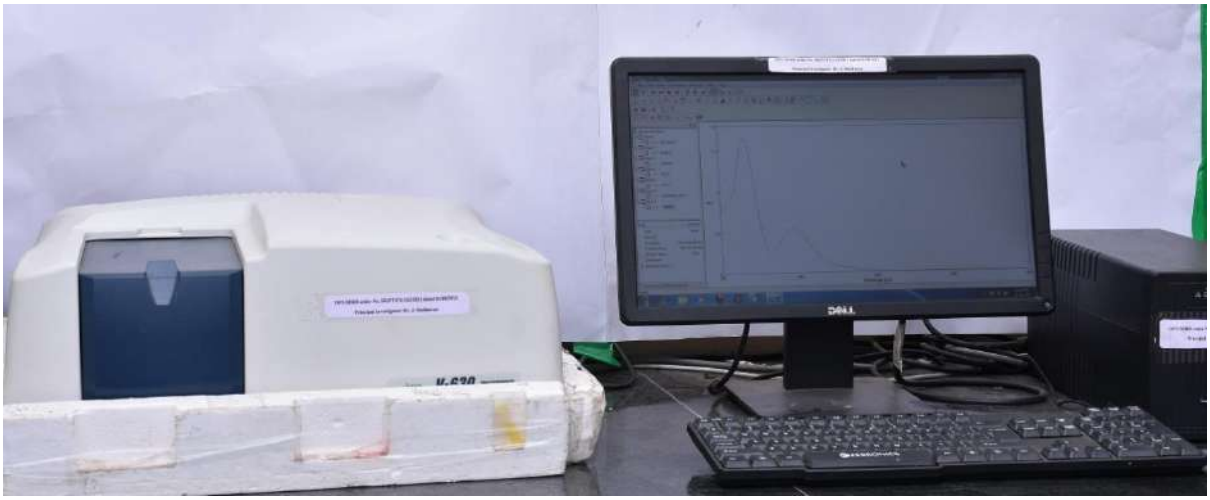
- The **PGSTAT204** combines the small footprint with a modular design. The instrument includes a base potentiostat/galvanostat with a compliance voltage of 20 V and a maximum current of 400 mA.
- The potentiostat can be expanded at any time with one additional module, for example the FRA32M electrochemical impedance spectroscopy (EIS) module.
- Analog and digital inputs/outputs are available to control Autolab accessories and external devices are available. The PGSTAT204 includes a built-in analog integrator.
- In combination with the powerful NOVA software it can be used for most of the standard electrochemical techniques.
- **Applications**: Corrosion & coatings, EIS, Electrochroms, Fuel Cell & Biofuel Cell, Fundamental electrochemistry and Sensors.

UV-Visible Spectrophotometer (UV-1800 SHIMADZU)



UV-Visible Spectrophotometer (UV-2300 TECHCOMP)

UV-Visible Spectrophotometer (JASCO V-630)



UV-VIS spectrophotometer-UV-2450 (SHIMADZU)

ELICO Double Beam SL210 UV-Visible spectrophotometer

Ultraviolet–visible spectroscopy refers to absorption spectroscopy or reflectance spectroscopy in part of the ultraviolet and the full, adjacent visible spectral regions. The most widely applicable cuvettes are made of high quality fused silica or quartz glass because these are transparent throughout the UV, visible and near infrared regions.

Applications

- UV/Vis spectroscopy is routinely used in analytical chemistry for the quantitative determination of different analytes, such as transition metal ions, highly conjugated organic compounds, and biological macromolecules.

- The reaction, occurring in solution, must present color or brightness shifts from reactants to products in order to use UV/Vis for this application.

- UV/Vis can be applied to determine the kinetics or rate constant of a chemical reaction.

Fluorescence spectrophotometer LS45 (PerkinElmer)

In **fluorescence spectrometry** both an excitation spectrum (the light that is absorbed by the sample) and/or an emission spectrum (the light emitted by the sample) can be measured. The concentration of the analyte is directly proportional with the intensity of the emission.

- Fluorescence analysis is suitable for analytes that can be dissolved in solvents like water, ethanol and hexane.
- The analytes need to absorb UV or visible light.
- The analytes need to emit visible or near infra red radiation
- With fluorescence analysis we can do quantitative measurements of a single analyte in solution (Or more than one analytes in solution provided thay do not interfere with each other.)

Magnus Inverted tissue culture Trinocular Microscope

Inverted microscopes for biological tissue culture applications. Plan infinity optics with long working distance objectives. Trinocular head for fitting documentation cameras. Available are a number of attachments to increase versatility of the microscope.

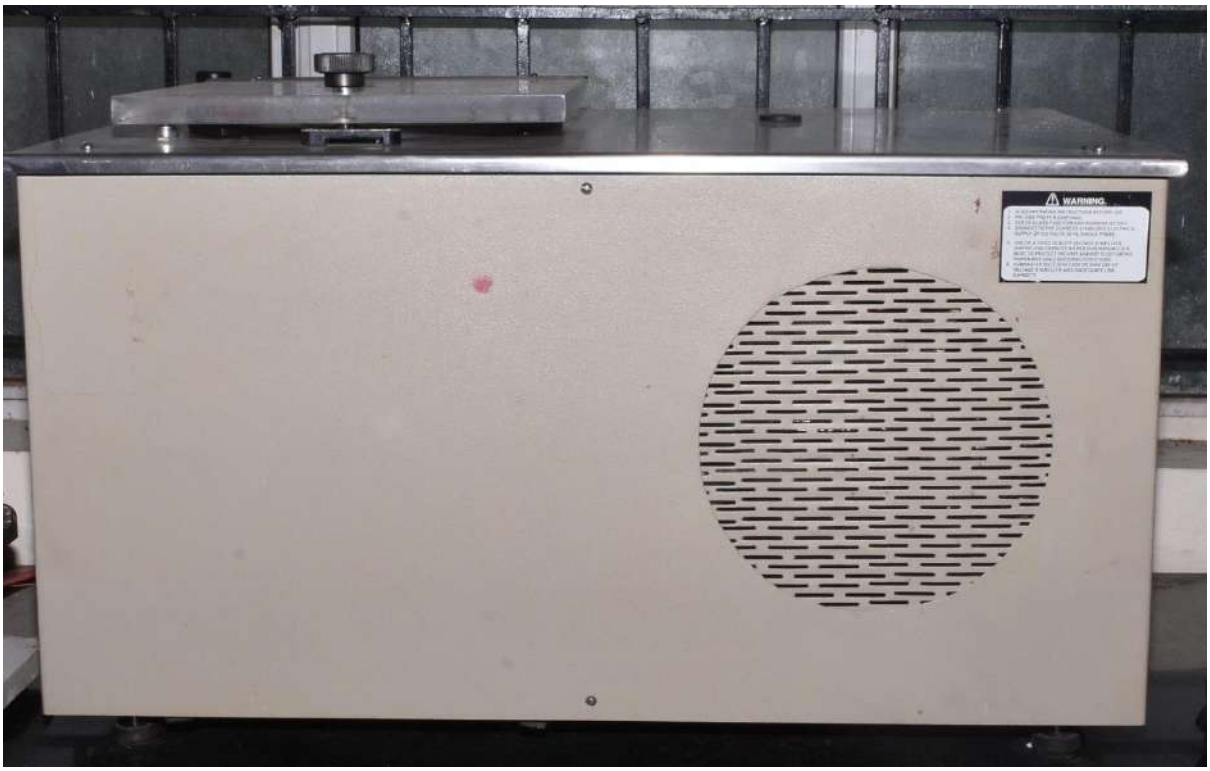
Features:

- Long working distance plan infinity optics
- Pre-centered phase annulus
- Trinocular port in standard unit
- Excellent field flatness

Uses:

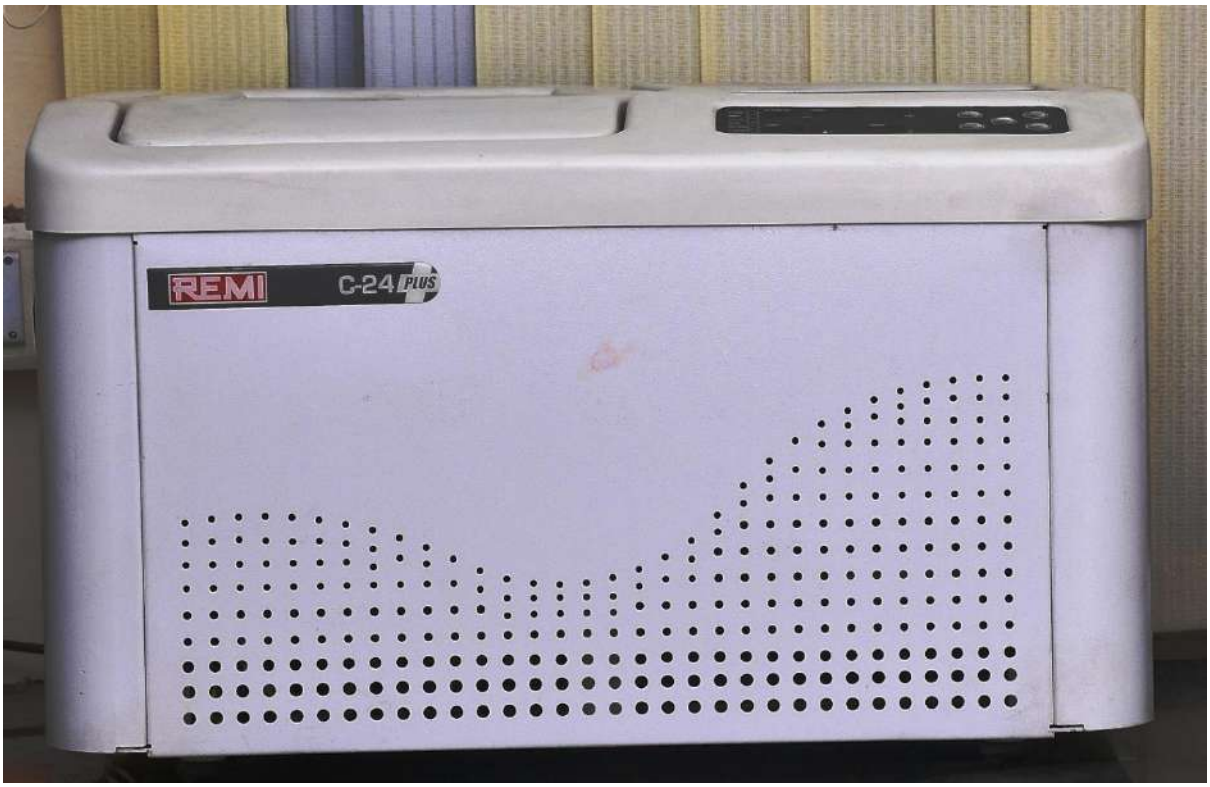
- Tissue Culture applications.
- Auto immune diseases identification.
- Cell Culture Studies.
- Microscope cameras with advance CMOS sensors.
- Multifunctional camera with High Resolution.

Cooling Centrifuge (REMI)



Cooling Centrifuge (REMI-24plus)

Cooling Centrifuge (REMI-24plus)

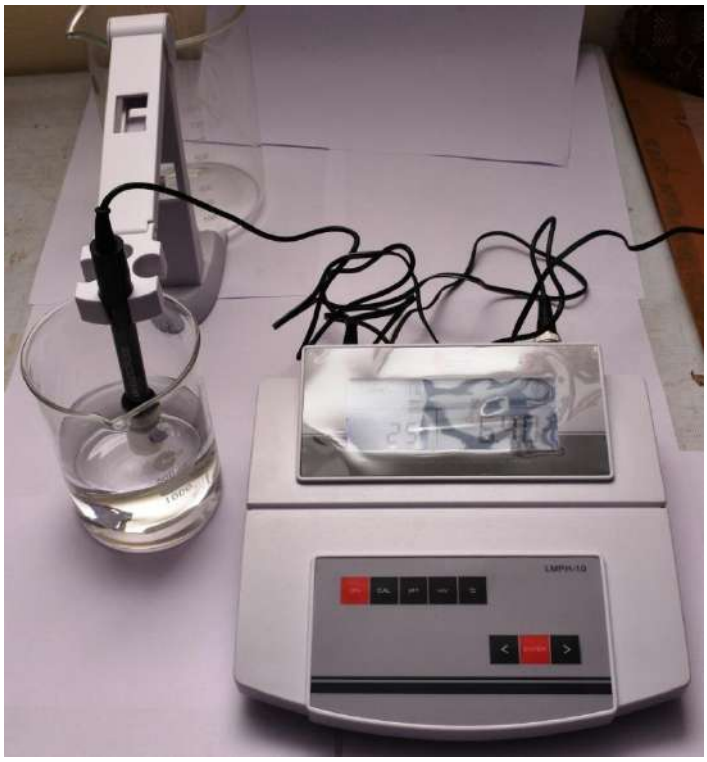


Application:

- Use in haematology lab for PCV determination.
- Isolation of macromolecules such as DNA, RNA, proteins, or lipids
- Removes protein precipitate from analytic sample.
- Conc. Cellular element for microscopy.
- Remove cellular elements from blood to provides cell-free serum or plasma

Deluxe pH meter model-101

pH meter LMPH-10



- A **pH meter** is a scientific instrument that measures the hydrogen-ion activity in water-based solutions, indicating its acidity or alkalinity expressed as pH.
- pH meters are used for soil measurements in agriculture, water quality for municipal water supplies, swimming pools, environmental remediation; brewing of wine or beer; manufacturing, healthcare and clinical applications such as blood chemistry; and many other applications.

REMI Centrifuge (R-8C)

REMI mini Centrifuge (RM-20 plus)

PCR Mini centrifuge - SPINWIN

- This equipment is extensively used in chemistry, biology, and biochemistry for isolating and separating suspensions.
- It additionally provides the cooling mechanism to maintain the uniform temperature throughout the operation of the sample.

Laminar air cabinet -Cleanair-CAB900

Laminar air cabinet (MANISH)

Laminar air cabinet (C-TECH instrument)

A **laminar flow cabinet** or **tissue culture hood** is a carefully enclosed bench designed to prevent contamination of semiconductor wafers, biological samples, or any particle sensitive materials.

- Air is drawn through a HEPA filter and blown in a very smooth, laminar flow towards the user.
- Due to the direction of air flow, the sample is protected from the user but the user is not protected from the sample.
- Laminar flow cabinets may have a UV-C germicidal lamp to sterilize the interior and contents before usage to prevent contamination of experiment.
- Germicidal lamps are usually kept on for 15 minutes to sterilize the interior and no contact is to be made with a laminar flow hood during this time.
- During this time, scientists normally prepare other materials to maximize efficiency. (It is important to switch this light off during use, to limit exposure to skin and eyes as stray ultraviolet light emissions can cause cancer and cataracts.

Fume cupboard (AEROMECH)

A fume hood is typically a large piece of equipment enclosing five sides of a work area, the bottom of which is most commonly located at a standing work height. Two main types exist, ducted and recirculating (ductless). The principle is the same for both types: air is drawn in from the front (open) side of the cabinet, and either expelled outside the building or made safe through filtration and fed back into the room.

This is used to:

- Protect the user from inhaling toxic gases (fume hoods, biosafety cabinets, glove boxes)
- Protect the product or experiment (biosafety cabinets, glove boxes)
- Protect the environment (recirculating fume hoods, certain biosafety cabinets, and any other type when fitted with appropriate filters in the exhaust airstream)

Secondary functions of these devices may include explosion protection, spill containment, and other functions necessary to the work being done within the device.

Gel documentation system (Biotech)

A gel doc, also known as a gel documentation system, gel image system or gel imager, refers to equipment widely used in molecular biology laboratories for the imaging and documentation of nucleic acid and protein suspended within polyacrylamide or agarose gels.

- These gels are typically stained with ethidium bromide or other nucleic acid stains such as Gel Green. Generally, a gel doc includes an ultraviolet (UV) light transilluminator, a hood or a darkroom to shield external light sources and protect the user from UV exposure, and a CMOS camera for image capturing.
- Recently produced imager models also include features to handle a variety of fluorescence and chemiluminescence with cameras cooled to -28 to -60 °C.
- Other advanced features include instant printing on-board the camera and Wi-Fi connectivity for control by smartphone and tablet devices.

Hot air oven

Hot air ovens are electrical devices which use dry heat to sterilize. They were originally developed by Pasteur. Generally, they use a thermostat to control the temperature. Their double walled insulation keeps the heat in and conserves energy, the inner layer being a poor conductor and outer layer being metallic.

- ✓ There is also an air filled space in between to aid insulation. An air circulating fan helps in uniform distribution of the heat.
- ✓ These are fitted with the adjustable wire mesh plated trays or aluminium trays and may have an on/off rocker switch, as well as indicators and controls for temperature and holding time.
- ✓ Temperature sensitive tapes or biological indicators using bacterial spores can be used as controls, to test for the efficacy of the device during use.

Hydraulic press

A **hydraulic press** is a machine press using a hydraulic cylinder to generate a compressive force. The hydraulic press depends on Pascal's principle-the pressure throughout a closed system is constant. One part of the system is a piston acting as a pump, with a modest mechanical force acting on a small cross-sectional area; the other part is a piston with a larger area which generates a correspondingly large mechanical force. Only small-diameter tubing (which more easily resists pressure) is needed if the pump is separated from the press cylinder.

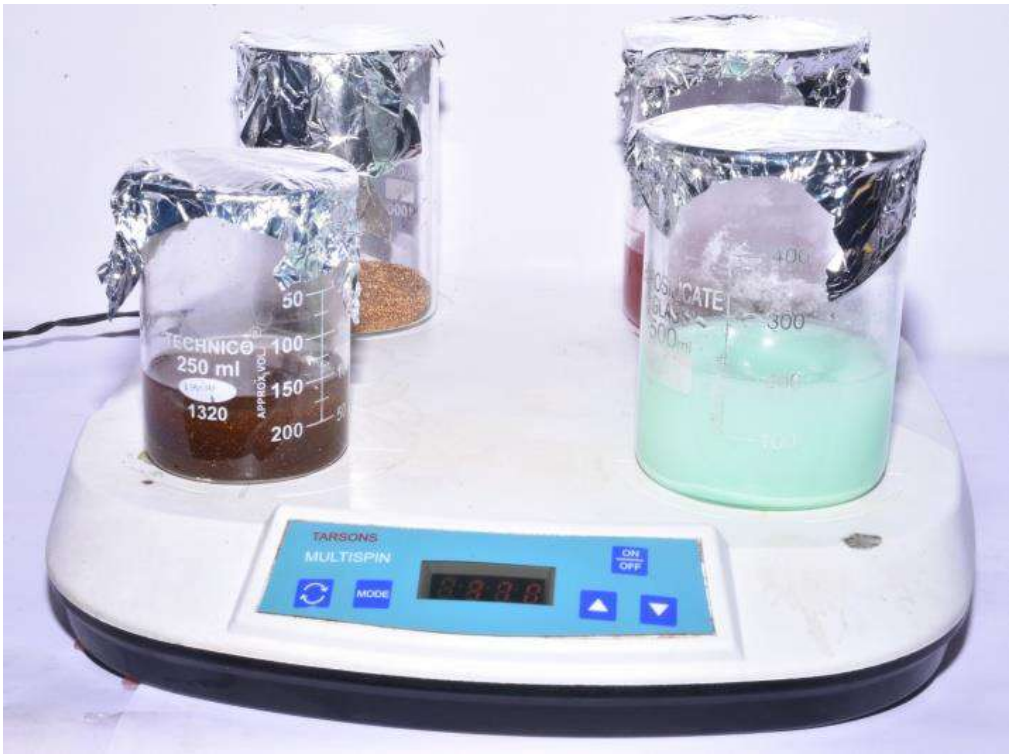
- ✓ Hydraulic presses are commonly used for forging, clinching, moulding, blanking, punching, deep drawing, and metal forming operations.
- ✓ The hydraulic press is advantageous in manufacturing, it gives the ability to create more intricate shapes and can be economical with materials.

Microscope-ACCU-SCOPE

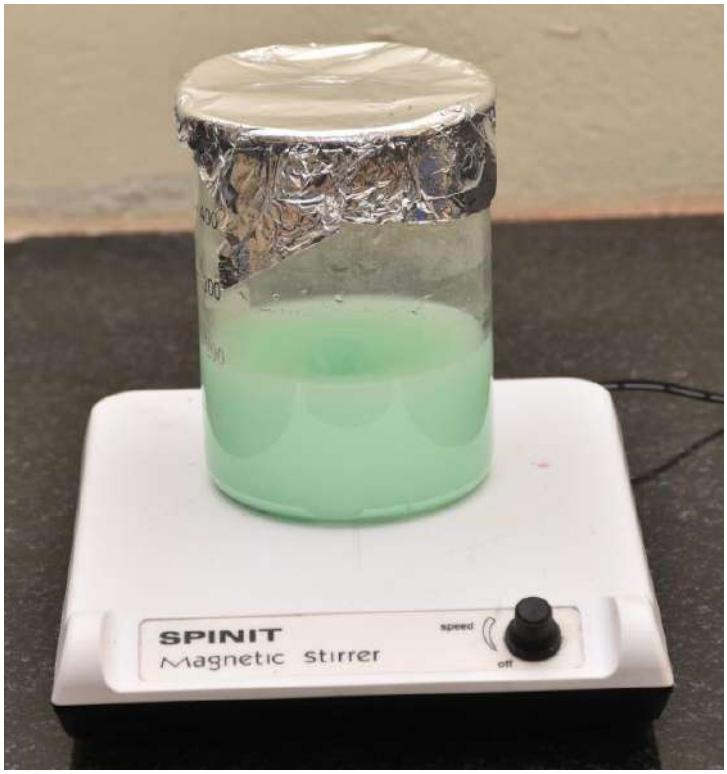
Microscopy is the science of investigating small objects and structures using such an instrument. Microscopic means invisible to the eye unless aided by a microscope.

- There are many types of microscopes, and they may be grouped in different ways. One way is to describe the way the instruments interact with a sample to create images, either by sending a beam of light or electrons to a sample in its optical path, or by scanning across, and a short distance from the surface of a sample using a probe.
- The most common microscope (and the first to be invented) is the optical microscope, which uses light to pass through a sample to produce an image.
- This microscope technique made it possible to study the cell cycle in live cells.

Multispin (Tarson)



Magnetic stirrer (SPINOT-Tarson)



Digital HOT plate with magnetic stirrer (SPINOT-Tarson)

REMI 1MLH **REMI 5MLH**

- The magnetic stirrers are also known as magnetic stir plates and quite commonly used for experiments in chemistry and biology.
- They are very useful when you need to mix component, either solids or liquids and get a homogeneous liquid mixture.
- Some of the common samples include bacterial growth media as well as buffer solutions.
- The main function of a stirrer is to agitate the liquid for speeding up the reactions or improving mixtures.

Serological Water bath

A **water bath** is laboratory equipment made from a container filled with heated water. It is used to incubate samples in water at a constant temperature over a long period of time.

- ✓ Utilisations include warming of reagents, melting of substrates or incubation of cell cultures.
- ✓ It is also used to enable certain chemical reactions to occur at high temperature.
- ✓ Water bath is a preferred heat source for heating flammable chemicals instead of an open flame to prevent ignition.
- ✓ Different types of water baths are used depending on application. For all water baths, it can be used up to 99.9 °C.
- ✓ When temperature is above 100 °C, alternative methods such as oil bath, silicone bath or sand bath may be used.

Digital Colony Counter (DEEP VISION)

- ✓ Digital Colony Counter is designed for quick and accurate counting of bacterial and mould colonies in petri dishes.
- ✓ Feature packed and easy to use, this is an indispensable bench top tool for the busy microbiologist.
- ✓ It is designed for rapid and accurate counting of bacterial and mould colonies.

Autoclave (MAHAVIR)

- Used for the sterilization of culture media, and all other materials through which steam can penetrate.
- Employed for glassware; syringes, metal instruments, and paper-wrapped goods
- They are used for general lab work, component and stability testing, core hardening, drying glassware, and sterilizing.

µP Photocolorimeter (DEEP VISION)

- ✓ The colour of light is the function of its wavelength.
- ✓ It involves the quantitative estimation of colour.
- ✓ Beer-Lambert Law states that the concentration of a solute is proportional to the absorbance.
- ✓ This device is commonly used to determine the concentration of a known solute in a given solution by the application of the Beer-Lambert law.

UV-trans illuminator (eps Researcher´s Choice) LUMiNA

INNOV BIO UV-TRANS ILLUMINATOR

- UV-transilluminators are used in molecular biology labs to view DNA (or RNA) that has been separated by electrophoresis through an agarose gel.
- During or immediately after electrophoresis, the agarose gel is stained with a fluorescent dye which binds to nucleic acid.
- Exposing the stained gel to a UVB light source causes the DNA/dye to fluoresce and become visible.
- This technique is used wherever the researcher needs to be able to view their sample, for example sizing a PCR product, purifying DNA segment after a restriction enzyme digest, quantifying DNA or verifying RNA integrity after extraction.

Eppendorf PCR Mastercycle® *personal*

PCR LARK CYCLER Model 125+

- Polymerase chain reaction (PCR) is a method widely used in molecular biology to make several copies of a specific DNA segment.
- Using PCR, copies of DNA sequences are exponentially amplified to generate thousands to millions of more copies of that particular DNA segment.

Applications of the technique include

- DNA cloning for sequencing,
- Gene cloning and manipulation,
- Gene mutagenesis,
- Construction of DNA-based phylogenies, or functional analysis of genes,
- Diagnosis and monitoring of hereditary diseases,
- Amplification of ancient DNA,
- Analysis of genetic fingerprints for DNA profiling (for example, in forensic science and parentage testing),
- Detection of pathogens in nucleic acid tests for the diagnosis of infectious diseases.

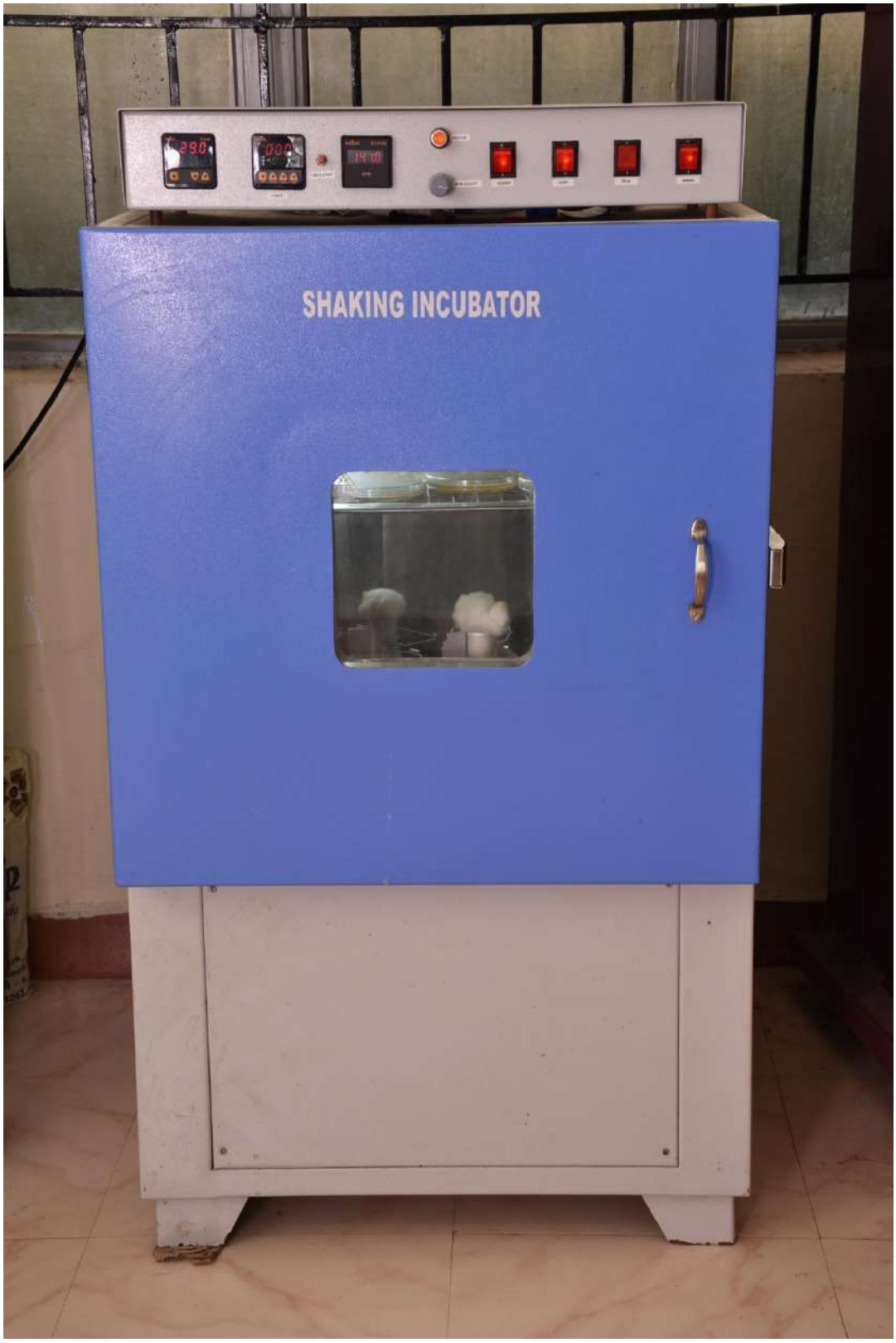
CO_2 Incubator (Lark Innovative Fine Teknowledge)

Incubator is a device used to grow and maintain microbiological cultures or cell cultures. The incubator maintains optimal temperature, humidity and other conditions such as the CO (CO_2) and oxygen content of the atmosphere inside.

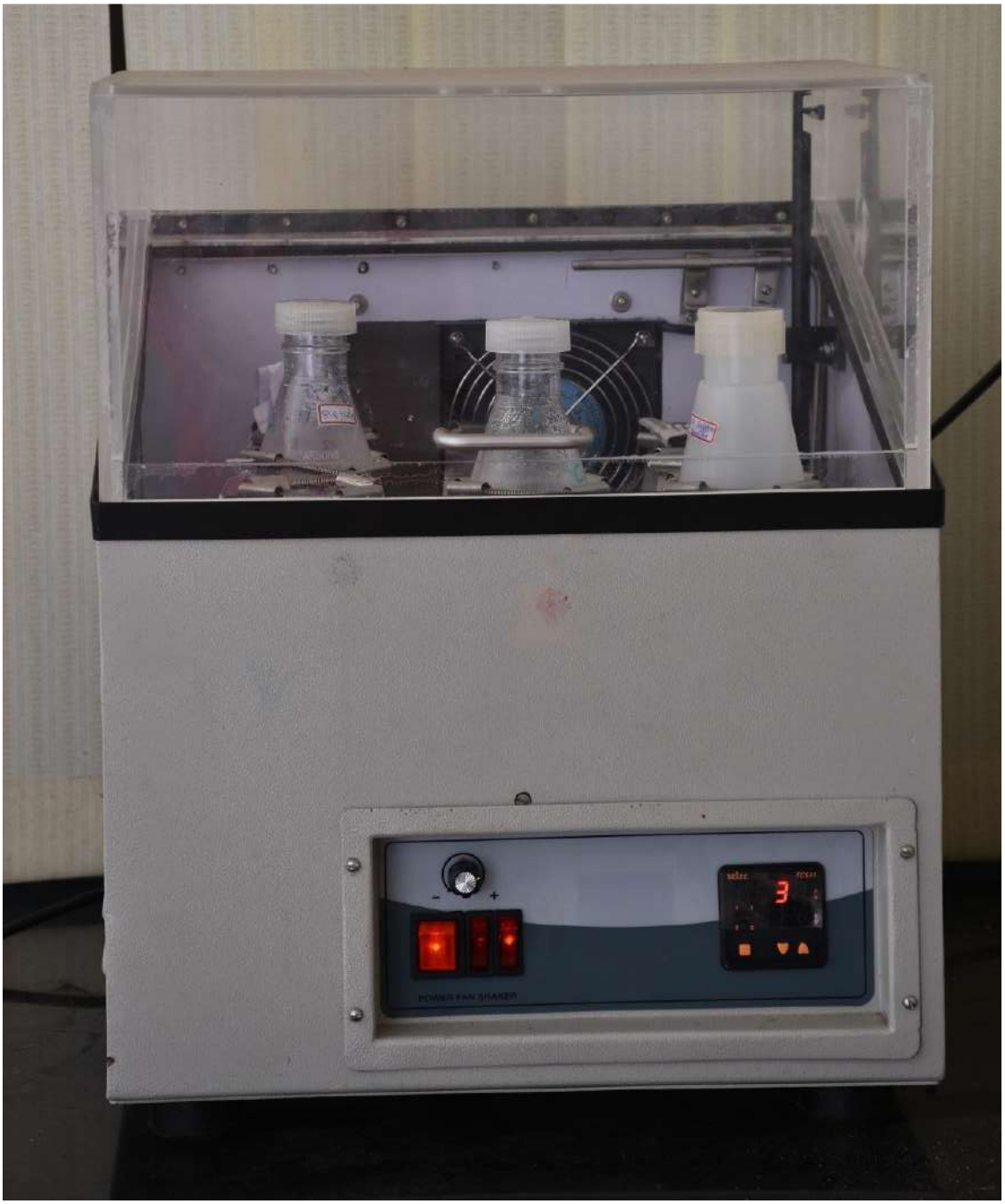
- ✓ Incubators are essential for a lot of experimental work in cell biology, microbiology and molecular biology and are used to culture both bacterial as well as eukaryotic cells.
- ✓ This is important in the cultivation of mammalian cells, where the relative humidity is typically >80% to prevent evaporation and a slightly acidic pH is achieved by maintaining a CO_2 level of 5%.

Incubator shaker (Revotek)

Shaking incubator



Incubator shaker



- A shaker is a piece of laboratory equipment used to mix, blend, or to agitate substances in tubes or flasks by shaking them, which is mainly used in the fields of chemistry and biology.
- An orbital shaker has a circular shaking motion and it is suitable for culturing microbes, washing blots, and general mixing.

Digital Ultrasonic cleaner WUC series

- ✓ Ultrasonic cleaning uses cavitation bubbles induced by high frequency pressure (sound) waves to agitate a liquid.
- ✓ The agitation produces high forces on contaminants adhering to substrates like metals, plastics, glass, rubber, and ceramics.
- ✓ This action also penetrates blind holes, cracks, and recesses.

Vacuum oven

- Vacuum ovens are very versatile pieces of equipment with applications in laboratory research, engineering, and industry.
- A vacuum drying oven is most often used for delicate drying processes, such as drying tiny parts or removing flammable solvents.
- The low pressure environment also minimizes oxidation during drying

REMI Quick freezers

Deep freezers (Blue star)

- ✓ Deep freezers are the testing equipment that are used to preserve and store food products, medical equipment, blood samples, medicines and injections, etc. for a long period of time.
- ✓ Deep Freezers are used for industrial purposes as well as for household purposes.

Gel electrophoresis (ORANGE)

Gel electrophoresis is a method for separation and analysis of macromolecules (DNA, RNA and proteins) and their fragments, based on their size and charge. It is used in clinical chemistry to separate proteins by charge or size (IEF agarose, essentially size independent) and in biochemistry and molecular biology to separate a mixed population of DNA and RNA fragments by length, to estimate the size of DNA and RNA fragments or to separate proteins by charge.

- Nucleic acid molecules are separated by applying an electric field to move the negatively charged molecules through a matrix of agarose or other substances.
- Shorter molecules move faster and migrate farther than longer ones because shorter molecules migrate more easily through the pores of the gel.
- This phenomenon is called sieving. Proteins are separated by charge in agarose because the pores of the gel are too large to sieve proteins.
- Gel electrophoresis can also be used for separation of nanoparticles.

Electronic Digital Balance

A Beam balance (or Beam scale) is a device to measure weight or mass. These are also known as mass scales, weight scales, mass balance, weight balance, or simply scale, balance, or balance scale.

- Some scales can be calibrated to read in units of force (weight) such as newtons instead of units of mass such as kilograms.
- Scales and balances are widely used in commerce, as many products are sold and packaged by mass.

Gel Rocker Li-GR-E-100 (ORANGE)

A **rocker** is a device used in laboratories for molecular and biological mixing applications. Rockers are often used in place of shakers when less aggressive mixing is required.

- Rockers are commonly used for staining and de-staining gels after electrophoresis, hybridization, washing, blotting, Cell culture and gentle mixing.
- Two-dimensional rockers use a platform that moves in a seesaw motion to create waves in liquid laboratory samples. Three-dimensional rockers move a platform in a three-dimensional gyratory motion to create a gentle swirling of samples.

Aplap Regulated dual Direct Current (DC) power supply (LD6402)

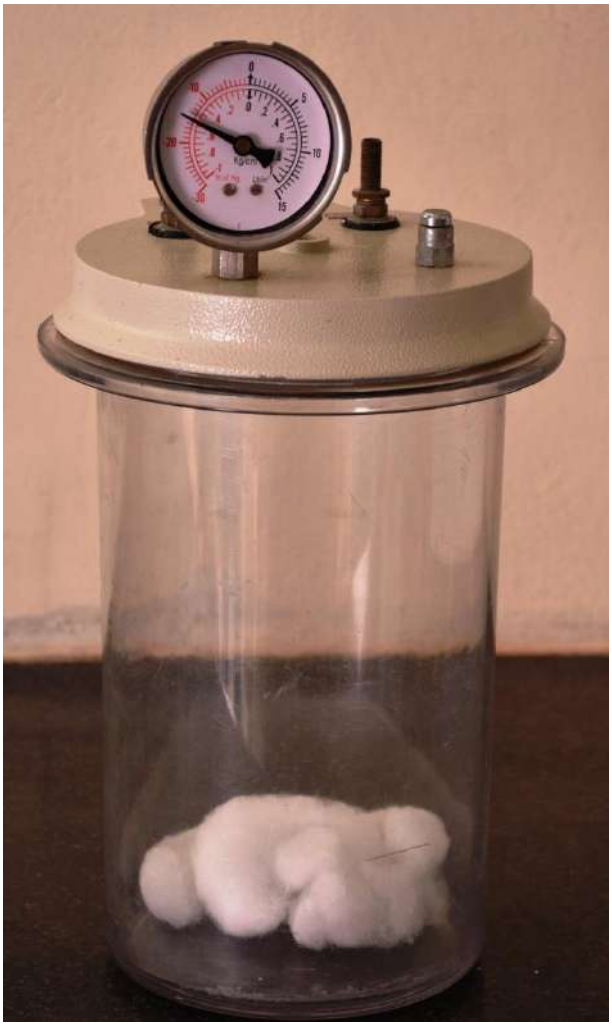
A **power supply** is an electrical device that supplies electric power to an electrical load. The primary function of a power supply is to convert electric current from a source to the correct voltage, current, and frequency to power the load. As a result, power supplies are sometimes referred to as electric power converters. Some power supplies are separate standalone pieces of equipment, while others are built into the load appliances that they power.

- A DC (Direct current) power supply is one that supplies a constant DC voltage to its load. Depending on its design, a DC power supply may be powered from a DC source or from an AC source such as the power mains.
- To removal of organic and inorganic contents from pollutant contaminated soil by Electrokinetic process

Chemical oxygen demand (COD) analyzer (Spectroquant TR320)

- ✓ The COD value indicates the amount of oxygen which is needed for the oxidation of all organic substances in water in mg/l or g/m3.
- ✓ The COD (Chemical Oxygen Demand) is closely related to the laboratory standard method named Dichromate-Method.
- ✓ With this method, the chemical oxygen demand is determined during chromic acid digestion of organic loads in the waste water.
- ✓ Based on this method the COD became a commonly used sum parameter in waste water analysis.
- ✓ It is used for planning of waste water treatment plants, for controlling the cleaning efficiency and for the calculation of waste water taxes.

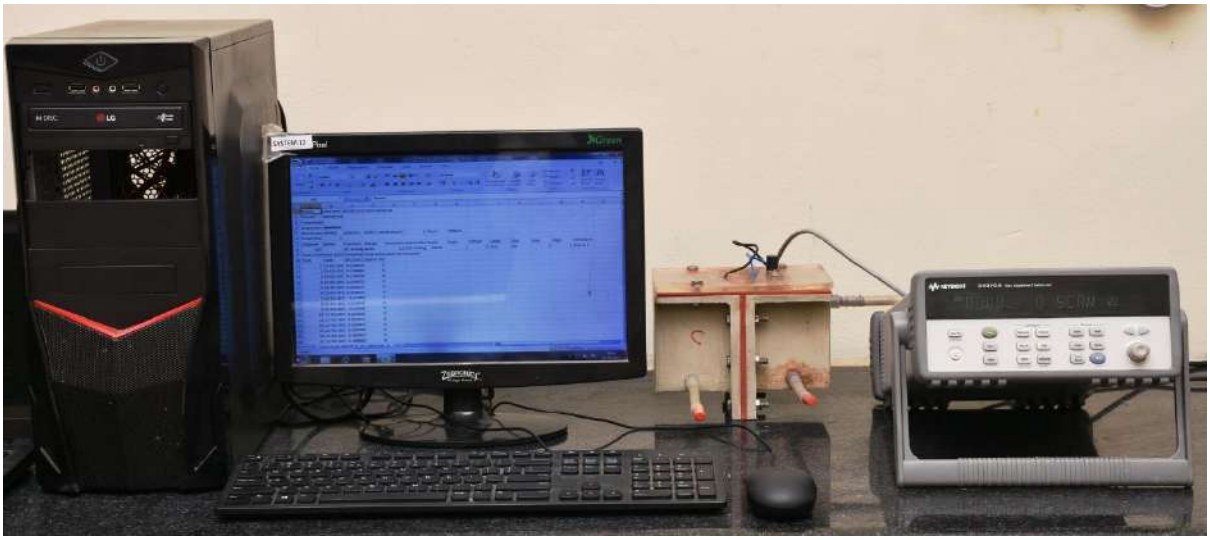
Anaerobic jar



Anaerobic jar is an instrument used in the production of an anaerobic environment. This method of *anaerobiosis* as others is used to culture bacteria which die or fail to grow in presence of oxygen (*anaerobes*).

- The culture media are placed inside the jar, stacked up one on the other, and growth free culture plate at the end of the process indicates a successful anaerobiosis. However, *P. aeruginosa* possesses a denitrification pathway. If nitrate is present in the media, *P. aeruginosa* may still grow under anaerobic conditions.

Keysight Data Acquistion switch Unit for microbial fuel cell



Key Features & Specifications

- 3-slot mainframe with USB and LAN
- 6 1/2-digit (22-bit) internal DMM, scanning up to 450 channels per second with new solid-state multiplexer module
- 8 switch and control plug-in modules to choose from
- Built-in signal conditioning measures thermocouples, RTDs and thermistors, AC/DC volts and current; resistance, frequency/period, diode test and capacitance
- 100k readings of non-volatile memory holds data when power is removed
- Hi/LO alarm limits on each channel, plus 4 TTL alarm outputs
- A BenchVue software license (BV0006B) is now included with your instrument. BenchVue makes it simple to connect, control instruments, and automate test sequences

This Data Acquistion switch Unit was mainly used for Data monitoring and recording on current profile vs Time from microbial fuel cell.

HIOKI 3632-50 LCR HiTESTER

An **LCR meter** is a type of electronic test equipment used to measure the inductance (L), capacitance (C), and resistance (R) of an electronic component.

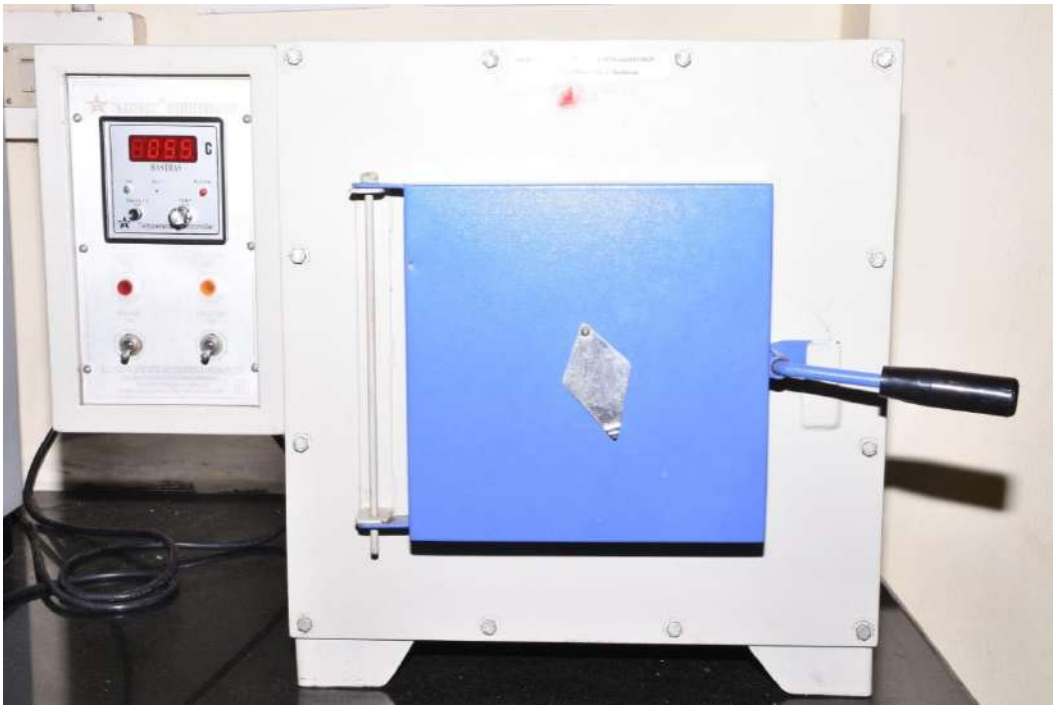
- In the simpler versions of this instrument the impedance was measured internally and converted for display to the corresponding capacitance or inductance value.
- Readings should be reasonably accurate if the capacitor or inductor device under test does not have a significant resistive component of impedance.
- More advanced designs measure true inductance or capacitance, as well as the equivalent series resistance of capacitors and the Q factor of inductive components.

Photocatalysis chamber with power supply unit (Revathe)

In chemistry, photocatalysis is the acceleration of a photoreaction in the presence of a catalyst. In catalysed photolysis, light is absorbed by an adsorbed substrate. In photogenerated catalysis, the photocatalytic activity (PCA) depends on the ability of the catalyst to create electron–hole pairs, which generate free radicals (e.g. hydroxyl radicals: •OH) able to undergo secondary reactions. Its practical application was made possible by the discovery of water electrolysis by means of titanium dioxide (TiO_2).

- Disinfection of water by supported titanium dioxide photocatalysts, a form of solar water disinfection (SODIS).
- Use of titanium dioxide in self-sterilizing photocatalytic coatings (for application to food contact surfaces and in other environments where microbial pathogens spread by indirect contact).
- Oxidation of organic contaminants using magnetic particles that are coated with titanium dioxide and agitated using a magnetic field while being exposed to UV light. nanoparticles

Muffle furnace



A **muffle furnace** or **muffle oven** (sometimes **retort furnace** in historical usage) is a furnace in which the subject material is isolated from the fuel and all of the products of combustion, including gases and flying ash.

- Today, a muffle furnace is (usually) a front-loading box-type oven or kiln for high-temperature applications such as fusing glass, creating enamel coatings, ceramics and soldering and brazing articles.
- In ceramics muffle kilns were typically used for relatively low temperatures, for overglaze decoration.
- They are also used in many research facilities, for example by chemists in order to determine what proportion of a sample is non-combustible and non-volatile (i.e., ash).

Tubular furnace (High power)

- A **tube furnace** is an electric heating device used to conduct syntheses and purifications of inorganic compounds and occasionally in organic synthesis.
- One possible design consists of a cylindrical cavity surrounded by heating coils that are embedded in a thermally insulating matrix.
- Temperature can be controlled via feedback from a thermocouple.
- Tube furnaces can also be used for thermolysis reactions, involving either organic or inorganic reactants.