WORK INSTRUCTION

1.0 EXPERIMENT NO.: MSL/01

2.0 NAME OF EXPERIMENT: DISPLACEMENT MEASUREMENT BY CAPACITIVE TRANSDUCER.

3.0 OBJECTIVE: To measure angular displacement using variable area capacitive transducer and Characterize the VAC for angle vs. capacitance, Characterize the VAC for angle vs. output voltage.

4.0 PRINCIPLE: The VAC consists of parallel plates, some of them fixed, and the others movable. A dielectric medium is present between each pair of plates. This results in capacitance between these parallel plates. The capacitance depends on the common area subtended by these two parallel plates, separated by the dielectric. When the position of the capacitor is changed, the capacitance changes as the common area between the pairs of plates changes. Signal conditioning this variation in capacitance results in a change in the output voltage
.

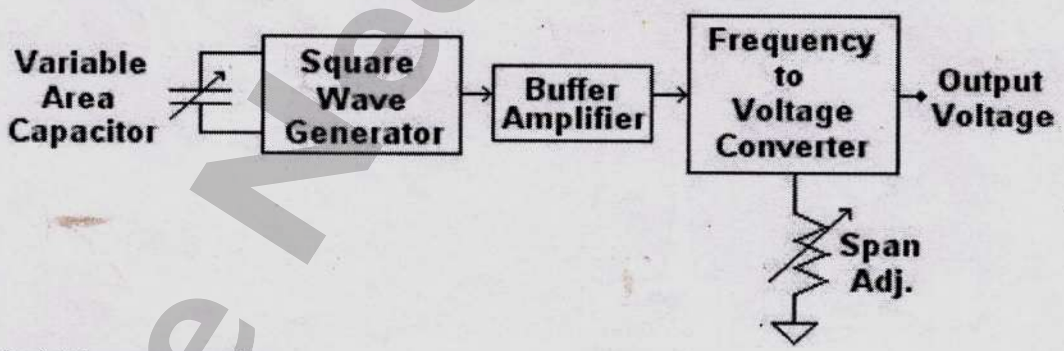
The VAC is very widely used in oscillators to change the frequency of oscillations and tuners of radio receivers etc.

The variable area capacitor trainer is intended to study the operation of a variable area capacitor. The system makes use of a variable area capacitor (VAC) and signal conditioning circuits. The output voltage is proportional to the angular position. The output voltage is available directly on the front panel. This allows the user to measure the angular position using a microprocessor or PC based system.

Technical specifications:

- Capacitance: 50pf to 500pf.
- Range of angular displacement: 0° to 180°
- Output voltage terminals.
- Output voltage: 0 to 5V, DC.
- Built-in power supply.

1. Functional block diagram of the system:
The functional block diagram of the trainer is shown below. The key blocks in this trainer are the variable area capacitor, the square wave generator, buffer, frequency to voltage converter and the output voltage terminals.



2. Variable area capacitor:
The VAC is the transducer in the feedback setup. It converts the angular position into an electrical quantity (capacitance). The two ends of the VAC are terminated to the capacitance input to the square wave generator. As the angular position of the capacitor is varied, its capacitance changes.

3. Square wave generator:
The square wave generator generates a square wave. The frequency of the square wave generated depends on the capacitance of the VAC. In other words, the frequency of the generated square wave is proportional to the change in capacitance.

4. Buffer amplifier:

The frequency of the square wave generator also depends on the load it is driving. To overcome this problem, a buffer amplifier is introduced between the square wave generator and frequency to voltage converters. It also increases the amplitude of the square wave.

5. Frequency to voltage converter:

The frequency to voltage converter produces an output voltage that is proportional to the change in the frequency of the square wave. The transfer function is given by:

$$\Delta V_O = (\Delta f \times \alpha) + c$$

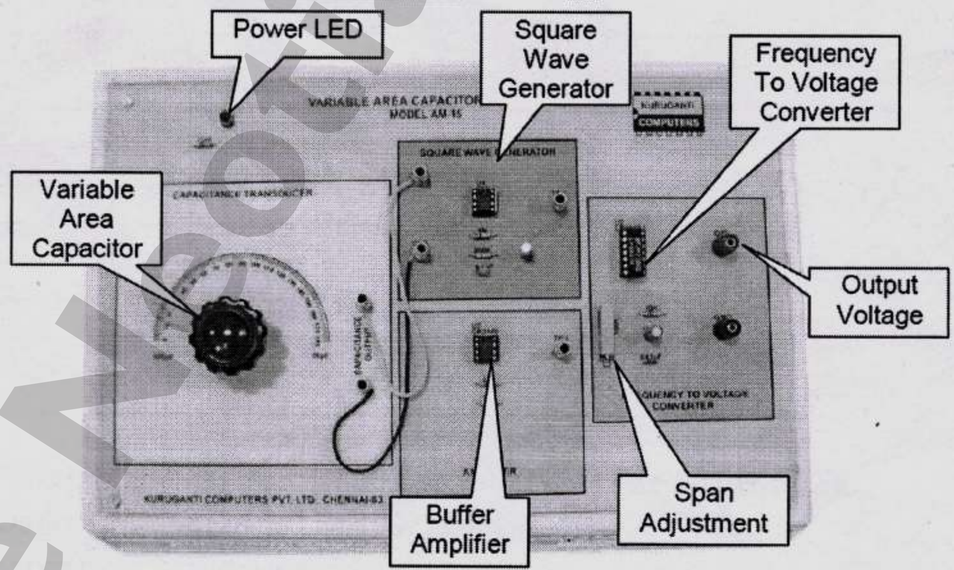
Where,
VO is the change in output voltage,
Δf is the change in frequency of the square wave,
α is the transfer function gain,
c is the output voltage offset.

Note: When the span adjustment potentiometer is adjusted, both α and c change. This means that both the total swing and operating range of the output voltage change. For instance, let us assume that for a particular span adjustment setting, the total swing is 0.5V and the offset if 1V. The output voltage will now change from 1V to 1.5V. For a different setting, the total swing will be 1V and the offset would be 2V. The output voltage will now vary from 2V to 3V.

6. Output Voltage Terminals:

The output voltage terminals provide the voltage output of the frequency to voltage converter. This allows the user to measure the output of the frequency to voltage converter and measure the capacitance or angular position using a microprocessor based system.

5.0 CIRCUIT CONNECTION:



6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

The steps required for experiment is broadly explained below:

1. Getting started:

To start using this trainer, a 3½ digital DMM (digital multimeter) is required to measure the output voltage. The output voltage of the system will be anywhere in the range of 0 to 5V DC. A Cathode Ray Oscilloscope (CRO) is required to observe the change in the frequency of the square wave output. In the absence of the CRO, a digital frequency meter of a DMM that can measure frequency can be used.

2. Hardware installation:

1. Plug the AC mains plug of the trainer into the 230V, 1Φ AC mains.
2. Turn ON the trainer using the power ON switch at the back panel of the trainer.
3. Observe that the POWER LED on the front panel glows.
4. Connect the DMM to the to the output voltage terminals of the system.
5. Position the VAC at 0 °.
6. Observe the value indicated by the DMM.
7. Change the angular position of the VAC.
8. Position the potentiometer to 180 °.
9. Observe that the value indicated by the DMM changes.
10. The total swing of the output voltage depends on the span adjustment setting on the front panel.
11. It is preferable to set output voltage for the 180 ° position to 5V. This will provide a good swing of around 1.5V between the 0 ° and 180 ° positions.

Note: When delivered, the trim pot has been adjusted properly to provide a reasonable large change in output voltage. It is advisable to seek our advice before attempting to adjust the potentiometer.

8.0 EXPERIMENTAL TABLE:

Sl. No.	Angle (°)	Voltage (mV)

9.0 SAFETY: 9.1 Do not switch on the circuits without the permission of the concerned teacher.
9.2 Do not wear loose garments inside the laboratory.
9.3 Do not touch the circuit haphazardly.
9.4 Do not enter the lab barefooted.

11.0 DISPOSAL: (NOT APPLICABLE)

12.0 REPORT WRITING: Attach the rough note with your final report.
The 1st Page of the report shall be as per the format shown in Annexure – 1.
Write the discussion along with all other information.

WORK INSTRUCTION

1.0 EXPERIMENT NO.: MSL/01

2.0 NAME OF EXPERIMENT: Displacement measurement by Linear Variable Displacement Transducers (LVDT).

3.0 OBJECTIVE: Displacement measurement by LVDT.

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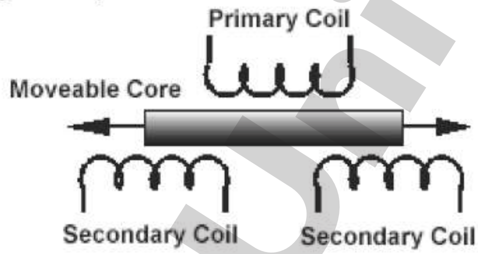
4.0 PRINCIPLE:

The Linear Variable Differential Transformer (LVDT) is a position sensing device that provides an AC output voltage proportional to the displacement of its core passing through its windings. LVDTs provide linear output for small displacements where the core remains within the primary coils. The exact distance is a function of the geometry of the LVDT.



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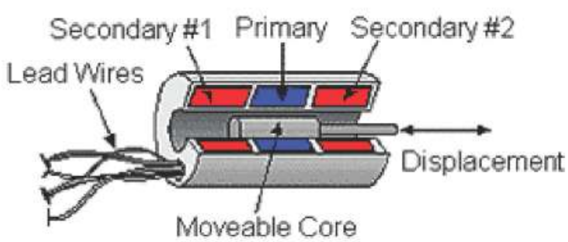
An LVDT is much like any other transformer in that it consists of a primary coil, secondary coils, and a magnetic core. An alternating current, known as the carrier signal, is produced in the primary coil. The changing current in the primary coil produces a varying magnetic field around the core. This magnetic field induces an alternating (AC) voltage in the secondary coils that are in proximity to the core. As with any transformer, the voltage of the induced signal in the secondary coil is linearly related to the number of coils. The basic transformer relation is:

$$V_{out}/V_{in} = N_{out}/N_{in}$$

where:

V_{out} is the voltage at the output,
V_{in} is the voltage at the input,
N_{out} is the number of windings of the output coil, and
N_{in} is the number of windings of the input coil.

As the core is displaced, the number of coils in the secondary coil exposed to the coil changes linearly. Therefore the amplitude of the induced signal varies linearly with displacement.



The LVDT indicates direction of displacement by having the two secondary coils whose outputs are balanced against one another. The secondary coils in an LVDT are connected in the opposite sense (one clockwise, the other counter clockwise). Thus when the same varying magnetic field is applied to both secondary coils, their output voltages have the same amplitude but differ in sign. The outputs from the two secondary coils are summed together, usually by simply connecting the secondary coils together at a common center point. At an equilibrium position (generally zero displacement) a zero output signal is produced.

The induced AC signal is then demodulated so that a DC voltage that is sensitive to the amplitude and phase of the AC signal is produced.

5.0 CIRCUIT CONNECTION:

6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

The steps required for experiment is broadly explained below:

7.1 Starting from 0mm to 20mm displacement, record the readings on the displacement indicator in tabular form.

7.2 Draw a graph between the displacements in mm vs. the readings observed on the displacement indicator. The graph will appear linear on either side.

7.3 Take the CRO screen traces for primary coil (PR1) signal and also, for sec-1 and sec-2 signals together (using both channels of CRO) when the output is zero, +ve and –ve.

8.0 EXPERIMENTAL TABLE:

Sl. No.	Displacement (mm)	Display reading (mm)	Error (%)
1.			
2.			
3.			
4.			

9.0 REPORT:

Plot the displacement vs. display reading curve.
All readings, calculation, drawing etc. should be done on a loose sheet. On completion of the Job/Experiment present it to the sessional in charge for his signature and performance gradation.
Grading shall be as per University rules.

10.0 SAFETY:

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12.0 REPORT WRITING:

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WORK INSTRUCTION

1.0 EXPERIMENT NO.: MSL/04

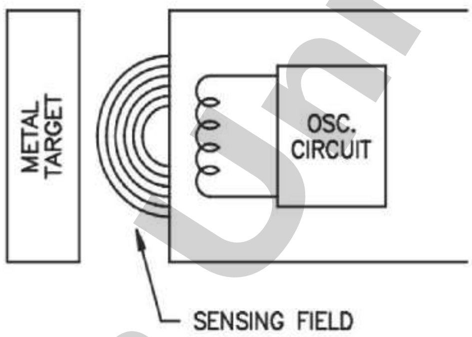
2.0 **NAME OF EXPERIMENT: Measurement of speed using Magnetic Pick-Up Proximity Sensor.**

3.0 OBJECTIVE: To measure the motor speed using Magnetic Pick-Up Proximity Sensor.

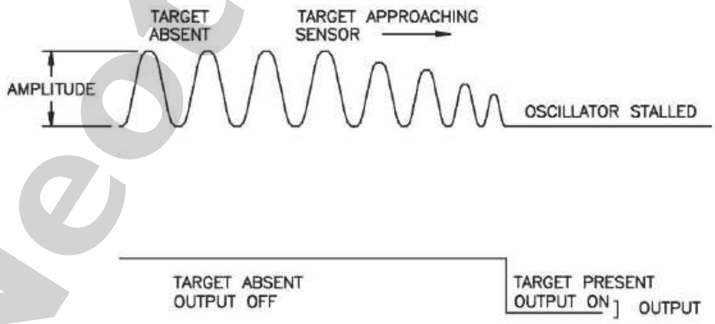
.

4.0 PRINCIPLE:

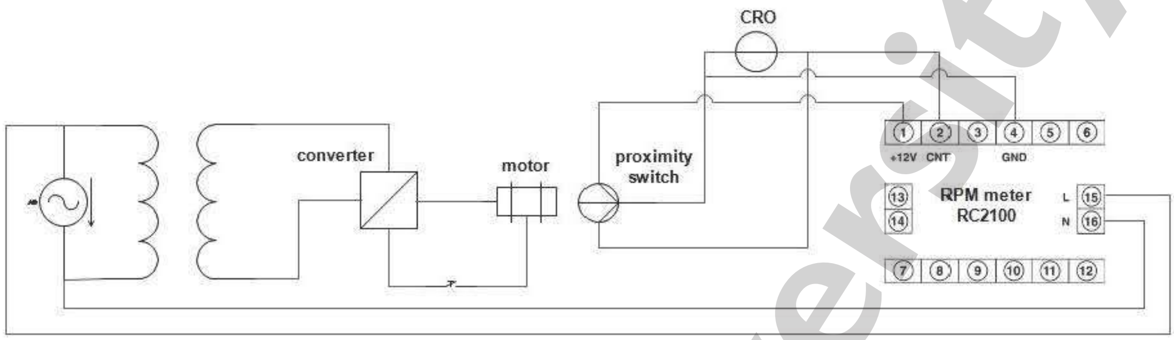
Inductive Proximity Sensors detect the presence of metal objects which come within range of their oscillating field and provide target detection. Internally, an oscillator creates a high frequency electromagnetic field (RF) which is radiated from the coil and out from the sensor face (See figure I). When a metal object enters this field, eddy currents are induced into the object.



As the metal moves closer to the sensor, these eddy curents increase and result in an absorption of energy from the coil which dampens ther oscillator amplitude until it finally stops.



5.0 CIRCUIT CONNECTION:



6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

1. Keep speed pot to min speed.
2. Connect the magnetic pickup trainer to 230 V AC mains.
3. Turn on mains.
4. Ensure that the RPM indicator is ON.
5. Connect the oscilloscope to the sensor output.
6. The motor will slowly gain the speed if the pot is rotated clockwise. Do not rotate the pot to the extreme right abruptly as it may damage the motor. Stop the pot at one spot so that motor rotates at constant speed.
7. Note down the RPM indicator reading .
8. Observe the pulses on CRO & note down the RPM.
9. Slowly increase the motor speed till 1500 RPM in ten steps & repeat '7' & '8' for each step.
10. Reduce the speed pot to min speed.
11. Switch off mains.

8.0 EXPERIMENTAL TABLE:

Sl. No.	RPM counter reading	RPM from CRO	% of error

9.0 REPORT:

Plot the RPM counter reading VS RPM from CRO curve.

All readings, calculation, drawing etc. should be done on a loose sheet. On completion of the Job/Experiment present it to the sessional in charge for his signature and performance gradation. Grading shall be as per University rules.

10.0 SAFETY:

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9.4 Do not enter the lab barefooted.

11.0 DISPOSAL: (NOT APPLICABLE)

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WORK INSTRUCTION

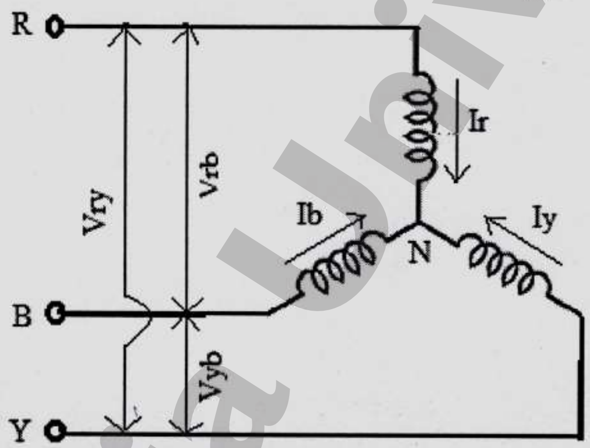
1.0 EXPERIMENT NO.: MSL/05

2.0 NAME OF EXPERIMENT: Measurement of power in a three phase circuit by two wattmeter method.

3.0 OBJECTIVE: To measure power of a poly phase circuit.

4.0 PRINCIPLE:

A three phase electric system may be considered as three separate single phases displaced from each other by 120 or $2\pi/3$ radians and the peak of the respective voltage do not occur simultaneously. The common configuration of interconnection of three phase system is in star connection described follows.



The star connection shown in the figure represents the phase connected in star, N being the star or neutral point. V_{NR}, V_{NY}, V_{NB} represent the phase voltage and may simply be termed as V_R, V_Y, V_B. The voltage between line i.e. V_{YR}, V_{BY}, V_{RB} are termed as line voltage. In a balanced three phase circuit.

$$V_R = V\ 0\ V$$

$$V_Y = V\ -120\ V$$

$$V_B = V\ -240\ V$$

It may be noted that the voltage between the neutral the neutral and line called phase voltage while the voltage two lines are called line voltage.

Let $|V_R| = |V_Y| = |V_B| = V_{PH}$

It may be noted that the line voltage V_{YR} is the vector difference of V_R & V_Y or vector sum of V_R & V_Y (Reversed).

$$V_{YR} = V_R - V_Y$$

$$= \sqrt{V_R^2 + V_Y^2 = 2V_R V_Y \cos 60}$$ (Angle between V_R & V_Y is 60

$$= \sqrt{2V_{PH}^2 + 2\ V_{PH}^2 \times 1/2}$$

$$= \sqrt{3}\ V_{PH}$$

Similarly $= V_{BY} = V_{RB} = \sqrt{3}\ V_{PH}$

However $V_{YR} = V_{BY} = V_{RB}$ = (line voltage) $= V_L$

So, In Star (Y) connection, $V_L = \sqrt{3}\ V_{PH}$

On the other hand, observation reveal that each line is in series with the individual phase winding. Hence in star connection the line current in each line is the same as the current in the phase winding to which the line is connected.

Let the current in the line R be I_R, current in line Y be I_Y and line current in line B be I_B.

Since $I_R = I_Y = I_B = I_{PH}$ (Say)

So $I_L = I_{PH}$

From the star connection it can easily be seen that, $I_R + I_Y + I_B = 0$

Total active power in Y connected three phase system,

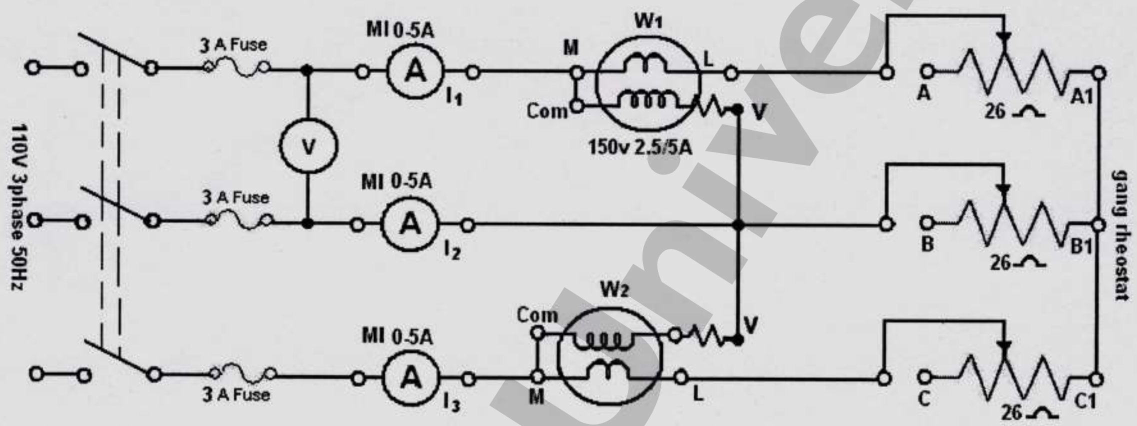
$P = 3$ Individual phase power

$= 3 \times V_{PH} I_{PH} COS\phi$

$= 3 \times (V_L/\sqrt{3}) I_L COS\phi$

$= \sqrt{3} V_L I_L COS\phi$ KW

5.0 CIRCUIT CONNECTION:



6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 EXPERIMENTAL TABLE:

Table-1

Sl. No.	Type of Load	Phase Voltage			Phase Current			Wattmeter Readings		Remarks
		V_R	V_Y	V_B	I_R	I_Y	I_B	W_1	W_2	

Table-2

Sl. No.	$\Phi = Tan^{-1}\sqrt{3}(W_1 - W_2)/(W_1+W_2)$	Practical Power Factor $(Cos\phi)$	Theoretical Power $(V_R I_R Cos\phi + V_Y I_Y Cos\phi + V_B I_B Cos\phi)$ Watt	Practical Power $(W_1 + W_2)$ Watt	% of Error	
					Power	Power factor

8.0 SAFETY: 8.1 Do not switch on the circuits without the permission of the concerned teacher.
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9.0 DISPOSAL: (NOT APPLICABLE)

10.0 REPORT WRITING: Attach the rough note with your final report.
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WORK INSTRUCTION

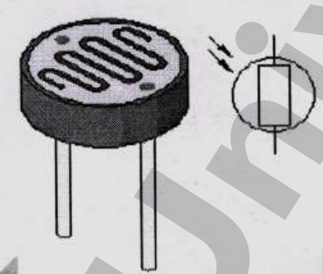
1.0 EXPERIMENT NO.: MSL/08

2.0 NAME OF EXPERIMENT: STUDY OF LDR

3.0 OBJECTIVE: To find out the characteristic of LDR with respect to varying light and simultaneously find its resistance.

4.0 PRINCIPLE:

A **Light Dependent Resistor** (LDR, photoconductor, or photocell) is a device whose resistance varies according to the amount of light falling on its surface.



A typical Light Dependent Resistor is depicted above together with (on the right hand side) its circuit diagram symbol. LDR has a resistance of 1 M Ohm in total darkness and a resistance of a couple of K Ohm in bright light.

Uses for Light Dependent Resistors

Light Dependent Resistors are a vital component in any electric circuit which is to be turned on and off automatically according to the level of ambient light - for example, solar powered garden lights, and night security lighting system.

An LDR can even be used in a simple remote control circuit using the backlight of a mobile phone to turn on a device - call the mobile from anywhere in the world, it lights up the LDR, and lighting (or a garden sprinkler) can be turned on remotely.

LDR Characteristic

Light Dependent Resistors (LDR) use a semiconductor material (I.e. a material that is neither a conductor nor an insulator) whose electrical characteristic vary according to the amount of incident light.

The two semiconductor materials used for the manufacture of LDRs are Cadmium Sulphide (CdS) and Cadmium Selenide (CdSe). These materials are much sensitive to light in the visible spectrum, peaking at about 0.6 µm for CdS and 0.75 µm for CdSe. A typical CdS LDR exhibits a resistance of around 1MΩ in complete darkness and less than 1KΩ when placed under a bright light source (see fig. 2).

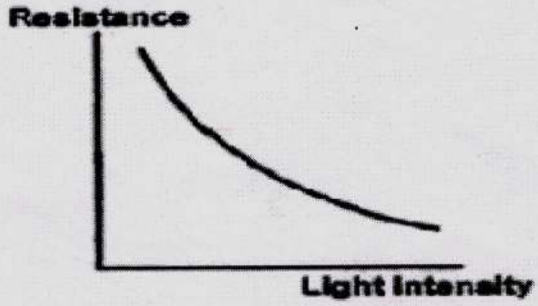


Figure 2 Characteristic of Light Dependent Resistor

Introduction of photoconductive cell (LDR)

The snake like track on the face of the LDR is a cadmium sulphide (CdS) film. On each side is a metal film which is connected to the terminal leads. Multimeter is used to measure its resistance when light falls on it and when it is placed in darkness. This will help to enhance your knowledge of the concept as to how the LDR works. Electrical conduction in semiconductor materials occurs when free charge carriers e.g. electrons are available in the material when an electric field is applied. In certain semiconductors, Photoconductive cell are elements whose conductivity is a function of incident electromagnetic radiation. Since, resistance of these materials decreases with
increase in incident light, therefore these materials are also called Light Dependent Resistor or LDR. Commercially available photoconductive cell materials are cadmium sulphide (CdS) and cadmium selenide (CdSe) with band gap of 2.42 e V & 1.74 e V respectively. On account of the large energy bands, both the materials have a very high resistivity at ambient temperature which gives a very high value of resistance for practical purposes. The photoconductive cells have a special type of construction which minimizes resistance while providing maximum surface. Photoconductive cells are made by chemically sintering the required powder into tablets of the protective envelope of glass or plastic. Electrons are deposited on the tablet surface and are made of materials which give an ohmic contact, but with low resistance compared with that of the
photoconductor. The electrodes are usually in the form of interlocked fingers as shown.

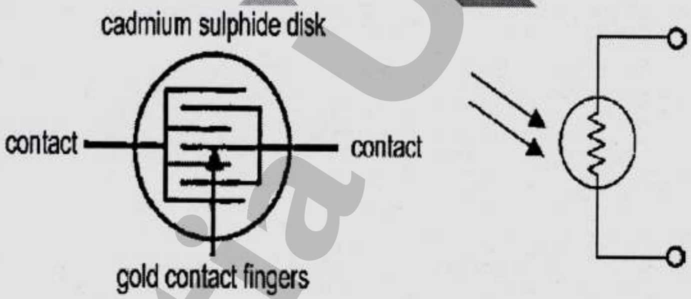


Figure 3

Photoconductive cell are made from cadmium sulfide doped with silver antimony or indium chemically deposited on a substrate. Light falling on the sensitive area breaks chemical bonds. The resulting free electrons and holes become available to increase the conductivity. These bonds are slow to be re-formed when light is removed and their response time is sluggish.
The device requires a suitable load resistor to provide a voltage output which falls with increasing illumination as its resistance decreases. The resistance depends on the physical character of photoconductive layer as well as on the dimensions of the cell and its geometric configuration. The current depends upon the voltage applied and it is of the order of the mA. When using photoconductive cell for a particular application it is important to select the proper dark resistance, as well as suitable sensitivity.
The sensitivity is defined as:

$$S = \frac{\Delta R}{\Delta H} \, \Omega / W.m^{-2}$$

Where,

ΔR = Change in resistance; in Ω.

ΔH = Change in irradiation; in W/m^{-2}

The spectral response of the sensor must match that of the light source. Photoconductor has a relatively large sensitive area. A small change in light intensity causes a large change in resistance. The relationship between irradiance and resistance is, however not linear. It is closely an exponential relationship. The spectral response of cadmium sulphide cell closely matches that of the human eye and the cell is often used in application where human vision is a factor, much as street light control or automatic control for cameras, to alter the bias of transistor or change the gain of an amplifier. Such circuits are used in automatic brightness composition of TV receivers. Photoconductive cells are also used in bridge circuit applications, and for measurement of attenuation of light etc.

The device used on NV6536 is ORP12. Its characteristics are given below:

Parameter	Conditions	Min.	Typ.	Max.
Cell resistance	501 µx		204KΩ	
	10001 µx		130Ω	
	typical ambient		500Ω	
Dark resistance		10 MΩ		
Rise time			75mS	
Fall time			350mS	
Peak spectral response			610nm	

The LDR (Photoconductive cell) on this board is already connected as shown:

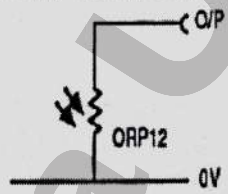
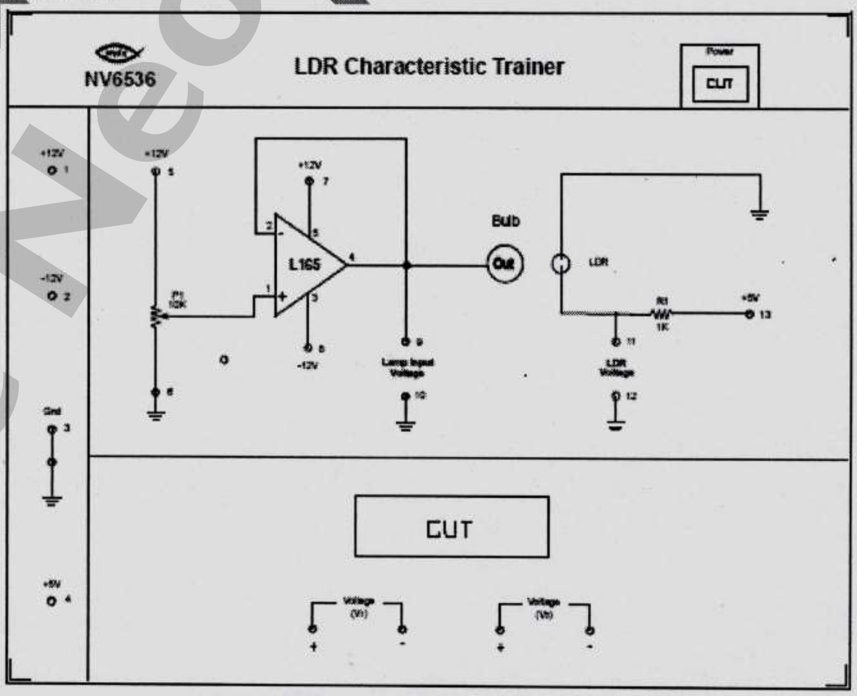


Figure 4

The characteristic of a photoconductive cell vary considerably depending upon the type of material used. When the cell is kept in darkness its resistance is called Dark Resistance. The dark resistance .may be as high as $10^{10}\Omega$.

5.0 CIRCUIT CONNECTION:

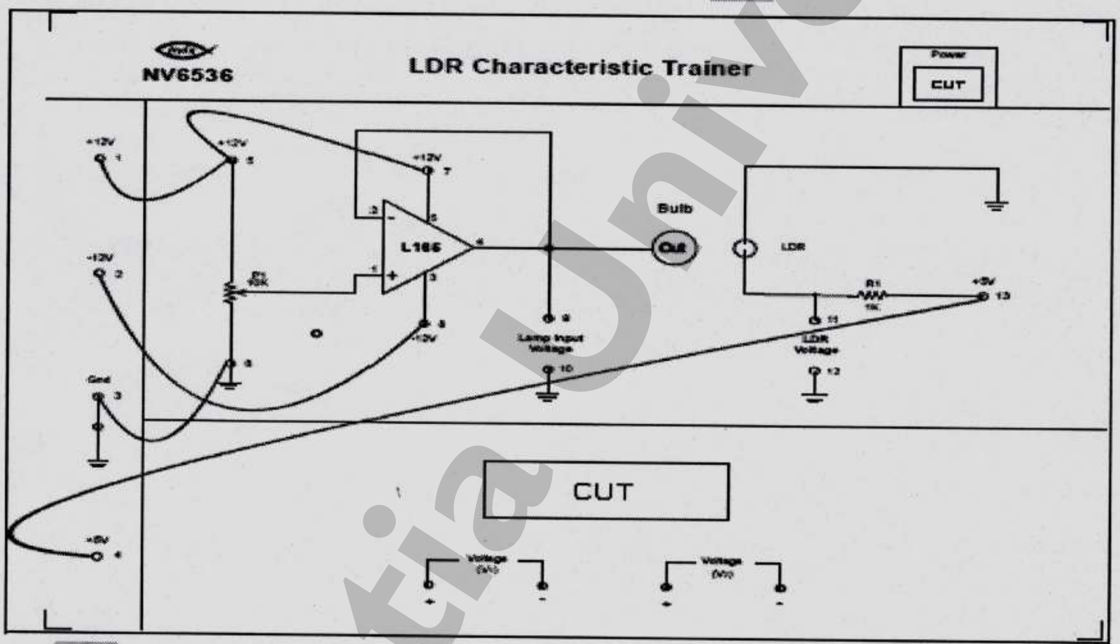


6.0 TOOLS/APPARATUS REQUIRED:

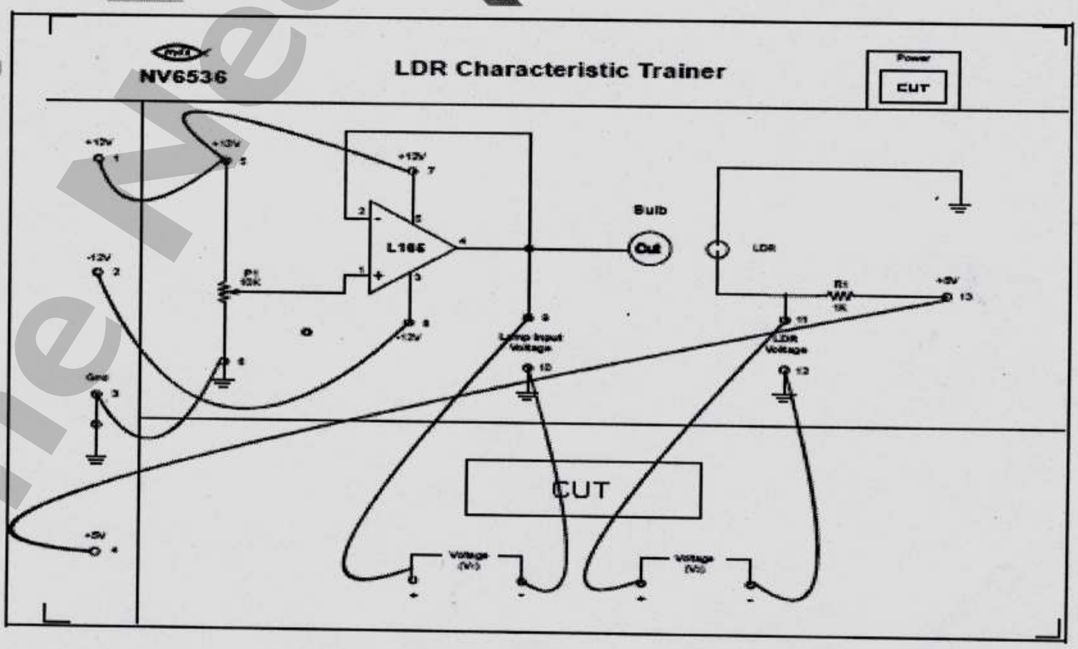
Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

7.1. Connect terminals 1 to terminal 5, terminal 5 to terminal 7, terminal 2 to terminal 8, terminal 3 to terminal 6, terminal 4 to terminal 13 using patch cords.



7.2. Connect voltmeter (V1) between terminal 9 and 10 named as "Lamp input voltage" and "ground".



7.3. Connect voltmeter (V2) between terminal 11 and 12 named as "LDR voltage" and "ground".

7.4. Rotate the 10KΩ wire-wound potentiometer P1 fully in counter clockwise (CCW) direction.

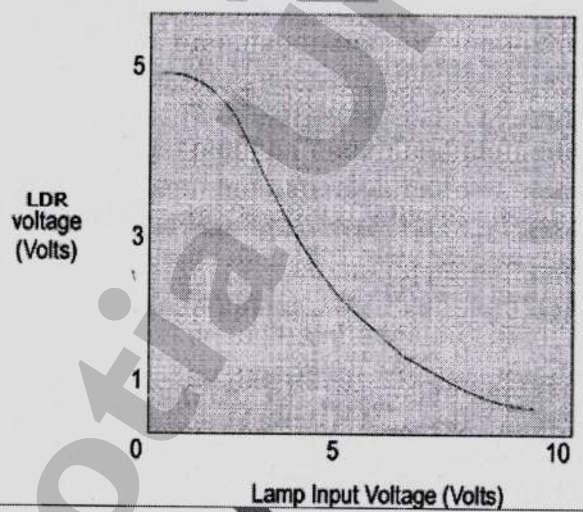
7.5. Place an opaque box over the LDR & lamp to exclude all ambient light.

7.6. Switch 'On' the power supply.

7.7. Rotate the 10KΩ wire-wound potentiometer P1 fully in clockwise (CCW) direction.

7.8. Take readings of Light Dependent Resistor (Photoconductive cell) output voltage as indicated on the LCD as the lamp input voltage is increased in 1V steps. Record results in an observation table shown below.

7.9. Plot the graph of LDR (photoconductive cell) output voltage against lamp input voltage. The approximate curve is shown in the following figure.



8.0 EXPERIMENTAL TABLE:

Sr. No.	Lamp Input Voltage (Volts)	LDR Output Voltage (Volts)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

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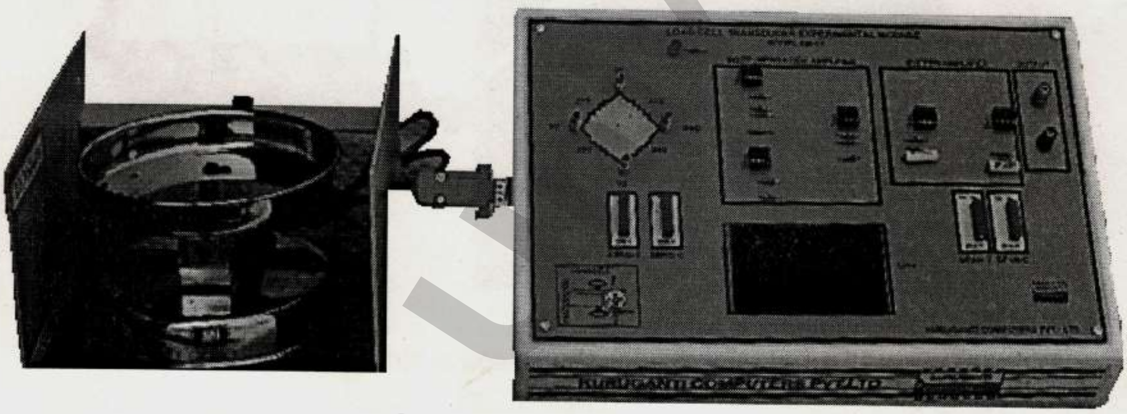
KURUGANTI COMPUTERS

LOADCELL EXPERIMENTAL MODULE
MODEL AM - 17

Loadcell Experimental Module is a demonstration system. Using this trainer, the student can experiment, how a Loadcell behaves for tensile and compressive loads. 1Kg Loadcell is used to conduct this experiment. This Loadcell is fixed on a mechanical structure (jig); which is used to experiment, both tension and compression. Assorted weights are supplied to add in steps of 50gm upto 1Kg. The output of the transducer is connected to the interface electronics, consisting of signal conditioner, instrumentation amplifier, adjustable gain data amplifier and a power supply. A digital display indicates the actual added weights, to the Loadcell. Negative sign on the display indicates compressive load.

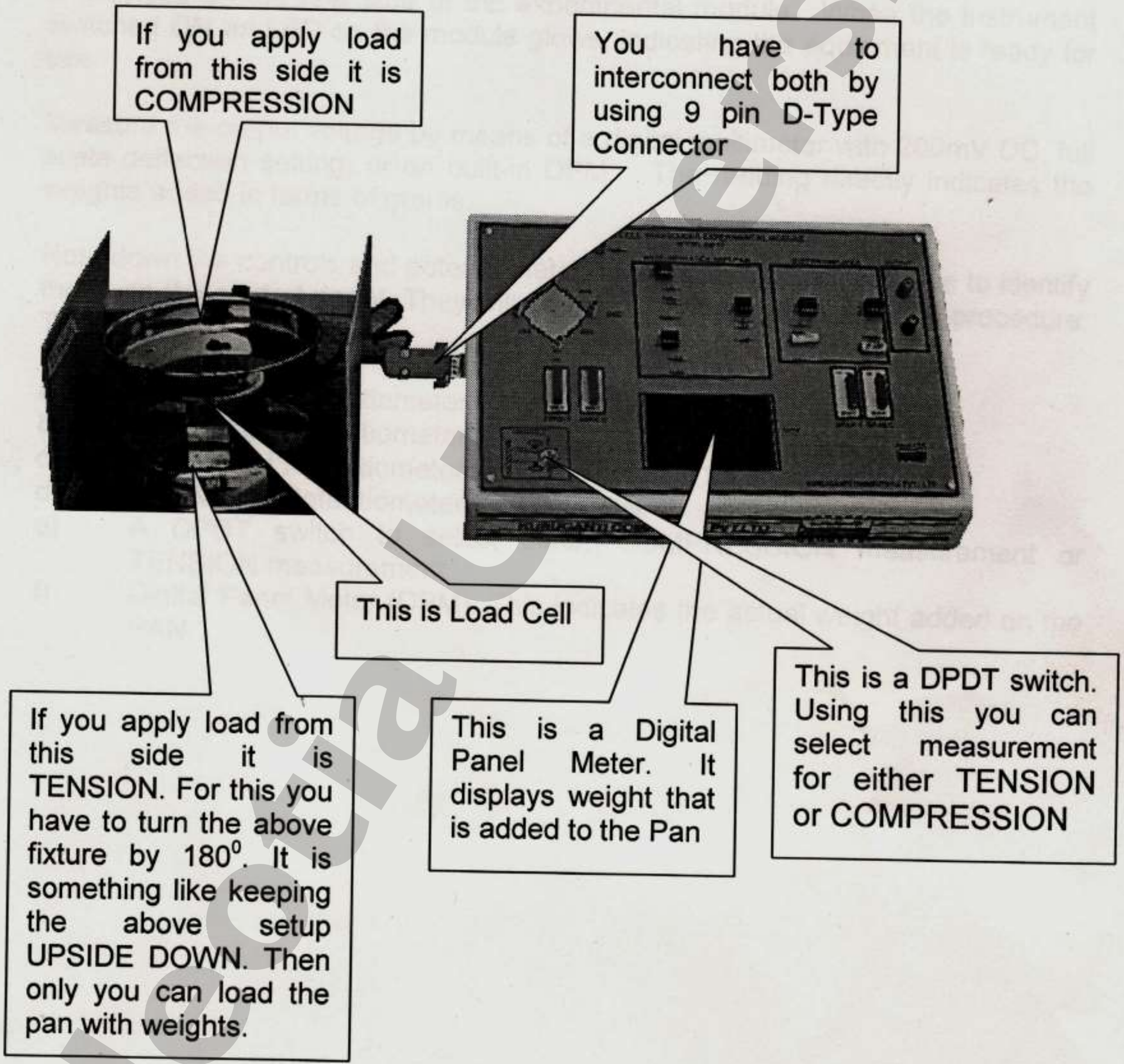


The Loadcell is commonly used form of strain- gauge transducer. It converts an applied force (weight) into a bridge output potential. In a Loadcell, the strain gauge is mounted on some form of a mechanical sensing element (column, beam etc.), and the gauge (or gauges) is (are) into a bridge configuration. Compensation of temperature and non-linearity is provided for by the manufacturer in the selection of resistance values for the arms of the bridge and in series with the bridge. Strain gauges are low-impedance devices; they require significant excitation power to get output at reasonable levels. A typical strain-gauge-based Loadcell will have a 350W impedance.

Specifications:-

- Universal type.
- Capacity : 1Kg
- Strain gauge impedance : 350 Ohms, connected in bridge configuration.
- Excitation : 9VDC
- Display : 3 1/2digit
- Power Supply : Built-in
- Jig : Approximately 35x25cm. Provision to test, compression and tension.
- Weights : Assorted weights, to measure upto 1Kg in steps of 50gm.
- Interface : This works as an interface to any Data Acquisition system or to DAS-1.

How to install the Instrument for the first time:



Installation:-

1. Connect the load-cell transducer to the module by means of 9-pin connector. This connector cable is already attached with the transducer.

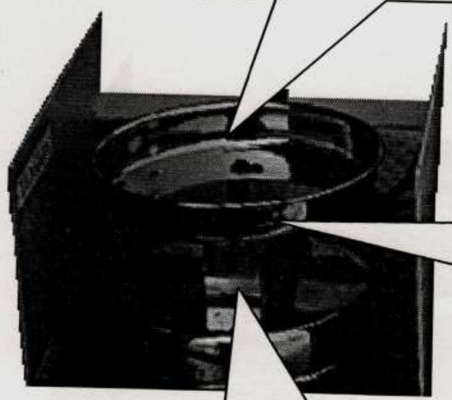
2. Connect the power cord of the module to 230 volts AC outlet. An ON/OFF switch is provided on the rear side of the experimental module. When the instrument switched ON an LED on the module glows, indicating the equipment is ready for use.

3. Measure the output voltage by means of a digital multimeter with 200mV DC, full scale deflection setting, or on built-in DPM. The reading directly indicates the weights added in terms of grams.

4. Note down the controls and potentiometer on the front panel. You have to identify these on the control panel. They will be referred during experimental procedure. They are

   a) ZERO ADJ Potentiometer for COMPRESSION
   b) ZERO ADJ Potentiometer for TENSION
   c) SPAN ADJ Potentiometer for COMPRESSION
   d) SPAN ADJ Potentiometer for TENSION
   e) A DPDT switch to select either COMPRESSION measurement or TENSION measurement.
   f) Digital Panel Meter (DPM). This indicates the actual weight added on the PAN.

How to perform COMPRESSION Experiment:-



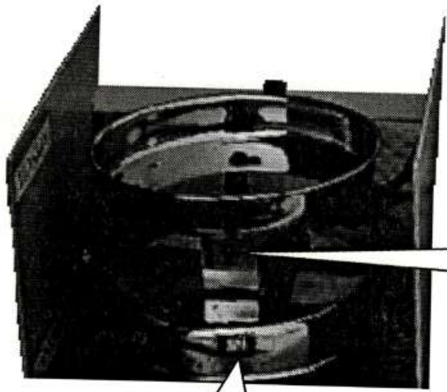
1. Place the load-cell transducer on flat surface after detaching from the frame.
2. A two-position (DPDT) switch is placed on the right hand side of the front panel. This switch can be set to read either COMPRESSION or TENSION by appropriately switching. Switch this to COMPRESSION side.
3. Do not add weights on the transducer.
4. Note down the DPM reading. It must read 000. If it is not then adjust ZERO ADJ Potentiometer intended for COMPRESSION. This swings between –ve to +ve during adjustment. Try to set it almost equal to zero. There may be a variation in terms of 2 to 3 counts from zero. This may be due to imperfect grounding of power lines.
5. Now add weights upto 1Kg.
6. Measure the output voltage on the built-in DPM. The reading corresponds to the actual weight added in terms of grams. It must show 1000. If it is not so, then adjust SPAN ADJ Potentiometer for COMPRESSION. For Compression Experiment the DPM shows +ve measurement. If it shows –1000, then you must be performing TENSION. The output is directly calibrated in terms of grams.
7. Repeat Step No:3 through 6 three to four times until the readings are repeatable.
8. Now start adding weights on the loading pan in steps of 50gms until the total weights add up to 1000gms.

Weights in Gms	DPM Reading
50	
100	
150	
200	
250	

Add weights upto 1000Gms in steps of 50Gms and make measurements.

How to perform TENSION Experiment:-

<u>After turning the COMPRESSION Setup it will be for TENSION SETUP</u>



1. Place the load-cell transducer on flat surface.

2. A two-position (DPDT) switch is placed on the right hand side of the front panel. This switch can be set to read either COMPRESSION or TENSION by appropriately switching. Switch this to TENSION side.

3. Do not add weights on the transducer.

4. Note down the DPM reading. It must read 000. If it is not then adjust ZERO ADJ Potentiometer intended for TENSION. This swings between –ve to +ve during adjustment. Try to set it almost equal to zero. There may be a variation in terms of 2 to 3 counts from zero. This may be due to imperfect grounding of power lines.

5. Now add weights upto 1Kg.

6. Measure the output voltage on the built-in DPM. The reading corresponds to the actual weight added in terms of grams. It must show -1000. If it is not so, then adjust SPAN ADJ Potentiometer for TENSION. For Tension Experiment the DPM shows +ve measurement. If it shows –1000, then you must be performing ~~TENSION~~ Compression. The output is directly calibrated in terms of grams.

7. Repeat Step No:3 through 6 three to four times until the readings are repeatable.

8. Now start adding weights on the loading pan in steps of 50gms until the total weights add up to 1000gms.

Weights in Gms	DPM Reading
50	
100	
150	
200	
250	

Add weights upto 1000Gms in steps of 50Gms and make measurements.

NEOTIA INSTITUTE OF TECHNOLOGY MANAGEMENT AND SCIENCE

WORK INSTRUCTION

1.0 JOB/EXPERIMENT NO.: EI (EEE)-491/EEE-14

2.0 NAME OF JOB/EXPERIMENT: Study of Photo Diodes & Photo Voltaic cells.

3.0 OBJECTIVE: To study the operation of Photo Diodes and PhotoVoltaic cells using Trainer Kit.

4.0 PRINCIPLE:

PHOTO DIODE

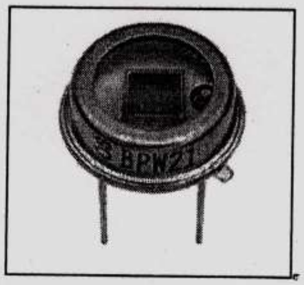
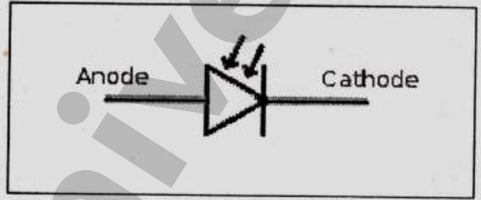


Photo Diode



Symbol of Photo Diode

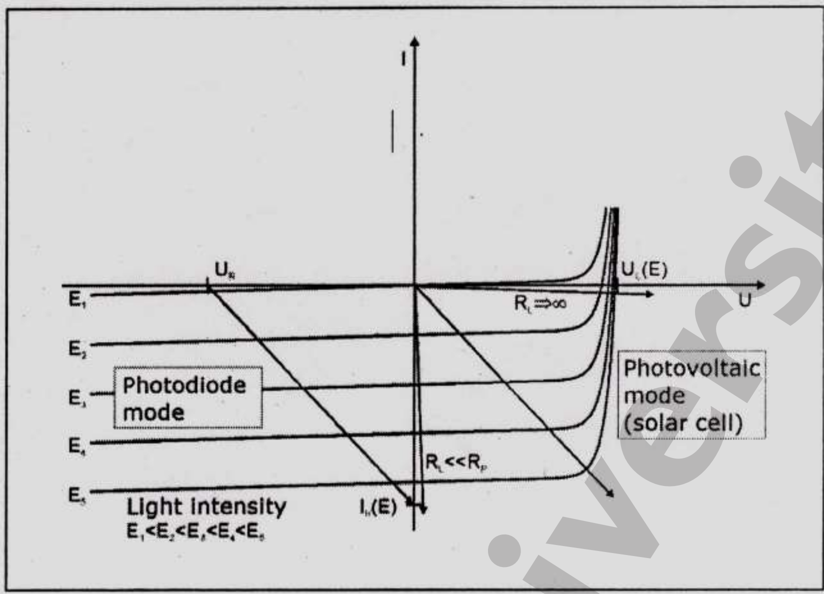
A **photodiode** is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. It is a p-n junction and is designed to operate in reverse bias. When a photon of sufficient energy strikes the diode, it creates an electron-hole pair. This mechanism is also known as the inner photoelectric effect. If the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carriers are swept from the junction by the built-in electric field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced. The total current through the photodiode is the sum of the dark current (current that flows with or without light) and the photocurrent, so the dark current must be minimized to maximize the sensitivity of the device.

PHOTO VOLTAIC MODE

When used in zero bias or photovoltaic mode, the flow of photocurrent out of the device is restricted and a voltage builds up. This mode exploits the photovoltaic effect, which is the basis for solar cells.

PHOTOCONDUCTIVE MODE

In this mode the diode is reverse biased (with the cathode driven positive with respect to the anode). Compared to forward bias, this dramatically reduces the response time at the expense of increased noise, because it increases the width of the depletion layer, which decreases the junction's capacitance. The reverse bias induces only a small amount of current (known as saturation or dark current) along its direction while the photocurrent remains virtually the same. For a given spectral distribution, the photocurrent is linearly proportional to the luminance.



I-V characteristic of a photodiode

PHOTO VOLTAIC CELL

A **solar cell** (also called a **photovoltaic cell** or **photocell**) is an electrical device that converts the energy of light directly into electricity by the photovoltaic effect.

The operation of a photovoltaic (PV) cell requires 3 basic attributes:

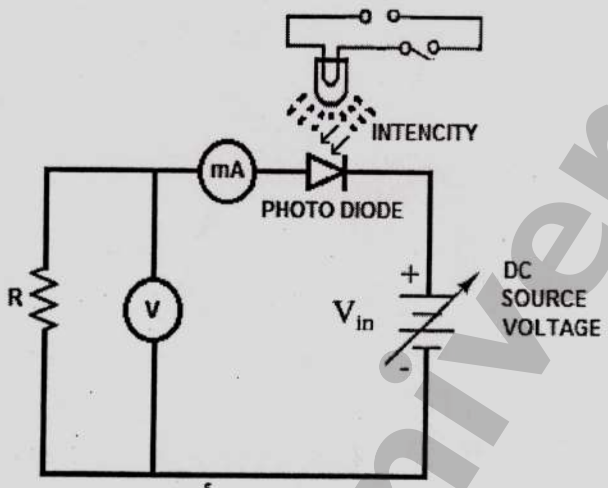
1. The absorption of light, generating either electron-hole pairs or excitons.
2. The separation of charge carriers of opposite types.
3. The separate extraction of those carriers to an external circuit.

The solar cell works in three steps:

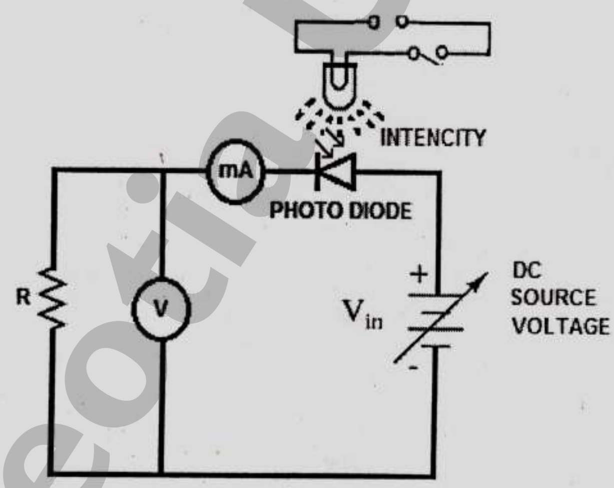
1. Photons in sunlight hit the solar panel and are absorbed by semiconducting materials, such as silicon.
2. Electrons (negatively charged) are knocked loose from their atoms, causing an electric potential difference. Current starts flowing through the material to cancel the potential and this electricity is captured. Due to the special composition of solar cells, the electrons are only allowed to move in a single direction.
3. An array of solar cells converts solar energy into a usable amount of direct current (DC) electricity

5.0 CIRCUIT DIAGRAM:

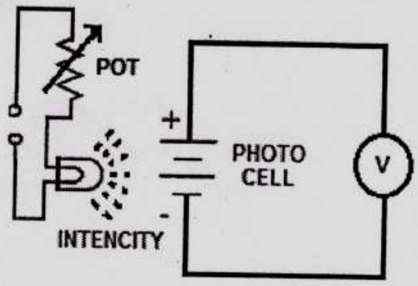
5. 1 Photoconductive Mode of Photo Diode



5. 2 Photovoltaic Mode of Photo Diode



5.3 Photo Voltaic Cell



6.0 TOOLS/APPARATUS REQUIRED:

Sl. No.	Item	Quantity	Maker's name	Range

7.0 PROCEDURE

7.1 Photo Diode

1. Connections are made as per the circuit diagram shown in 1st circuit diagram.
2. Switch ON the power supply.
3. Vary the value of DC voltage source slowly from positive to negative and note down the corresponding current through the diode. Light is off at this condition.
4. Switch on the light source and vary the light intensity and repeat step 3 for each intensity.
5. Switch off the power supply.

7.2 PhotoVoltaic Cell

1. Connections are made as per the circuit diagram shown in 3rd circuit diagram.
2. Switch ON the supply.
3. Measure the developed voltage when light is off.
4. Switch on the light source and vary the intensity and measure the corresponding voltage.
5. Switch off the power supply.

8.0 OBSERBATION TABLE:

8. 1 Photo Diode ~~ERR~~ REV

SL NO.	LIGHT CONDITION	LIGHT INTENSITY	LOAD	DC SUPPLY VOLTAGE	DIODE CURRENT
1	OFF				
2	ON				
...	...	...	...	...	...

8. 2 Photo Voltaic Cell

SL NO	LIGHT CONDITION	LIGHT INTENSITY	GENERATATED VOLTAGE
1	OFF		
2	ON		

9.0 REPORT

Plot the diode current vs. applied voltage curves for different light intensities. Also, plot the generated voltage vs. light intensity curve for the solar cell.

All readings, calculation, drawing etc. should be done on a loose sheet. On completion of the Job/Experiment present it to the sessional in charge for his signature and performance gradation. Grading shall be as per University rules.

10.0 SAFETY:

(NOT APPLICABLE)

11.0 DISPOSAL:

(NOT APPLICABLE)

12.0 REPORT WRITING:

Attach the rough note with your final report.
The 1st Page of the report shall be as per the format shown in Annexure – 1.

WORK INSTRUCTION

1.0 EXPERIMENT NO.: MSL/06

2.0 NAME OF EXPERIMENT: STUDY THE BEHAVIOR OF A SERIES R -L-C CIRCUIT.

3.0 OBJECTIVE: i) To study the behavior of a series R -L-C circuit
ii) To familiarize with the phasor diagram of series R -L-C circuit

4.0 PRINCIPLE:

An A.C supply voltage of RMS value V volts when applied to an RLC circuit, an rms current 'I' Amperes flows through it,

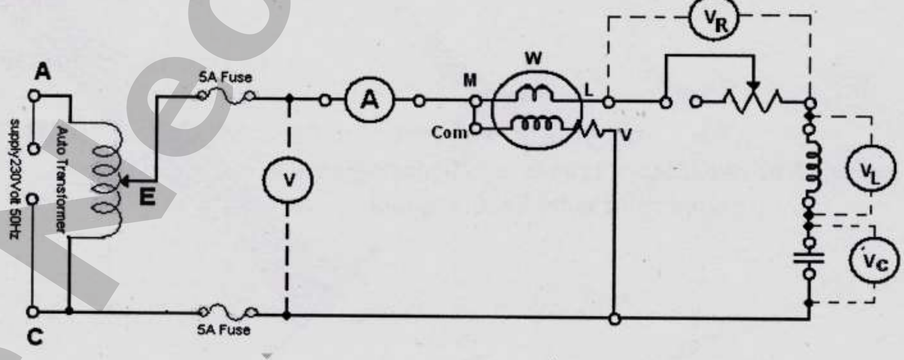
$$I = V/Z \text{ Amp}$$

Where $Z = [R^2 + (X_L - X_C)^2]^{1/2}$ ohms = impedance of the series R-L-C circuit, R=resistance in the circuit in ohms, X_L=inductive reactance in the circuit = ωL in ohms, and X_C = capacitive reactance in the circuit = $1/\omega C$ ohms, ω = Angular frequency of the supply (rad/sec).

Voltage across resistance = $V_R = IR$ volts
Voltage across inductance = $V_L = jIX_L$ volts
Voltage across capacitance = $V_C = -jIX_C$ volts
Total active power loss = $VI \cos\Phi = I^2R$ volts
Power factor in the circuit p.f = $\cos\Phi$

The copper loss in a coil takes place due to resistance of its own, and the core loss takes place in the magnetic core (in case of 'iron core' inductor). In the capacitor, the loss takes place in the dielectric medium used for making it. The losses in the magnetic core of the inductor and in the dielectric medium of the capacitor are usually ignored. In a series circuit, the copper loss is taken into account when the resistance is connected in series with the inductance, as shown in Fig

5.0 CIRCUIT CONNECTION:



6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

The steps required for experiment is broadly explained below:

7.1 Connect the circuit as in Fig.

7.2 Adjust the rheostat in maximum position.

7.3 Adjust the variac at zero output position and switch on A.C mains.

7.4 Apply a suitable voltage from the variac, so that a reasonable current flows through the circuit. Take the readings of output voltage of the variac and the voltages across R, L and C and also note the current and power.

7.5 Take different readings by varying voltage from the variac.

7.6 Draw phasor diagrams and find out V_L and Vr from the phasor diagram.

8.0 EXPERIMENTAL TABLE:

Table-1

Source Voltage Vs	Current I	V_R	V_{Lr}	V_C	V_{RLr}	P	r

Table-2 (Supply frequency f = 50Hz, ω = 2πf)

$V_r = r*I$	$V_L = V_{Lr} - V_r$	$R = V_R / I$	$X_C = V_C / I$	$C = I / \omega V_C$	$X_L = V_L / I$	$L = X_L / \omega$	$Z = V / I$	$Z = \sqrt{[(R + r)^2 + (X_L - X_C)^2]}$	$P = I^2(R + r)$	$\cos\theta = (R + r) / Z$

9.0 SAFETY: 9.1 Do not switch on the circuits without the permission of the concerned teacher.

9.2 Do not wear loose garments inside the laboratory.

9.3 Do not touch the circuit haphazardly.

9.4 Do not enter the lab barefooted.

10.0 DISPOSAL: (NOT APPLICABLE)

11.0 REPORT WRITING: Attach the rough note with your final report.

The 1st Page of the report shall be as per the format shown in Annexure – 1.

Write the discussion along with all other information.

WORK INSTRUCTION

1.0 EXPERIMENT NO.: MSL/07

2.0 NAME OF EXPERIMENT: STUDY THE BEHAVIOUR OF A R -L-C PARALLEL CIRCUIT.

3.0 OBJECTIVE: i) To study the behavior of a R -L-C parallel circuit
ii) To familiarize with the phasor diagram of parallel R -L-C circuit

4.0 PRINCIPLE:

Let the total current flowing through the circuit be I ampere. The supply voltage be V volts. If the current through the capacitor is I_2, then, $X_C = V/I_2$

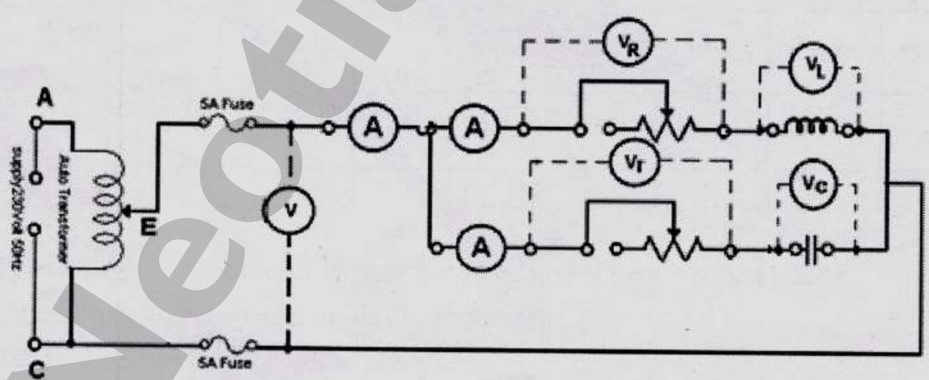
If current through the resistor is I_1 and voltage across it, is V_R, then the value of resistance is given by $R = V_R/I_1$.

If the voltage across the inductor is $V_{R,L}$, then
$V_{r,L}/I_1 = \sqrt{(r^2+X_L^2)}$ ....(1)
and $V_{R,L}/I_1 = \sqrt{(R+r)^2 + X_L^2}$ .... (2)

Where $V_{R,L}$ in the voltage across R, L.

Solving the equation (1 & 2) the value of r and X_L can be found out.
Power factor of the branch 1, $\cos\Phi = (R+r) / \sqrt{(R+r)^2 + X_L^2}$. The total power consumed is $I_1^2(R + r)$ watt.
The power factor of the circuit is given by $\cos\Phi = I_1^2(R+r)/VI$.

5.0 CIRCUIT CONNECTION:



6.0 TOOLS/APPARATUS REQUIRED:

Sl No.	Item	Quantity	Maker's Name	Range

7.0 PROCEDURE:

The steps required for experiment is broadly explained below:

7.1 Make the circuit connection as shown in fig.

7.2 The variac is adjusted to zero output position and the circuit is switched on.

7.3 A suitable voltage is applied from the variac so that a reasonable current flows through the circuit. The in different branches are noted along with the input voltage.

7.4 Different readings are taken by varying voltage from the variac.

7.5 The readings are noted in the data sheet.

All readings, calculation, drawing etc. should be done on a loose sheet. On completion of the Job/Experiment present it to the sessional in – charge for his signature and performance gradation. Grading shall be as per University rules.

8.0 EXPERIMENTAL TABLE:

TABLE: I

Sl No.	Supply Voltage (V) Volt	Current (I) Amp.	Voltage across resistor (V_R) Volt		Voltage across inductor and capacitor ($V_{,Lr}$) / V_C Volt		Current through Capacitor I_2(A)	Voltage across Resistor & Inductor $V_{R,L}$ (Volt)	Current through Inductor I_1 (A)

TABLE: II (Frequency f = 50 H_Z)

Sl No.	R = V_R/I_1 Ω	X_C = V_C/I_2 Ω	C = $I_2/\omega V_C$ Farad	X_L Ω	r Ω	L = X_L/ω (H)	Z = V/I Ω	P_1 = $I_1^2(R+r)$ W	P_2 = $I_1^2(R+r)$ W	Cos Φ_1	Cos Φ_2	Cos Φ

9.0 SAFETY: 9.1 Do not switch on the circuits without the permission of the concerned teacher.

9.2 Do not wear loose garments inside the laboratory.

9.3 Do not touch the circuit haphazardly.

9.4 Do not enter the lab barefooted

10.0 DISPOSAL: (NOT APPLICABLE)

11.0 REPORT WRITING: Attach the rough note with your final report.
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Write the discussion along with all other information.