CHARACTERIZATION OF LED

Light Dependent Resistor (LDR)

AIM:

1. To study the V-1 Characteristics of LDR
2. To study the Response characteristics of LDR

THEORY:

A photoresistor of Light Dependent Resistor (LDR) is a resistor whose resistance decreases with increasing incident light intensity; in other words, it exhibits photoconductivity. Light detection operation depends on the fact that the resistance of certain materials like Cadmium Sulphide (CdS) varies with the intensity of light failing on the surface of the film. They have no power and voltage handling capabilities similar to those of a conventional resistor.

EXPERIMENT SET-UP

1. Fix the kinematic laser mount on the optical rail and mount the diode laser.

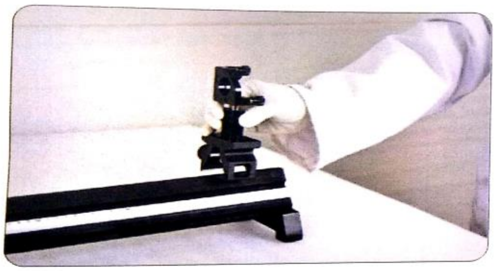


Fig (1)

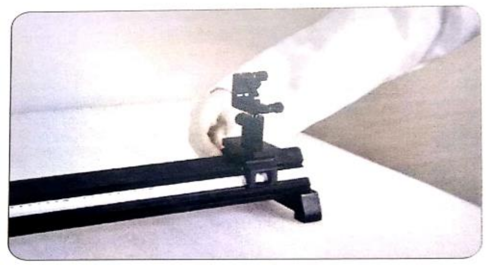


Fig (2)

Fig (3)

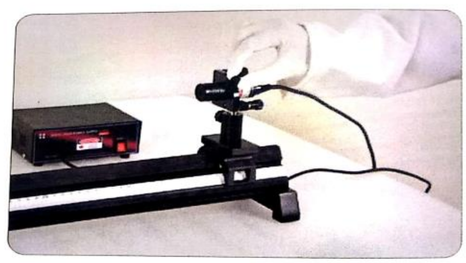


Fig (4)

2. Mount the Polarizer Rotator on the optical rail. Then fix the cell mount and insert the LDR with mount into the cell mount.

Fig (5)

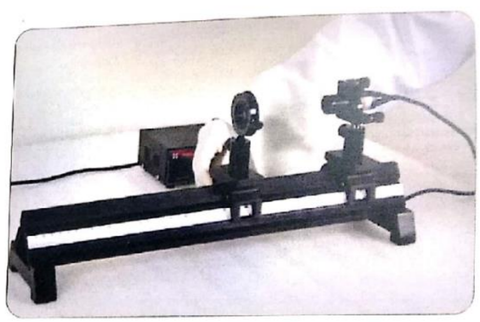


Fig (6)

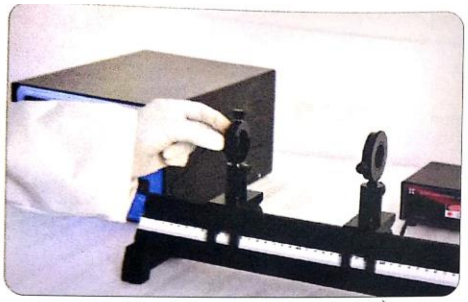


Fig (7)

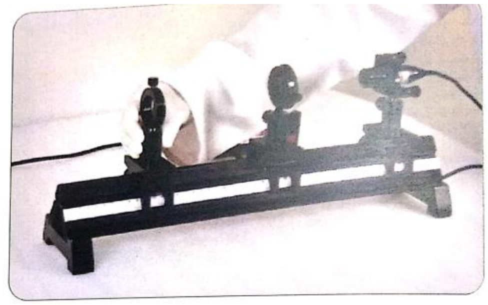


Fig (8)

3. Connect the output probes of the LDR to the 0-5V variable socket in the optoelectronics source and measurement unit. Connect the ammeter in series and voltmeter in parallel with the LDR.

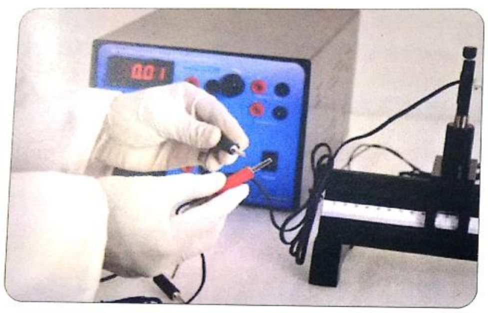


Fig (9)

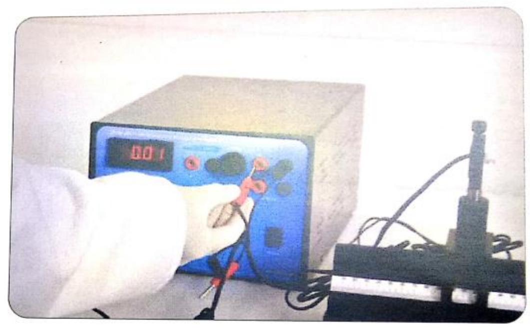


Fig (10)

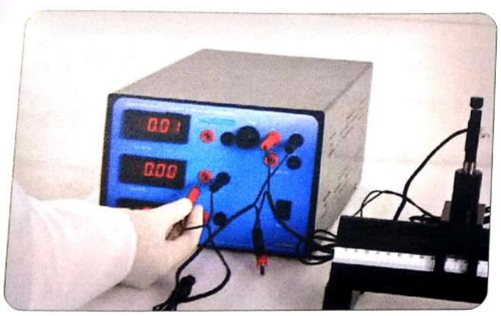
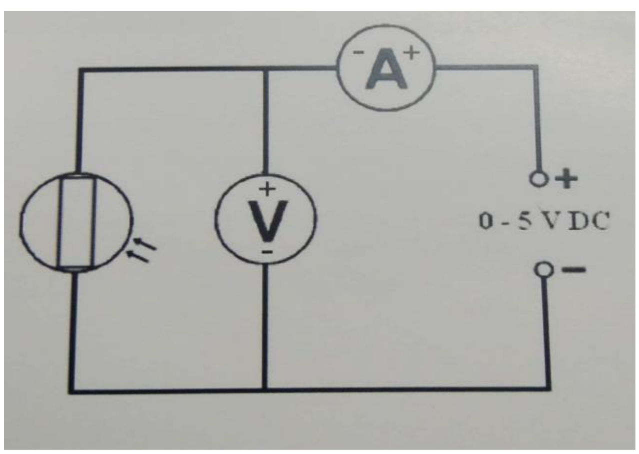


Fig (11)

Fig (12)

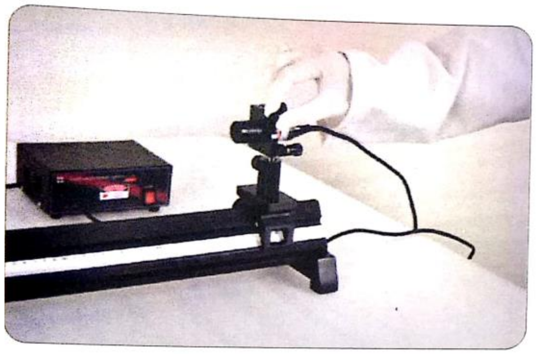
CIRCUIT DIAGRAM:

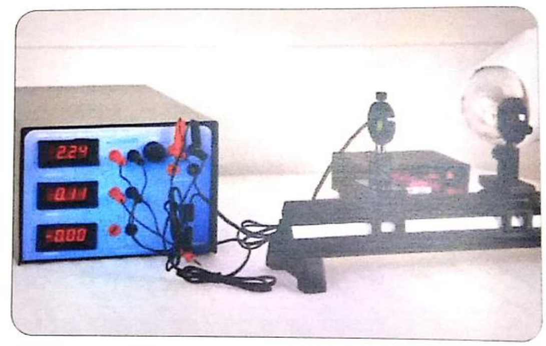


PROCEDURE

V-1 CHARACTERISTICS

1. Switch On the diode laser.
2. Rotate the polarizer to get maximum intensity. Align the laser beam to get maximum light on the LDR.





3. Vary the Voltage across LDR ranging from 0 to 5V. Note the Voltage and Current in voltmeter and ammeter at different intervals.

4. V-I Characteristics

| Sl.No. | Voltage (V) in volts | Current (1) mA |
|---|---|---|
| | | |

RESPONSE CHARACTERISTICS

1. Switch On the laser and opto-electronic source and measurement unit.
2. Align the laser beam to get maximum light on the LDR.
3. Fix the Voltage across LDR at a particular voltage.
4. Rotate the polarizer to get maximum intensity and note its angle.
5. Note the corresponding current from ammeter.
6. Rotate the polarizer in an interval of $10^0$ and note down the corresponding current each time.
7. Plot a Polarizer angle vs. Current graph.

| Sl.No. | Angle of the Polarizer (degree) | Current through LDR (I) mA |
|---|---|---|
| | | |

RESULT :

1. V-I Characteristics of LDR is studied and graph is plotted.
2. Response characteristics of LDR is studied and graph is plotte

PHOTO TRANSISTOR

AIM:

1. To study the V-I characteristics of phototransistor.
2. To study the Response characteristics of phototransistor.

THEORY:

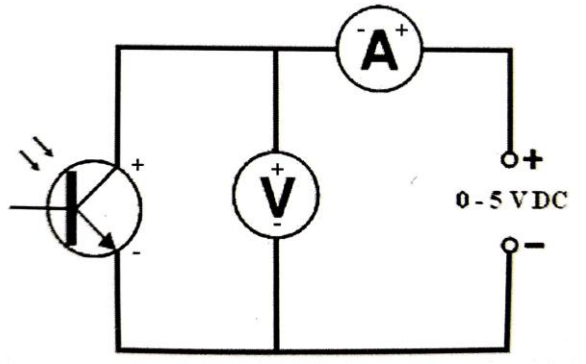
In a phototransistor, the base region is enlarged and generally does not have a lead attached to it. The collector-base junction is sensitive to light falling on it. When light falls on the base junction, a base current proportional to light intensity is produced. This initiates a collector current proportional to the light intensity. Phototransistors have a higher responsivity for light but they are not able to detect low levels of light.

EXPERIMENT SET-UP:

1. Remove the LDR from the mount in the above experiment and mount the phototransistor.

2. Connect the output probes of the phototransistor to the 0-5V variable socket in the opto-electronic source and measurement unit.
3. Connect the ammeter in series and voltmeter in parallel with the Phototransistor.

CIRCUIT DIAGRAM:




PROCEDURE

V-I CHARACTERISTICS

1. Rotate the polarizer to get maximum intensity.
2. Align the laser beam to get maximum light on the phototransistor.
3. Vary the Voltage across phototransistor ranging from 0 to 2V.
4. Note the Voltage and Current in voltmeter and ammeter at different intervals.
5. Plot the V-I Graph.

V-I CHARACTERISTICS

| Sl. No. | Voltage (V) in volts | Current (I) mA |
|---|---|---|
| | | |

RESPONSE CHARACTERISTICS

1. Fix the Voltage across phototransistor at a particular voltage not more than 2V.
2. Rotate the polarizer to get maximum intensity and note its angle.
3. Note the corresponding current from ammeter.
4. Rotate the polarizer in an interval of $10^0$ and note down the corresponding current each time.
5. Plot a Polarizer angle vs. Current graph.

| Sl. No. | Angle of the Polarizer (degree) | Current (I) mA |
|---|---|---|
| | | |

RESULT:

1. V-I characteristics of phototransistor is studied and graph is plotted.
2. Response characteristics of phototransistor is studied and graph is plotted.

PHOTODIODE

AIM:

To study the response characteristics of Photodiode.

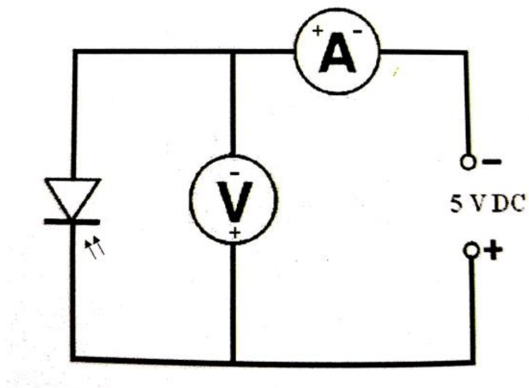
THEORY:

A photodiode is a type of photo detector capable of converting light into either current or voltage, depending upon the mode of operation. A photodiode is a p-n junction or PIN structure. When a photon of sufficient energy strikes the diode, it excites an electron, thereby creating a free electron and a positively charged electron hole… if the absorption occurs in the junction's depletion region, or one diffusion length away from it, these carries are swept from the junction by the built-in field of the depletion region. Thus holes move toward the anode, and electrons toward the cathode, and a photocurrent is produced. This photocurrent is the sum of both the dark current (without light) and the light current, so the dark current must be minimized to enhance the sensitivity of the device. The mechanism of the photodiode is like that of a (miniaturized) solar cell. They are not as sensitive as a phototransistor but their linearity can make them useful in simple light meters.

EXPERIMENTAL SET-UP:

1. Remove the Phototransistor from the cell mount in the above experiment and mount the photodiode.
2. Connect the output probes of the photodiode to the 5V socket in the opto-electronic source and measurement unit.
3. Connect the ammeter in series and voltmeter in parallel with the Phototransistor.

CIRCUIT DIAGRAM




PROCEDURE

1. Fix the voltage of across the photodiode at a particular voltage < 2 V.
2. Rotate the polarizer to get maximum intensity and note its angle.
3. Note the corresponding current from ammeter.
4. Rotate the polarizer in an interval of $10^0$ and note down the corresponding current each time.
5. Plot a Polarizer angle vs. Current graph.

RESPONSE CHARACTERISTICS

| Sl. No. | Angle of the Polarizer (degree) | Current (1) mA |
|---|---|---|
| | | |

RESULT:

Response characteristics of photodiode is studied and graph is plotted.

SOLAR CELL

AIM:

To study the Response characteristics of a Solar cell.

THEORY:

A solar cell is a semiconductor device, which generates an emf when illuminated by light. When light hits the surface of a solar cell near the p-n junction, the crystal is ionized and new electron hole pairs are generated. These electrons and holes created in the n and p-region diffuse towards the junction and if they have no time to recombine in the transit, they fall under the influence of the internal electric field existing in the junction. The electric field forces the electrons to move to n-region and holes to the p-region. This produces an excess of hole in the p-region and electrons in the n-region. These electrons and holes build up charges in their respective regions and a potential difference called photo emf appear across the cell. The solar cells are usually made of p-type Selenium and n-type Cadmium oxide. The p-type material is typically connected to the base and top of the wafer, n-type, has a grid of electrical contacts. The n-type is exposed to the light.

EXPERIMENTAL SET-UP:

1. Remove the Photodiode from the cell mount in the above experiment and mount the Solar cell.
2. Connect the probes of the solar cell to the voltmeter of the Opto-electronic source and measurement unit.

CIRCUIT DIAGRAM

PRODUCEDURE

1. Rotate the polarizer to get maximum intensity and note its angle.
2. Note the corresponding voltage from voltmeter.
3. Rotate the polarizer in an interval of $10^0$ and note down the corresponding voltage each time.
4. Plot a Polarizer angle vs. voltage graph.

| Sl. No. | Angle of the Polarizer (degree) | Current (1) mA |
|---|---|---|
| | | |

RESULT:

Response characteristics of Solar Cell is studied and graph is plotted.

LIGHT EMITTING DIODE (LED)

AIM:

To study the V-I Characteristics of an LED.

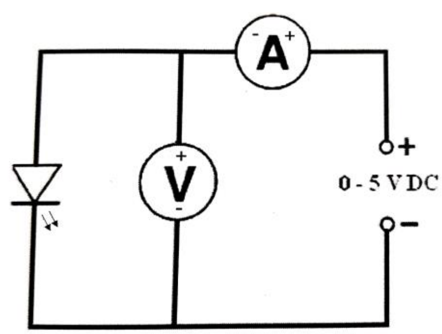
THEORY:

A light-emitting diode (LED) is a semiconductor light source. When a light-emitting diode is forward biased, electrons are able to recombine with holes within the device, releasing energy in the form of photons. This effect is called electroluminescence and the color of the light is determined by the energy gap of the semiconductor. Here we are finding the relationship between the input voltage V and forward current I. The biasing voltage is increased from zero by V in suitable steps by varying the biasing supply. The corresponding reading in the ammeter connected to the LED is noted at each step. A graph plotted between V and I, which represents the V-I Characteristics.

EXPERIMENTAL SET-UP:

1. Remove all the components from the optical rail except cell mount insert the LED on the cell mount.
2. Connect the probes to the 0-5V variable socket of the optoelectronic source and measurement unit.
3. Connect the ammeter in series and voltmeter in parallel with the LED.

CIRCUIT DIAGRAM:




PROCEDURE

1. Vary the voltage across the LED at regular interval and not each time the voltage and corresponding current.
2. Plot the V-I Graph.

CAUTION:

Don’t increase the voltage beyond 2V for Red LED and 2.75 V for Blue LED.

| Sl. No. | Voltage (V) in volts | Current (I) mA |
|---|---|---|
| | | |

RESULT:

V-I characteristics of LED is studied.

OPTO – COUPLER

AIM:

To study characteristics of an opto-coupler.

THEORY:

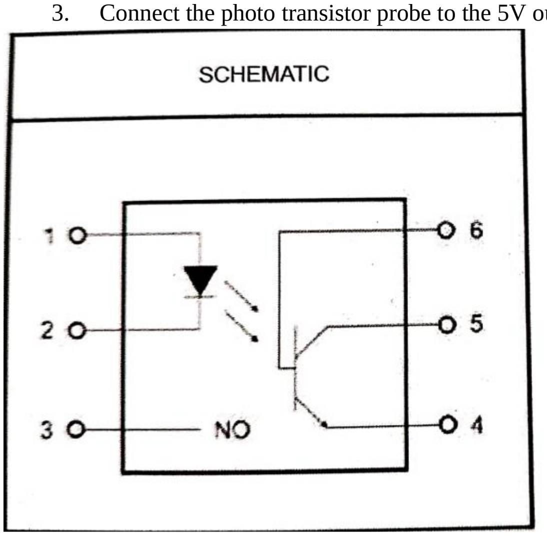
The opto-coupler or opt isolator is essentially a device that uses a short optical path to couple an electrical signal from one area to another. Typically the opto coupler is housed within a single small package, often around the size of a small integrated circuit, although sizes vary according to the application and the specification. The opto-coupler is a component that contains the two elements required for an opto-isolator.

1. Light emitter: The light emitter is on the input side and takes the incoming signal and converts it into a light signal. Typically, the light emitter is a light emitting diode.
2. Light Detector: The light detector within the opto-coupler detects the light from the emitter and converts it back into an electrical signal. The light detector can be any one of a number of different types of device from a photodiode to a phototransistor, photodarlington, etc.

The MCT 2E opto isolator (opto coupler) consists of a Gallium Arsenide infrared emitting diode driving a silicon phototransistor in a 6-pin dual in-line package.

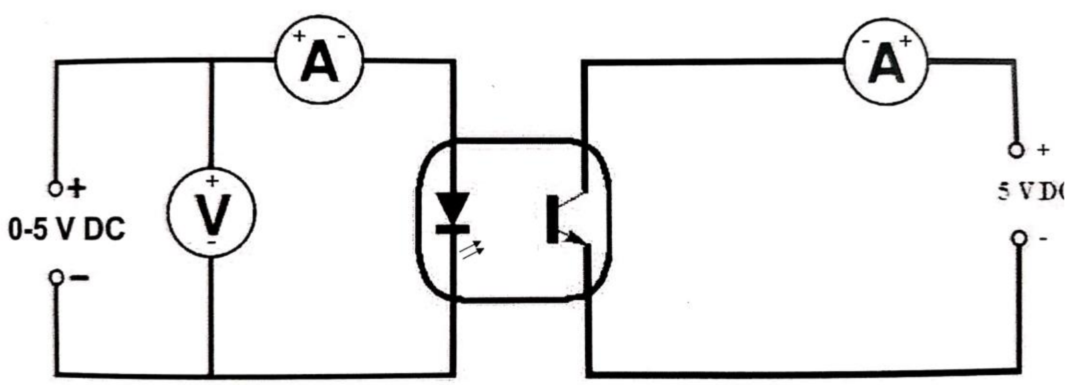
EXPERIMENTAL SET-UP

1. Place the cell mount the optical rail and mount the opto coupler.
2. Identify LED probe and phototransistor probe. Connect the LED probe to the 0-5V variable output of the Opto-electronic source and measurement unit with an ammeter in series and a voltmeter in parallel.
3. Connect the photo transistor probe to the 5V output in series with an ammeter.




PIN 1 ANODE
2 CATHODE
3 NO CONNECTION
4 EMITTER
5 COLLECTOR
6 BASE

CIRCUIT DIAGRAM:



PROCEDURE

1. Vary the input voltage of the LED and note down the input voltage. Input current and output current from the corresponding displays connected.
2. Plot the graph input current verses input voltage.
3. Also plot the graph input current verses output current.

V-I CHARACTERISTCS

| Sl. No. | Voltage (V) in volts | Input Current Ma | Output Current mA |
|---|---|---|---|
| | | | |

RESULT

The characteristics of an opto-coupler is studied.

TECHNICAL SPECIFICATIONS

1. OPTICAL RAIL
   Length ……………500mm

2. DIODE LASER WITH POWER SUPPLY
   Input …………………..230V AC/50Hz
   Output power …………3Mw
   Wavelength ……………650nm

3. KINEMATIC LASER MOUNT
   Adjustment Range: +/-4 degrees

4. OPTO-ELECTRONIC SOURCE AND MEASUREMENT UNIT
   Input ……………………………230V AC/50Hz
   Output …………………………..0-5V Variable DC & 5V Constant DC
   Voltmeter Range ………………..0-5V
   Ammeter Range…………………0-20Ma/0-200Ma

5. POLARIZER ROTATOR
   Polarizer: Linear Film Polarizer
   Optical Type: Transmissive
   Polarizing efficiency: 99%
   Wavelength: 400-700nm

6. CELL MOUNT
   Diameter: 25mm

7. OPTOELECTRONIC COMPONENTS
   a. Solar Cell
   b. LED (Blue and Red)
   c. LDR
   d. Photo Diode
   e. Photo Transistor
   f. Opto Coupler

MAINTENCANCE NOTES

a. Always keep the equipment in a moisture and dust free atmosphere.
b. Do not touch the active region of polarizer and other optical components with bare hands.
c. Switch on all the electronic devices used in this experiment at least once in a week.