STANDARD OPERATING PROCEDURE

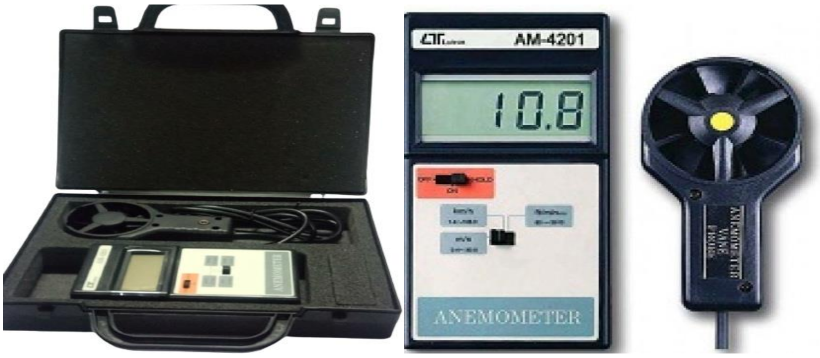
DEPARTMENT OF PHYSICS

Spot Reflecting Galvanometer

- Spot reflecting galvanometer has a built-in lamp and scale arrangement based in a sturdy bakelite case with lock/ unlock knob at the top and on/ off switch. It is used to detect low currents as of micro ampere.
- Set up the Galvanometer on a vibration – free mount (FREE position). Connect the lamp supply to the plug, which fits the socket on the backside of the case. The correct voltage is engraved on the socket.
- The spot of light is set on the middle of the scale by turning slowly the small knob at the top.
- Generally, the galvanometers are fitted with a built – in – transformer operatable on 220 V. AC mains if desired it can be supplied 6 Volt battery operated.
- The galvanometer is provided with a pointed clamping lever with which the coil can be clamped or released by moving it to the clamp or release position. The Galvanometer zero may be set by means of the adjuster situated behind the clamping lever and engraved as ‘Z’, which allows the spot to any point on the scale.
- The Galvanometer terminals are brought out on the left-hand side of the case. When the instrument is being moved from place to place, it is advisable either to clamp the coil or short circuit these terminals to prevent violent oscillations of the moving coil.

  Galvanometer fitted with universal shunt
- A switch has been provided at the right-hand side of the case having 6 positions marked as D, 1, 1/10, 1/100, 1/1000 it has the respective sensitivities with respect to the position while on S/C is short circuited and gives no deflection.

Digital Anemometer



Anemometer is a device used for measuring wind speed.When the anemometer faces the wind, concave surfaces of the cup create more resistance than it's convex surfaces and hence an unbalanced moment is produced which causes rotational motion with respect to its centre axis. Under steady flow condition, the rotational speed of the anemometer is directly related to the wind speed.

One of the fan blades have tiny magnets mounted on it and each time when the arms make a single rotation, the magnet moves past a magnetic detector called a reed switch. When the magnet is nearby, the reed switch closes and generates a brief pulse of electric current, before opening again when the magnet goes away. This kind of anemometer effectively makes a series of electric pulses at a rate that is proportional to the wind speed. Counting how often the pulses come in and the wind speed can be measured from that.

- Press "MODE" button for 2 seconds to turn on the unit. LCD will display Air velocity, temperature and battery icon. LCD backlight will last for 12 seconds.
- Press "MODE" button more than 3 seconds until "m/s" starts to blink. Press "SET" button to select desired air velocity unit. To confirm the unit, press "MODE" button.
- For setting MAX/AVG/CU mode, press "SET" button again and again until CU/MAX/AVG blink, then press "MODE" button to confirm.
- Temperature switch key (℃/℉) conceals in the rear cabinet, by pressing the key for ℃/℉ conversion.
- The backlight will be activated for 12 seconds by press any key.
- When the wind vane (impeller) turns, LCD will display wind speed instantly, temperature and beau fort scale.
- When temperature below 0 ℃, "WIND CHIU" will be shown on the LCD.
- Press "MODE" + "SET" buttons at the same time to turn off the unit.
- The unit will be shut off without any operation for 14 minutes.

Digital Precision Balance

- Digital precision balance is used to measure the mass of the substance in milligram level with high accuracy.
- Before performing weighing, make sure the balance is kept clean and dry.
- And ensure that the spirit level is in the center of the circle.
- Switch on the main power supply of the balance.
- Balance should show 0.000 and if the balance is showing some reading on the display then press tare key.
- After stabilizing the balance, open the door from one side and place the container.
- Close the door and press tare key.
- Then open the door and place the material to be weighed on the pan.
- Close the door and wait until the number is fixed on the screen and note it down.
- After getting a stable display, open the door and take out the sample with container or sampling bag.
- Close the door and press 'Tare key' again.

Magnetic Stirrer with Hot Plate

- A magnetic stirrer is a device widely used in laboratories and consists of a rotating magnet or a stationary electromagnet that creates a rotating magnetic field.
- This device is used to make a stir bar, immerse in a liquid, quickly spin, or stirring or mixing a solution.
- A magnetic stirring system generally includes a coupled heating system for heating the liquid.
- Magnetic stirrer/hotplate should be used on level surfaces.
- If hazardous vapours will not be produced, hot plates should be in an area free of drafts to ensure heating efficiency.
- Keep the top surface of the magnetic stirrer / hot plate clean. Use a non-abrasive cleaner to clean the surface and the outside of the unit.
- Replace the top surface if damaged.
- Do not use metal foil on hotplates.
- Ensure that the working bench is clean.
- Ensure that the stirrer 'Speed control knob' is in off position.
- Switch on the power supply.
- Place the solution to be stirred on the magnetic stirrer.
- Increase the stirring speed by rotating the 'Speed control knob' clockwise.
- After the stirring is completed, decrease the stirring speed slowly by rotating the 'Speed control knob anti clock wise and keep the knob in 'off' position.
- Then switch off the power supply.

Hot Plate Operation

- Magnetic stirrers include a hot plate for heating the liquid.
- During initial operation of a hot plate, some odour and vapours may be produced from the heating element, which is normal.
- Place the sample vessel on the hotplate so that it is centred, where practical. For hot plates with multiple heating elements, centre the vessel over a heating element, where practical.
- Turn the instrument on and set the thermostat to the desired setting.
- Allow around 10 minutes for hot plate and liquid temperatures to stabilize.
- If necessary, adjust the temperature by adjusting the thermostat.
- When heating is complete, turn the unit off.

Precautions:

- Keep the top plate clean.
- Avoid spillage of sample.

Muffle Furnace

- Muffle furnaces are used to achieve greater control of temperature uniformity and isolate heated materials from combustion contaminants. Excashing samples, heat-treating applications, and materials research.
- Keep the Muffle Furnace on a levelled and firm platform.
- Ensure that the instrument is connected with the main power supply.
- Both the ON/OFF power switch and digital display illuminate.
- The door safety switch removes power from the heating elements when the door is open.
- The set point controller that provides single display to indicate the current chamber temperature or set point temperature.
- When the controller is turned ON it will perform a short self-test and then display a current temperature inside the chamber.
- Then set the required temperature by pressing **(▲)** or **(▼)** arrow key until the desired set point value is displayed and then release the button.
  - ✓ Down Button: allow you to decrease a value
  - ✓ UP Button: allow you to increase a value
- A few seconds after the button is released the controller will accept the new value and raise its temperature gradually.
- The working temperature range is 100 to 1000°C.

Planck's Constant by Photoelectric Effect

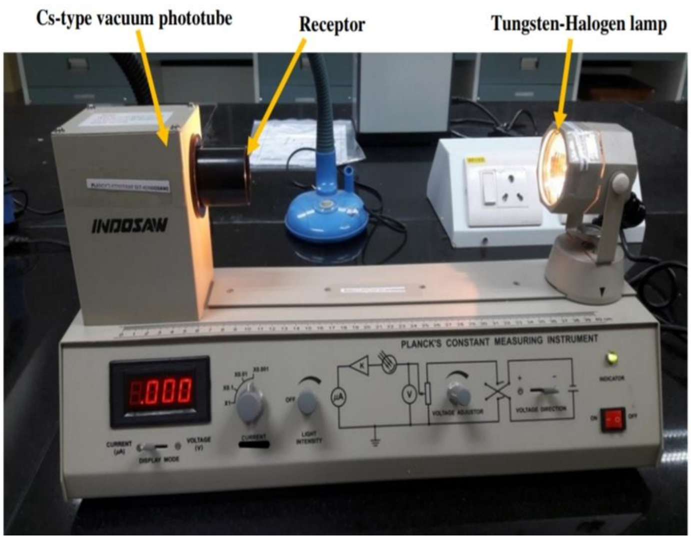


Photo electric effect is the liberation of electrons from the surface of a material by absorption of energy from incident light. For each metal, there exists a minimum binding energy for electron, which is a characteristic of the element, called the work function .When a photon strikes a bound electron, it transfers its energy to the electron. If this energy is less than the metal's work function, the photon is remitted and no electrons are liberated. If this energy is greater than an electron's binding energy, the electron escapes from the metal with a kinetic energy equal to the difference between the photon's original energy and the electron's binding energy.The stopping potential is measured by varying the anode voltage until the current drops to zero. The slope of a plot of stopping potential versus frequency is the value of the ratio, h/e. Hence the value of Planck's constant (h) and work function of the material can be determined.

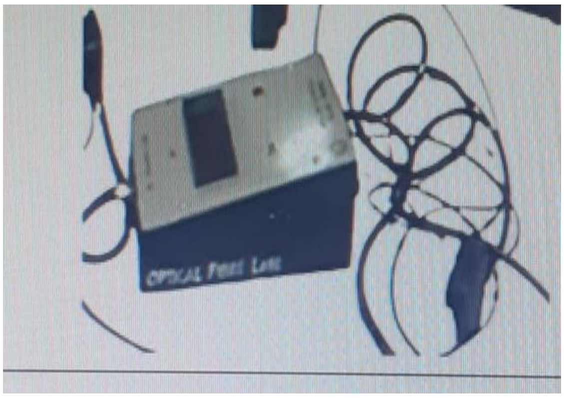
The apparatus demonstrates the quantum mechanical property that energy is a function of frequency, not intensity, and to qualitatively show the photoelectric effect and Planck's constant. It also imparts students, fundamental understanding of the quantum nature of light.

Planck's constant – Experimental set up

Planck experimental set up comprises a tungsten-halogen light source, caesium type vacuum photo tube, built in power supply, current (μA), voltage (V), current multiplier, variable (adjustable) light intensity and voltage direction.

- Switch on the apparatus using red button at the bottom right corner of the experimental set up.
- Before the lamp is switched on, put the display mode (toggle switch) in current and check that the dark current is zero.
- Turn on the lamp source. It may take 5 to 10 minutes to warm up.
- Adjust (Set) the light intensity near to maximum. Note that the intensity should be such that the value of current should not exceed the display range. If it happens, reduce the light intensity.
- Keep the light intensity as constant while taking reading.
- Insert the specified colour filter (Blue, Green, yellow, Orange and Red) into the draw tube of the receptor.
- Set the voltage direction to negative polarity.
- Adjust the voltage knob at minimum and current knob at '× 0.001' position, which means higher resolution since current will be less. The current knob at '× 0. 1' position means the resolution is up to one decimal point.
- Use the display mode to record the values of voltage for the corresponding current.

Optical Fibre Loss, Numerical Aperture, Acceptance

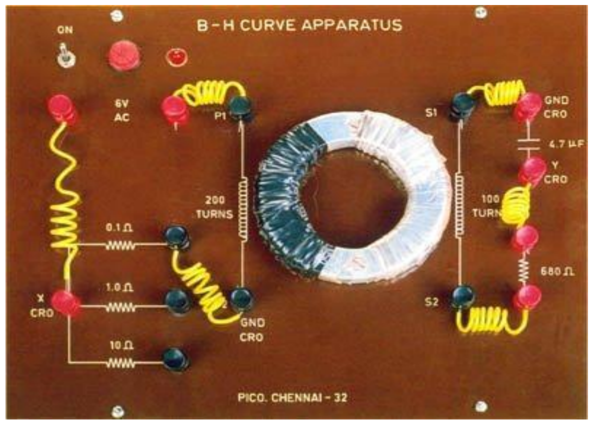


An optical communication system is one that uses light as the carrier of information. The fibre optic kit offers optical laboratory solutions from elementary to advanced topic. Using Fibre Optic Kit, Numerical aperture, acceptance angle and bending losses are calculated.

Fibre Optic Kit comprises a Fibre Optic LED light source, Power meter, Fibre Optic cable (1/2m and 2 m), Adaptor, Numerical Aperture Jig and Mandrel.

- The fibre optic led and driver convert an input voltage to an optical output.
- Connect the optical fibre patch cord securely after relieving all twists and strains on the fibre.
- Optical power meter displays the optical power in decibels.
- Numerical aperture Jig has four concentric circles of 10, 15, 20 and 25mm diameter.
- The circumference of the spot must coincide with the circle.
- The fibre is under filled, the intensity within the spot may not be evenly distributed.
- To ensure the even distribution of light in the fibre, first remove twist on the fibre and then wind 5 turns of the fibre on to the mandrel. Use an adhesive tape to hold the winding position. Now view the spot. The intensity will be more evenly distributed within the core.
- A dark room will facilitates good contrast record the diameter of the spot accurately.
- In-line adaptor is a mechanical components with which two optical fibre cables may be connected in series.
- In-line adaptor without air gap facilitate low loss intensity.

B-H Curve Apparatus

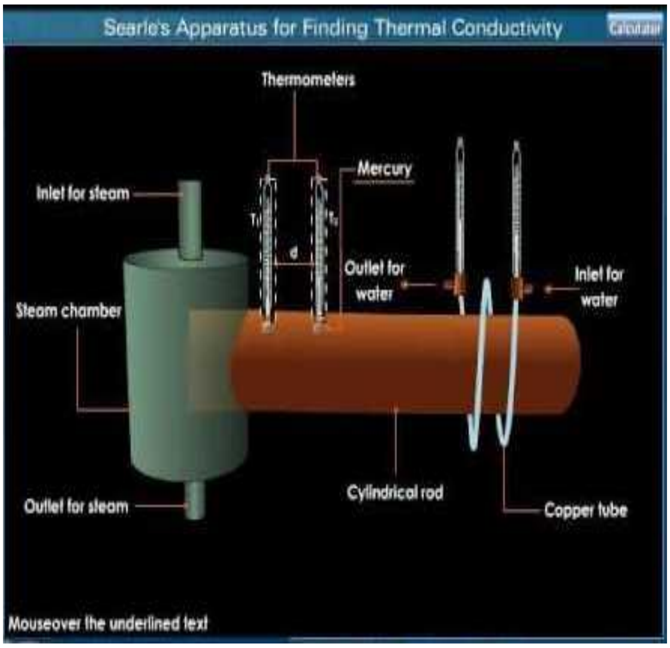


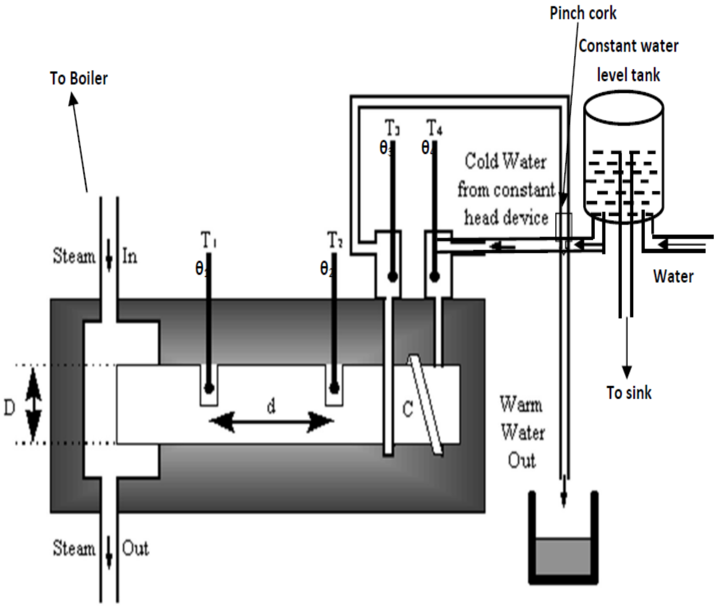
B-H Curves and Hysteresis Loops are valuable tools for comparing the characteristics and behaviour of different magnetic materials, in order to select them for an appropriate applications.

With this apparatus we can determine the ferromagnetic constant, retentivity, permeability and susceptibility by tracing B-H curve.

- Fed a low AC voltage to the primary windings of the specimen along with R1 in series connection.
- Select a suitable R1 value and connections across R1 is given to CRO horizontal axis (X-axis).
- Ensure proper ground connection at the terminal marked GND CRO for the horizontal axis in the primary side.
- Secondary windings of the coil is connected in series with 4.7 micro farad and 680 ohms.
- Connections across secondary should be given to CRO vertical axis (Y-axis)/
- Ensure proper ground connection at the terminal marked GND CRO for the vertical axis in the secondary side.
- Adjust horizontal and vertical gains so that loop occupies maximum area on the screen.

Searle's Apparatus





- Searle's Apparatus is used to measure the thermal conductivity of metal.
- The apparatus consists of cylindrical rod (CD) of the metal placed centrally along the axis of a wooden box.
- The end D of the rod is enclosed in a steam jacket and steam is allowed to pass through it.
- The other end C of the rod is kept cool by circulating water through coils surrounding it.
- The rod is lagged with felt and enclosed in a wooden box to reduce heat loss and to maintain a constant temperature gradient.
- From the steam boiler pass a steady steam through the rubber tube into the steam chamber to heat the end 'D'.
- Temperature is measured by two thermometers T1 and T2.
- Allow the water to flow through the copper coil by adjusting the height of constant level tank so that watercomes out through the outlet end
- The temperature of water entering at the cold end and that of leaving is measured with thermometers T3 and T4.
- Reading of temperature of all the four thermometers should be constant and there should not be any further increase in temperature in the steady state
- Steady state temperatures recorded by thermometers T1, T2, T3 & T4 be $\theta 1$, $\theta 2$,$\theta 3$& $\theta 4$ respectively.

- Collect the water in a measuring beaker kept below the outlet of the copper coil for a known time't' and calculate the mass of water 'm' flowing per second.
- The above procedure is repeated for 3 to 4 times.
- The distance between the two thermometers T1 and T2 is measured and the diameter of the rod is also measured
- Use the observed values to find the thermal conductivity of metal.

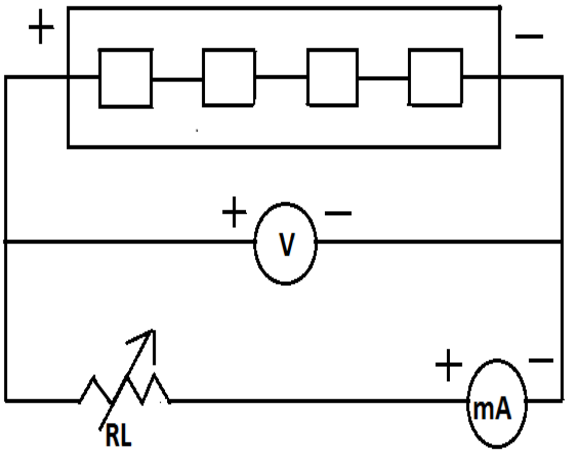
Dielectric Constant Apparatus

Dielectric Constant Apparatus is used to measure dielectric constant of different solids such as Bakelite, Teflonetcand liquids such as distilled water, transformer oil etc.

Standard Operating Procedure:

1. Connect the variable capacitor with the terminals marked variable capacitor on the front panel of the instrument.
2. Switch on the instrument. Set the standard variable capacitor at 100 pF(approximately).
3. Set the sensitivity of the meter at 85µA (approx.) by the sensitivity control knob.
4. Adjust the standard capacitor knob for maximum deflection. At any position of standard variable capacitor, the deflection should be near to 85 to 90µA.
5. Note this value of the variable capacitor as C_1.
6. Do not disturb the sensitivity knob for the whole experiment, after getting the value of C_1
7. Include the unknown test capacitor and repeat the experiment by varying variable capacitor to obtain resonance point (maximum deflection) in the meter. Note this value of the variable capacitor as C_2.
8. Remove the dielectric material (Bakelite sheets) from the test capacitor and repeat the experiment by varying variable capacitor to again obtain resonance point (maximum deflection) in the meter. Note this value of the variable capacitor as C_3.
9. Repeat the experiment with materials of different thickness.

Solar Cell Characteristics



- It is used to Study the I-V Characteristic of a solar cell illuminated by an incandescent lamp, at different frequencies.
- Complete the circuit connections as shown in the above figure and place the light source S at a distance of 15cm from solar cell.
- Now measure the open circuit voltage Voc by opening the connecting wire joining –ve of milliammeter to the load (i.e connecting +ve of cell to the +ve of voltmeter and –ve of cell to the –ve of voltmeter).
- Onceagain complete the circuit connections as shown in fig.
- Bring the load selector switch at S.C position and note the reading in the ampere meter under short circuit condition (if meter shows out of scale then decrease the light intensity), this maximum current is called short circuit current Isc.
- Now introduce the load resistance in the circuit (start from low value of resistance) and note down the current and volts reading.
- Repeat the same with different values of load resistances.
- Draw the graph between V and I.
- Repeat the experimet with other intensities placing the light source at different positions.

Digital pH Meter

A digital potential of hydrogen (pH) meter is an electronic gadget used to measure accurately measure and record the pH value of liquids. Measuring pH allows one to determine the acidity or alkalinity of a substance in a liquid state.

The following steps are required for the calibration:

- After attaching the pH electrode to the BNC socket, wash the pH electrode with distilled water. Put the electrode in first buffer solution, say 7 pH buffer, together with temperature probe if ATC is desired. The display shows the pH value of the solution.
- Press ‘Cal 7 pH’ key. The display starts blinking. The blinking indicates that the system is in calibration mode. Let the pH reading stabilize (Note that the display shall still be blinking indicating calibration mode, but the variation in pH readings should stabilize).
- Press ‘Cal 7 pH’ key again to complete 7 pH calibration.
- Remove electrode from 7 pH buffer, wash with distilled water and put it in 4/9.2 pH’ buffer, say in 4 pH buffers.
- Now press ‘Cal 4/9.2 pH’ key The display again starts blinking. Let the reading stabilize. Press ‘Cal 4/9.2 pH’ key again. The instrument is now calibrated for 4 pH.
- If 3-point calibration is desired, take out the electrode, wash with distilled water and put it in 9.2 pH buffer.
- Now press ‘Cal 4/9.2 pH' key. The display again starts blinking, let the reading stabilize. Again press ‘Cal 4/9.2 pH’ key to complete the calibration process.
- The instrument is now ready to take any pH measurements.

Spectrometer

- Spectrometer is a device for measuring wavelengths of light over a wide range of the electromagnetic spectrum. It is widely used for spectroscopic analysis of sample materials.
- The incident light from the light source can be transmitted, absorbed or reflected through the sample.
- Turn the telescope towards the white wall or screen and looking through eye-piece, adjust its position till the cross wires are clearly seen.
- Turn the telescope towards window, focus the telescope to a long distant object.
- Place the telescope parallel to collimator.
- Place the collimator directed towards sodium vapor lamb. Switch on the lamp.
- Focus collimator slit using collimator focusing adjustment.
- Adjust the collimator slit width.
- Place prism table, note that the surface of the table is just below the level of telescope and collimator.
- Place spirit level on prism table. Adjust the base levelling screw till the bubble come at the centre of spirit level.
- Clamp the prism holder.
- Clamp the prism in which the sharp edge is facing towards the collimator, and base of the prism is at the clamp.

Cathode Ray Oscilloscope (CRO)

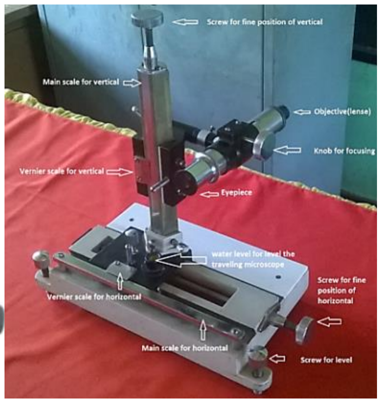
- The CRO is used to measure the voltage, current, frequency, inductance, admittance, resistance, and power factor.
- Check the AM and FM circuits characteristics
- Monitor the signal properties as well as characteristics and also controls the analog signals.
- Proper grounding is an important step when setting up to take measurements or work on a circuit.
- Proper grounding of the oscilloscope protects you from a hazardous shock and grounding yourself protects your circuits from damage.
- To ground the oscilloscope means to connect it to an electrically neutral reference point, such as earth ground.
- Ground your oscilloscope by plugging its three-pronged power cord into an outlet grounded to earth ground.

Setting the Controls

- After plugging in the oscilloscope, take a look at the front panel.
- Mostoscilloscopeshaveatleasttwoinputchannelsandeachchannelcandisplayawaveform on the screen.
- Some oscilloscopes have AUTOSET and/or DEFAULT buttons that can set up the controls in one step to accommodate a signal.
- Set the oscilloscope to display channel1.
- Set the vertical volts/division scale and position controls to mid–range positions turn off. The variable volts/division turn off all magnification setting.
- Set the channel1 input coupling to DC set the trigger mode to auto.
- Set the trigger source to channel 1Turn trigger hold off to minimum or off.
- Set the horizontal time/division and position controls to mid-range positions.

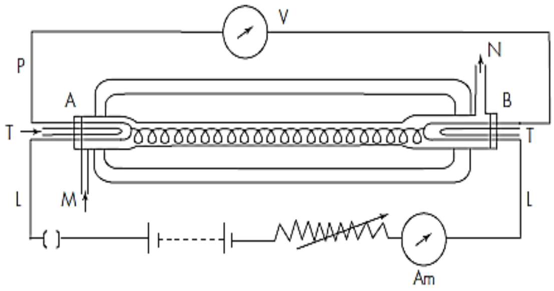
- Adjust channel1volts/division such that the signal occupies as much of the 10 vertical divisions as possible without clipping or signal distortion.
- Most oscilloscopes have a square wave reference signal available at a terminal on the front panel used to compensate the probe. General instructions to compensate the probe areas follows:
- Attach the probe to a vertical channel.
- Connect the probe tip to the probe compensation, i.e.square wave reference signal.
- Attach the ground clip of the probe to ground. View the square wave reference signal.
- Make the proper adjustments on the probe so that the corners of the square wave are square.

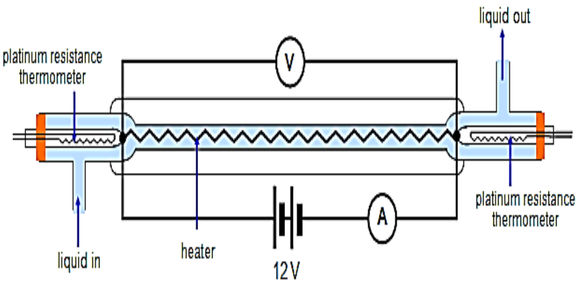
Travelling Microscope



- A travelling microscope is used for the accurate measurement of diameters of different objects.
- It is also used in Physics Laboratories for more accurate determination of small variation in the liquid levels, Manometers, the refractive index of liquids as well as in surface tension & viscosity experiments.
- A microscope attached to a graduated vertical pillar, which is mounted on rigid platform.
- The platform is provided with three levelling screws. The microscope can be moved in the vertical or horizontal direction by means of a screw arrangement attached to it.
- To get a sufficient amount of light, place the travelling microscope (M) near the window.
- For clear visibility of the cross wire, adjust the position of the eyepiece.
- Place the object horizontally on the adjustable stand.
- Make the cross- wire touch one end of the object (A). Note microscope reading on the vertical scale.
- Raise the microscope to make the cross wire touch the other end of the object (B). Note the vertical scale reading.
- The difference between the two readings will give the diameter (AB) of the object.

Callendar Barne's Apparatus





- Callendar Barne's Apparatus is used for the determination of specific heat of water or similar liquids.
- The apparatus consists of platinum resistance wire in the form of the coil placed centrally along the axis of a narrow glass tube AB.
- This wire serves as heater as well as stirrer.
- The ends of wire are connected to metal tubes provided at the ends of glass tube.
- Continuous flow of water is maintained (using a constant level bath) through the tube and the temperatures of inlet and outlet are measured by two thermometers T1and T2.
- The resistance coil is connected in series with the Battery Eliminator (0) V and the ammeter (0) mA.
- A voltmeter (0) V is connected across the terminals of resistance wire.
  - ✓ Adjust the tap of the water system so that the flow rate should be 1cc/sec.
  - ✓ Switch on the current so that the current passing is about 1 A.
  - ✓ Wait for around 20 – 30 minutes. As soon as the temperature in both the thermometer becomes stationery. Note that the temperature of the two thermometers (θ_1& θ_2), ammeter and the voltmeter readings.
  - ✓ To minimize the error set the water flow rate such that the temperature difference between the two thermometers should be less than 10°C.
  - ✓ Collect the water in the measuring cylinder for 5 minutes (300 sec) and calculate the mass of the flowing water per second ($1cm^3$ = 1ml = 1 g)
  - ✓ Increase the height of the reservoir and this will increase the flow of water. Now vary the electric current until the two thermometers show the same stationery readings of θ_1& θ_2.
  - ✓ Note the new readings of the ammeter and the voltmeter and measure the new rate of flow of water.
  - ✓ Use the observed values; find the specific heat capacity of water.

Function Generator

- A function generator is a electronic test instrument used to generate and deliver standard waveforms, typically sine and square waves, to a device under test.
- Display Screen: Here the frequency input is shown.
- Coarse and Fine knobs: These knobs are to put different input frequency. Coarse is used to vary the frequency with large difference. Fine knob is used to vary frequency in decimals.
- Frequency Range Buttons: These are to change the range of frequency after it’s control we change frequency with the help of Coarse and Fine Knobs.
- Duty Cycle knob: It changes the duty cycle of wave.
- INV button: It invert the signal.
- Function buttons: To change the type of waveform.
- ATTN buttons: This control is used to set the voltage level.
- Sync terminal: This connector sends TTL trigger signals.
- Power on the generator and select the desired output signal: square wave, sine wave or triangle wave.
- Connect the output leads to an oscilloscope to visualize the output signal and set its parameters using the amplitude and frequency controls.
- Attach the output leads of the function generator to the input of the circuit you wish to test.
- Attach the output of your circuit to a meter or oscilloscope to visualize the resulting change in signal.

Polarimeter

Polarimeter is used to determine the specific rotation and optical rotation of products such as amino acids, antibiotics, dextrose, carbohydrate, vitamins, steroids, sugars, serums, etc.

Standard Operating Procedure:

- Switch ON the instrument and allow it to warm up for about 5 minutes.
- Put the solution of blank in the polarimeter tube (10cm or 20cm). Look through the side glass to make sure that no bubble is trapped in the path. Any bubble which remains inside should be removed to centre bubble trap by tilting.
- Rotate the polaroid wheel so that the degree meter reads "00.0".
- Place the blank filled tube inside the chamber and close the lid. Rotate the wheel back and forth so that the needle on the intensity meter dips to minimum (L.H.S). Try to get exact minima by using lens. Stop the wheel at this point. Note the readings of degree meter say X_1. Do not disturb the setup.
- Carefully remove the tube and refill the solution under test and insert it back in its position. The intensity will increase due to rotation of plane of polarisation. Rotate the wheel in the direction of decreasing intensity till intensity reaches minimum. Rotate back and forth to arrive at exact minimum in the intensity meter. Note the reading say X_2. Angle of rotation is X_2-X_1.

Calibration Procedure:

- Rotate the polaroid wheel back and forth so that display reads "00.0" in air only.
- Fill the tube with distilled water and place it in the chamber.
- Rotate the wheel back and forth so that the intensity meter needle is at minimum. The display should read "00.0". If not, then with the help of screw driver adjust the control knob in the panel so that the display reads "00.0". Now fill the tube known solution (20% weight/volume sucrose solution). Rotate the wheel in the direction of decreasing intensity, so that the intensity of light is minimum. Adjust control knob so that the display reads $+26.4^0$.

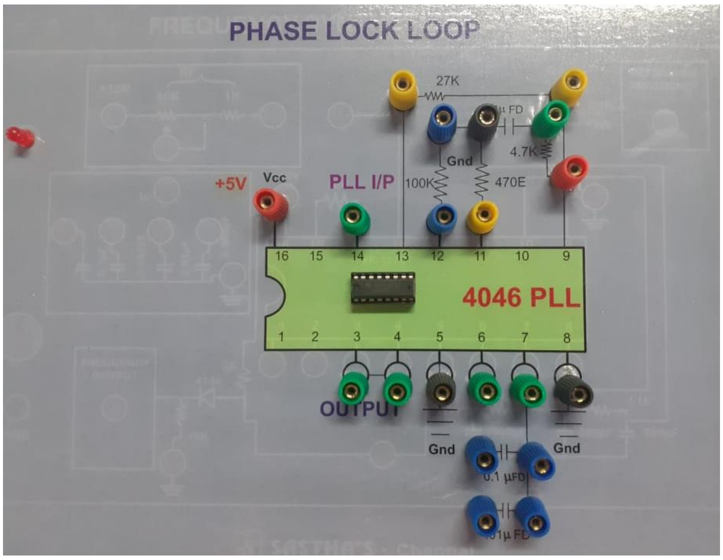
Microprocessor

- Microprocessor is used in microwave oven, washing machine and mobile phones.
- Reset the Microport with the RESET Key.
- Press MEM ADS Key.
- Enter the address as four hexadecimal digits starting with most significant digit.
- Press NEXT Key.
- Before you press the NEXT key, Be sure that you have entered the address correctly.
- Once you have examined the contents of a memory location, you can examine the contents of the nest location by pressing the NEXT Key again.
- Repeat this again and again you can go on examining contents of locations 8000, 8001, 8002 and so on.
- To come backwards e.g.800A, 8009, 8008 and so on, we should press PREV(Previous) Key.
- If we wish to stop examining memory we have to press EXEC (execute) Key, or RESET.

Logic IC Trainer

1. Digital IC trainer kit is used to study the operation of digital Logic ICs TTL, CMOS, AND, OR, NOT, NAND, NOR, XOR Gates, Flip-Flops, Counters, Shift Register, Multiplexer and De-Multiplexer, Encoder, Decoder and ALU.
2. Keep the digital logic IC trainer kit in a clean environment. This will help to prevent possible contamination.
3. Check the input voltage at the power cord of the kit.
4. Switch ON the kit and measure all the output voltage levels as per the specification of the kit.
5. Place corresponding ICs in the breadboard one by one as per thelogic circuit diagram.
6. Connect the output voltage Vcc and Ground to all the ICs
7. Connecting wires should be rubbed with sand papers so that there is no rust.
8. Make sure that the apparatus is switched off while placing ICs and connecting of wires
9. The connections should be tights.
10. ICs are placed in a proper way in the breadboard. There is no short of current in the same inputs.

Phase Lock Loop



The phase locked loop is used in radio frequency or wireless applications.

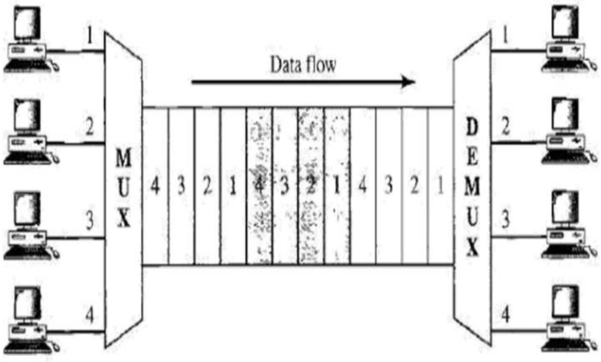
Some phase lock loop applications include:

- **FM demodulation:** One major phase locked loop application is that of a FM demodulator. With PLL chips now relatively cheap, this PLL applications enables high quality audio to be demodulated from an FM signal.
- **AM demodulation:** Phase locked loops can be used in the synchronous demodulation of amplitude modulated signals. Using this approach, the PLL locks onto the carrier so that a reference within the receiver can be generated. As this corresponds exactly to the frequency of the carrier, it can be mixer with the incoming signal to synchronous demodulate the AM.
- **Indirect frequency synthesizers:** Use within a frequency synthesizer is one of the most important phase locked loop applications. Although direct digital synthesis is also used, indirect frequency synthesis forms one of the major phase locked loop applications.
- **Signal recovery:** The fact that the phase locked loop is able to lock to a signal enables it to provide a clean signal, and remember the signal frequency if there is a short interruption. This phase locked loop application is used in a number of areas where signals may be interrupted for short periods of time, for example when using pulsed transmissions.

- **Timing distribution:** Another phase locked loop application is in the distribution precisely timed clock pulses in digital logic circuits and system, for example within a microprocessor system.

- Make connections as indicated in the trainer kit.
- Centre frequency for VCO is set by capacitors on pins 6 and 7.
- Large resistor at pin 12 provides any frequency offset.
- Observe the VCO (square wave) at the output with channel 1.
- Connect CRO channel 2 to output.
- Adjust the generator for locking range.
- Observe the lock range.

Time Division Multiplexer



Multiplexing is used to combine multiple communication links into a single stream.

- Connect the instrument to 230 V AC supply.
- Turn the scan rate knob full clockwise
    - ➢ Connect a channel A of the DSO to SIG-1at the sender side
    - ➢ Connect a channel B of the DSO to SIG-2at the sender side
    - ➢ Observe the waveform
    - ➢ Connect a channel A of the DSO to SIG-1at the sender side
    - ➢ Connect a channel B of the DSO to SIG-1at the receiver side
    - ➢ Observe the waveform
    - ➢ Connect channel A of the DSO to SIG-1at the receiver side
    - ➢ Connect channel B of the DSO to SIG-1at the receiver side
    - ➢ Change the scan rate
- Repeat the experiment with scanning frequency F2.

Strain Gauge

Strain gauge is used to measure strain of an object. It converts the applied force pressure, torque etc in to an electrical signal which can be measured.

- Clamp the beam to the table in such a way that the strain gauges are close to the clamped end. Load and unload the free end of the beam for many times.
- Make the connections of the circuit diagram.
- Switch on the constant current source and the digital multimeter.
- Balance the bridge using Decade Resistance Box and the digital multimeter read zero. This is done without any load.
- Load the beam with a hanger of mass (m). Suspending it as close to the free end as possible. Note the digital multimeter reading.
- Increase the load in steps of m grams and take the reading in each time.
- Unload the beam in steps of m grams and note the corresponding reading.