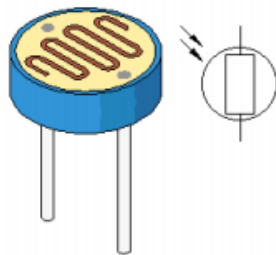


## Experiment-2

### Light Dependent Resistors (LDRs)

#### BACKGROUND INFORMATION:

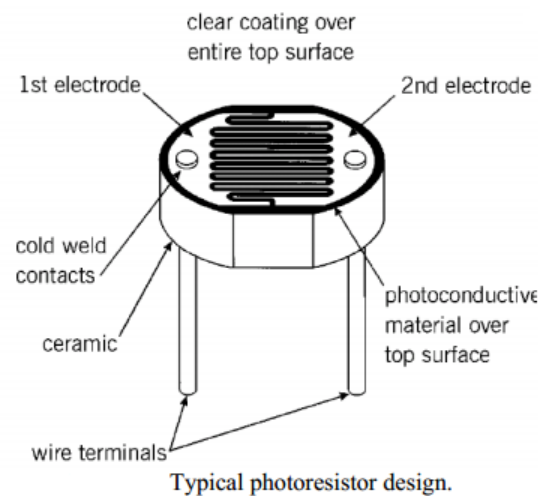
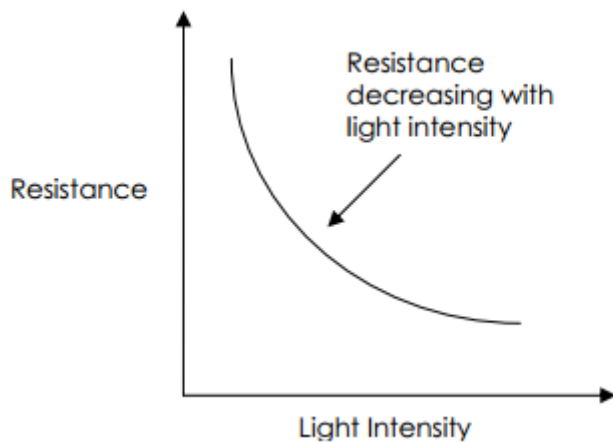
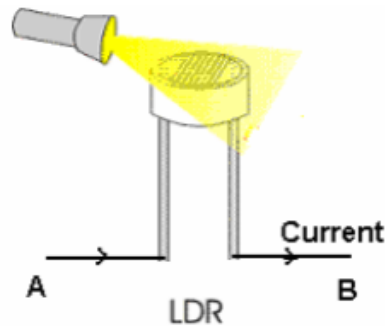
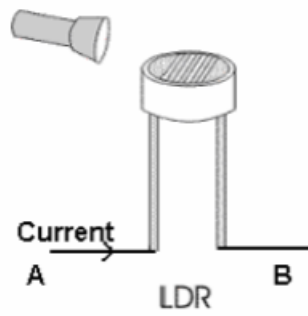
Light dependent resistors or in other words photoresistors are very useful especially in light /dark sensor circuits. They can also be referred to as photoconductors. Normally the resistance of an LDR is very high, but when they are illuminated with light resistance drops dramatically. A LDRs can have a variety of resistance and functions. For example, it can be used to turn on a light when the LDR is in darkness or to turn o a light when the LDR is in light. It can also work the other way around so when the LDR is in light it turns on the circuit and when it's in darkness the resistance increase and disrupts the circuit.



LDR symbol

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.

When the light level is low, the resistance of the LDR is high as shown in Figure 2. In this case, the current does not flow from A to B due to high resistance.



The light photons falling on LDR surface excite electrons in the valence band. The electrons move to the conduction band by absorbing energy. This movement decreases the resistance of the material. In the presence of external battery current flows through the LDR. The current increases with the light intensity. As the light intensity is increased, more and more electrons move to the conduction band increasing the current or decreasing LDR resistance.

The effect of light intensity is seen as resistance variation in LDR. The LDR resistance is given by

$$R_{LDR} = R_{dark} L^{-b}$$

Where  $R_{LDR}$  is LDR resistance

$R_{dark}$  is the LDR dark resistance (Resistance without light)

L is the light intensity at the surface of the LDR in Lux

b is a constant depends on the material

Taking logarithm of Equation, and rewriting it as

$$\log R_{LDR} = \log R_{dark} - b \log L$$

Substituting,  $y = \log R_{LDR}$ ,  $C = \log R_{dark}$ ,  $m = -b$  and  $x = \log L$

This equation is rewritten as

$$y = m x + C$$

It represents a straight line with slope m, and y intercept C. Therefore by drawing a graph of  $\log L$  versus  $\log R_{LDR}$ , the two constants  $R_{dark}$  and b can be estimated.

To study the variation of LDR resistance with light intensity an electric bulb is selected as light source. An electric bulb produces usually 11 lumen of light per watt.

If we know the wattage or power consumption by the light source, the amount of light produced can be estimated. Further the light intensity at a distance d from the light source is given by

$$L = \frac{\text{Light produced in Lumen}}{d^2}$$

Where, L is the light intensity at the surface in LUX

d is the normal distance between the source and the surface in meters

Measuring the distance between the LDR and light source the light intensity can be determined from this equation.

## Experiment-2: Light Dependent Resistors (LDRs)

**AIM:** The investigation of LDR's with regard to their operating principles.

### EQUIPMENT

Power Supply

Oscilloscope

Voltmeter, Ampermeter

LDR

Transistor BC547

Resistors  $100\Omega$ ,  $270\Omega$ ,  $1k\Omega$ ,  $2k\Omega$

12V Bulb (night lamb)

The experiment consists of 3 parts.

### PROCEDURE -1:

1. Connect the LDR as shown in Figure 1.
2. Measure the resistance of LDR in daylight, shadowy and dark. Write these values to Table-1.

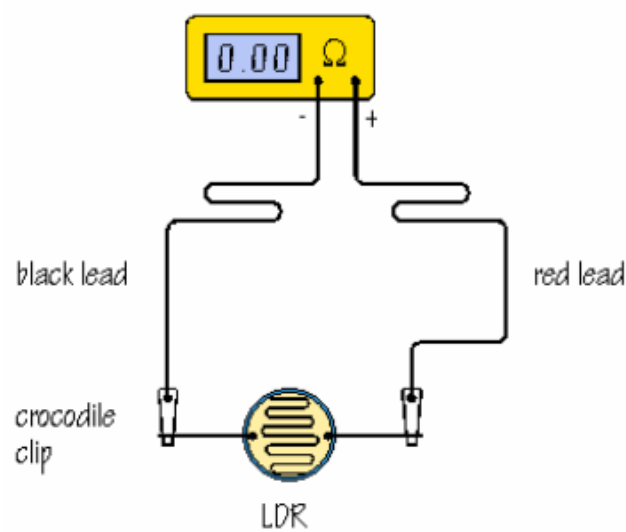
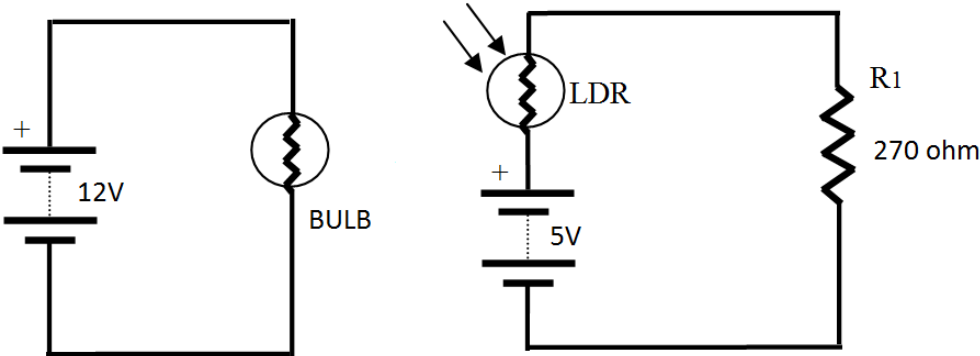


Fig.1

Table 1	Resistance Value
Day light ( $R_{DL}$ )	
Shadowy ( $R_{SH}$ )	
Dark ( $R_D$ )	

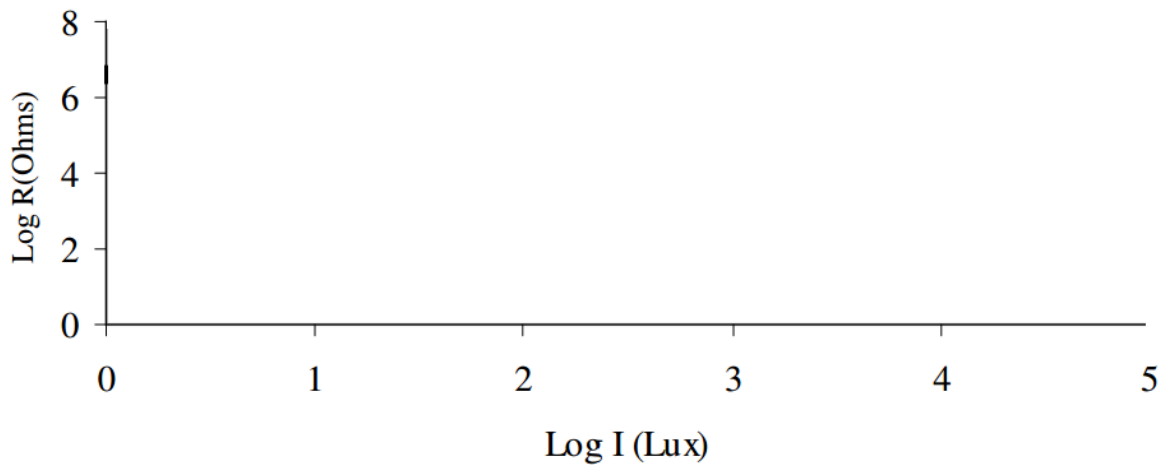
**Procedure 2:** Construct the circuit below on your breadboard.

The LDR is mounted with its active surface facing white light source at a distance of 20cm from the light source, Make sure that the LDR is in full light and then in complete darkness adjusting the voltage source from 2V to 12V . Do not use your finger or hand! Complete the following table below by measuring the voltage across the  $R_1$  resistors and bulb current.



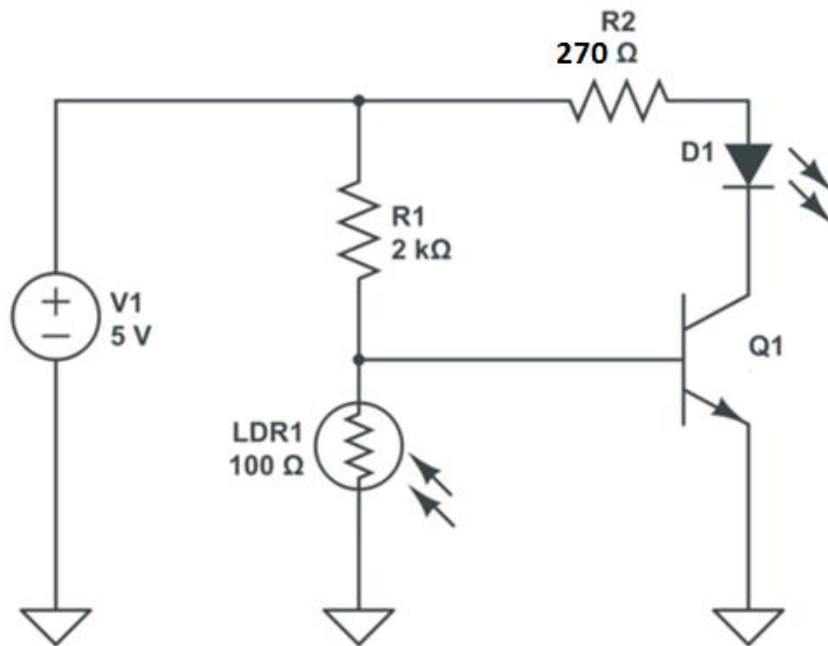
Bulb		Light			LDR	
$V_{Bulb}(V)$	$I_{Bulb}(A)$	Power(W)	L(Lumen)	I(Lux)	$I_{LDR}(mA)$	$R_{LDR}(\Omega)$
2						
4						
6						
8						
10						
12						

Sketch the graphics of variation of LDR resistance with light intensity in logarithmic form.



**Procedure 3:**

Construct the circuit below on your breadboard. Observe the Led by checking the light on the LDR.



### Answer the questions

1. Briefly explain how the circuit works.
2. When the light is on or the room is bright, block a part of the light coming into the LDR with a piece of paper. Is there a change in the intensity of the light emitted by the LED?
3. This circuit can automatically turn on / off the street lamps according to the intensity of light day or night. In that case, in order to turn on the LED in the desired light intensity, what resistor must be adjustable resistor (trimpot) in the circuit.
4. Re-setup the circuit using a trimpot and note your observations.

### **REFERENCES**

1. Course notes of Dokuz Eylul University
2. <http://kamaljeeth.net>