

Experiment No.:- 04
(Module 4)

Date:- 20/07/2021

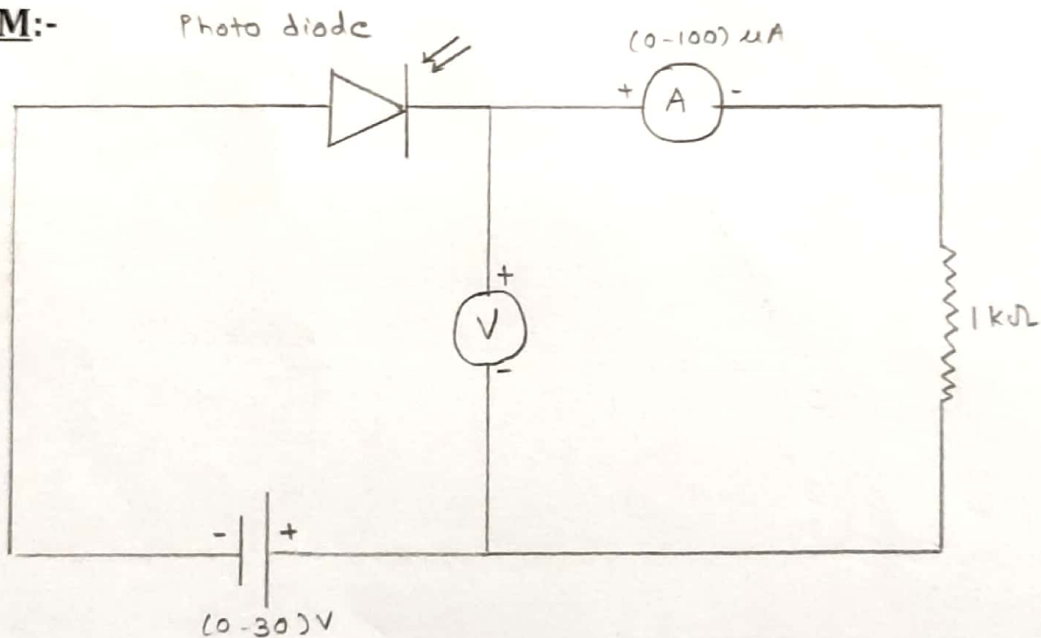
Photo Diode

DJ19FEC202.4: Interpret and explore basic sensing techniques for physical measurements in modern instrumentation.

AIM: - To study the reverse bias characteristics of a Photo-diode.

APPARATUS: - Photo-diode, voltmeter (0-10volt), milli-ammeter, variable DC source (0-10 volt), Digital multi meter, wires/leads.

DIAGRAM:-



Theory:-

Reverse bias characteristics of Photo diode

Photo-Diode: It is a silicon or germanium p-n junction diode which is photo-sensitive in reverse bias condition. i.e. the reverse current in a photodiode depends on the intensity of light falling on it or exposure of light. When it is in reverse biased condition it is operated in photoconductive mode.

When a p-n junction is illuminated with light, it breaks covalent bonds and additional electron hole pairs are generated. This boost the conduction resulting in an increase in the reverse current. Thus by controlling the illumination level, the current flowing through the device can be regulated.

The photo current varies almost linearly with incident light flux or optical power.

V-I Characteristics: The voltage-current equation for photodiode is given by following equation.

$$I = I_0 \left(e^{V/\eta V_T} - 1 \right) - I_P \quad \dots\dots\dots (1)$$

Here I_0 = reverse saturation current,

V = Applied potential to diode,

V_T = voltage equivalent to temperature = KT/e ,

η = constant (=1 for Ge and 2 for Si)

I_P = Photo current

When, $V = (-)$ ve then $e^{V/\eta V_T}$

$$I_R = -I_0 - I_P \quad (2)$$

Equation (2) indicates that in reverse biased photo-diode the total current is sum of reverse saturation current and photo-current. In absence of light, the photo-current becomes zero and the total current flowing through diode is equal to reverse saturation current. This current is known as **Dark Current**.

PROCEDURE:-

1. Connections are given as per the circuit diagram.
2. Place the photo diode at a particular distance from the illumination.
3. Voltage is varied using regulated power supply in steps of 0.5V and corresponding current is noted.
4. Readings are tabulated for three different distances and the graph is drawn between voltage (V_R) and current (I_R).

OBSERVATIONS:-

Distance d	d1>d2>d3		d1= <u>30cm</u>		d2= <u>20cm</u>		d3= <u>15cm</u>	
Intensity I	I=0		Intensity I=0<I1<I2<I3					
			I1		I2		I3	
Sr. No.	V _R (Volt)	I _R (μA)	V _R (Volt)	I _R (μA)	V _R (Volt)	I _R (μA)	V _R (Volt)	I _R (μA)
1.	0	0	0	0	0	0	0	0
2.	-0.5	0	-0.5	-0.32	-0.5	-0.36	-0.5	-0.44
3.	-1.0	0	-1.0	-0.71	-1.0	-0.78	-1.0	-0.91
4.	-1.5	0	-1.5	-1.04	-1.5	-1.3	-1.5	-1.29
5.	-2.0	0	-2.0	-1.06	-2.0	-1.69	-2.0	-1.8
6.	-2.5	0	-2.5	-1.08	-2.5	-2.04	-2.5	-2.18
7.	-3.0	0	-3.0	-1.09	-3.0	-2.49	-3.0	-2.58
8.	-3.5	0	-3.5	-1.11	-3.5	-2.6	-3.5	-2.93
9.	-4.0	0	-4.0	-1.12	-4.0	-2.67	-4.0	-3.24
10.	-4.5	0	-4.5	-1.13	-4.5	-2.76	-4.5	-3.35
11.	-5.0	0	-5.0	-1.15	-5.0	-2.78	-5.0	-3.4
12.	-5.5	0	-5.5	-1.17	-5.5	-2.8	-5.5	-3.44
13.	-6.0	0	-6.0	-1.19	-6.0	-2.88	-6.0	-3.5
14.	-6.5	0	-6.5	-1.2	-6.5	-2.92	-6.5	-3.56
15.	-7.0	0	-7.0	-1.21	-7.0	-2.96	-7.0	-3.59
16.	-7.5	0	-7.5	-1.22	-7.5	-2.99	-7.5	-3.6
17.	-8.0	0	-8.0	-1.24	-8.0	-3.02	-8.0	-3.65
18.	-8.5	0	-8.5	-1.25	-8.5	-3.06	-8.5	-3.68
19.	-9.0	0	-9.0	-1.26	-9.0	-3.08	-9.0	-3.73
20.	-9.5	0	-9.5	-1.27	-9.5	-3.12	-9.5	-3.77
21.	-10.0	0	-10.0	-1.28	-10.0	-3.14	-10.0	-3.8

RESULT:-

The photodiode is sensitive to change in light intensity.

COMMENTS:-

1. Write any two applications of photodiode.

- 1) Photodiodes are used in safety electronics such as fire and smoke detectors.
- 2) Photodiodes are used in solar panels.
- 3) Photodiodes are used in character recognition circuits.

2. State any two differences between Photodiode and LED.

- 1) Photodiode detects light ^{whereas} ~~between~~ LED emits light.
- 2) Photodiode is reverse bias whereas LED is forward biased.
- 3) Photodiode converts light energy into electric energy whereas LED converts electric energy into light energy.

D.J.S.C.E. (Physics)		
Journal		
Knowledge	3	
Documentation	3	
Punctuality	3	
Virtual Lab (Performance & Documentation)	6	
Total	15	

Date	Signature of the faculty

