Experiment-5

Objective:

To understand the characteristics of a Light Dependent Resistor (LDR) and use it to design a light dependent electronic switch.

Introduction:

The LDRs or in other words photoresistors are very useful especially in light/dark sensor circuits. They can also be referred to as photoconductors. In dark, the resistance of an LDR is very high, however, when it is illuminated with light, its resistance decreases. It is often used as a light sensor in light meters, automatic street lighting, and in areas where we need to have light sensitivity. LDR is also known as a Light Sensor. The LDRs are made with photosensitive semiconductor materials like Cadmium Sulphides (CdS), lead sulfide, lead selenide, indium antimonide, or cadmium selenide and they are placed in a zig-zag shape as depicted below in Fig.1. Two metal contacts are placed on both ends of the zig-zag shape; these metal contacts help in creating a connection with the LDRs.

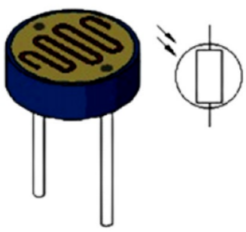

Figure 1: LDR and its circuit symbol.

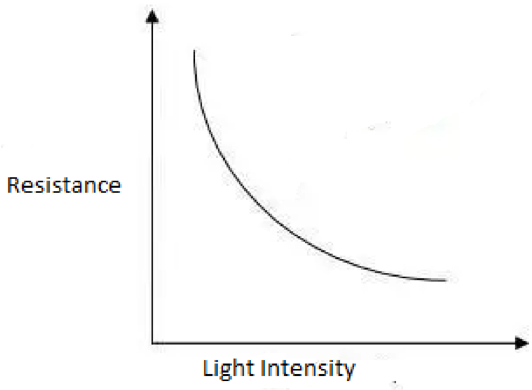

Figure 2: Plot showing the variation of the resistance of LDR with Light Intensity.

It works on the principle of photoconductivity whenever the light falls on its photoconductive material, it absorbs its energy and the electrons of that photoconductive material in the valence band get excited and go to the conduction band thus increasing the conductivity. Also, the energy in incident light should be greater than the bandgap energy so that the electrons from the valence band get excited and go to the conduction band. 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 on the resistance is schematically plotted in Fig.2. Further, the resistance of LDR, R_{LDR} is related to the light intensity L as

$$R_{LDR} = R_{Dark} \times (L - b) \qquad \ldots(1)$$

where R_{Dark} is the resistance in dark and b is a constant depending on the material of the LDR.

Experimental Procedure:

[A] Measurement of resistance of the given LDR

Equipment Required: LDR and Multimeter.

1. Use the multimeter to measure the resistance of the given LDR under dark, within the laboratory light and under solar radiation.
2. Write down the measured resistance in the table below:

Resistance (in ohm) of LDR measured under the following condition:	
In Dark (placed within black box)	
Under Laboratory Lighting	
Under Solar Radiation	

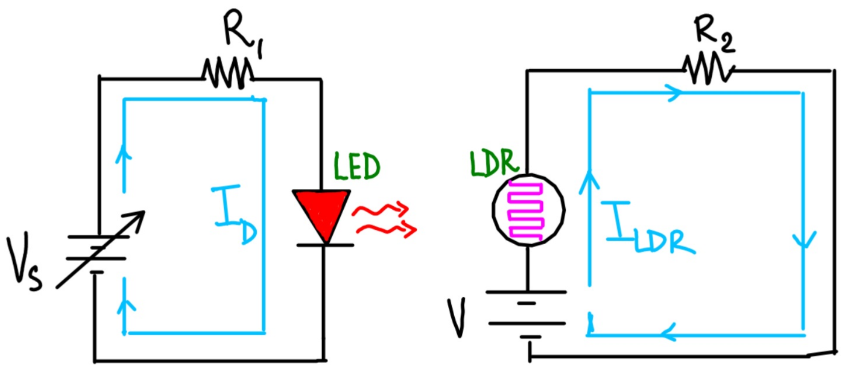

Figure 3: Circuit design to study the characteristics of LDR.

[B] Study the characteristics of the given LDR

Equipment Required: Breadboard, Connecting Wires, Resistors, LED, DC Power Supply, Multimeter and LDR.

1. Connect the circuits shown in Fig. 3 on a breadboard. Make sure that the LED faces the active surface of the LDR.

2. Vary the voltage V_S such that the current I_D through the LED varies which, in turn, varies the intensity of light emitting from the LED.
3. Measure I_D and I_{LDR} for each variation.
4. Plot I_{LDR} versus I_D.
5. Estimate the experimental values R_{Dark} and b given in Eq. (1).

[C] Application of LDR: Design and analyze light dependent electronic switches.

Equipment Required: Breadboard, Connecting Wires, Resistors, LED, DC Power Supply, Multimeter, BJT and LDR.

1. Design the circuit shown in Fig. 4 on the breadboard.
2. Vary the intensity of illumination on LDR and observe the light emitting from the LED D1.
3. Measure the resistance of LDR when the LED D1 turns ON/OFF.
4. Adjust the value of R1 so that the LED D1 turns ON/OFF at different intensity of illumination of LDR.
5. Note down the observations.

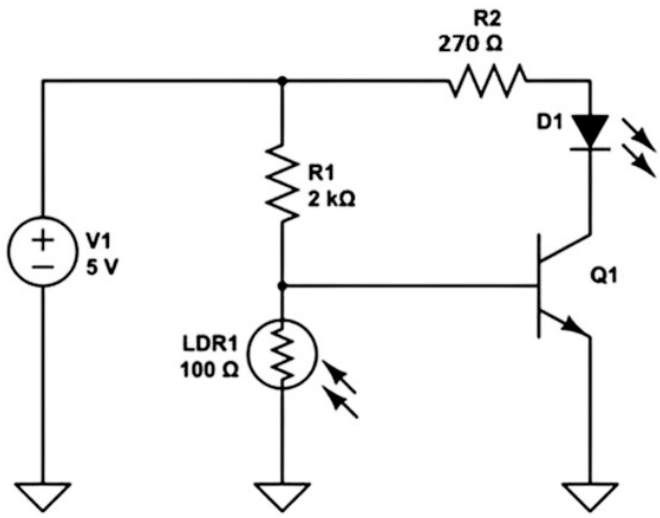

Figure 4: Application of LDR as light sensor to design an electronic switch.