

ELECTRONIC MEASUREMENT & INSTRUMENTATION (BEC-29)



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UNIT- 2
Lecture-7
Transducers

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Photo-electric Transducer

- The photoelectric transducer converts the light energy into electrical energy.
- It is made of semiconductor material. The photoelectric transducer uses a photosensitive element, which ejects the electrons when the beam of light absorbs through it.
- The discharges of electrons vary the property of the photosensitive element. Hence the current induces in the devices. The magnitude of the current is equal to the total light absorbed by the photosensitive element.
- The photoelectric transducer absorbs the radiation of light which falls on their semiconductor material. The absorption of light energizes the electrons of the material, and hence the electrons start moving. The mobility of electrons produces one of the three effects.
- The resistance of the material changes.
- The output current of the semiconductor changes.
- The output voltage of the semiconductor changes.

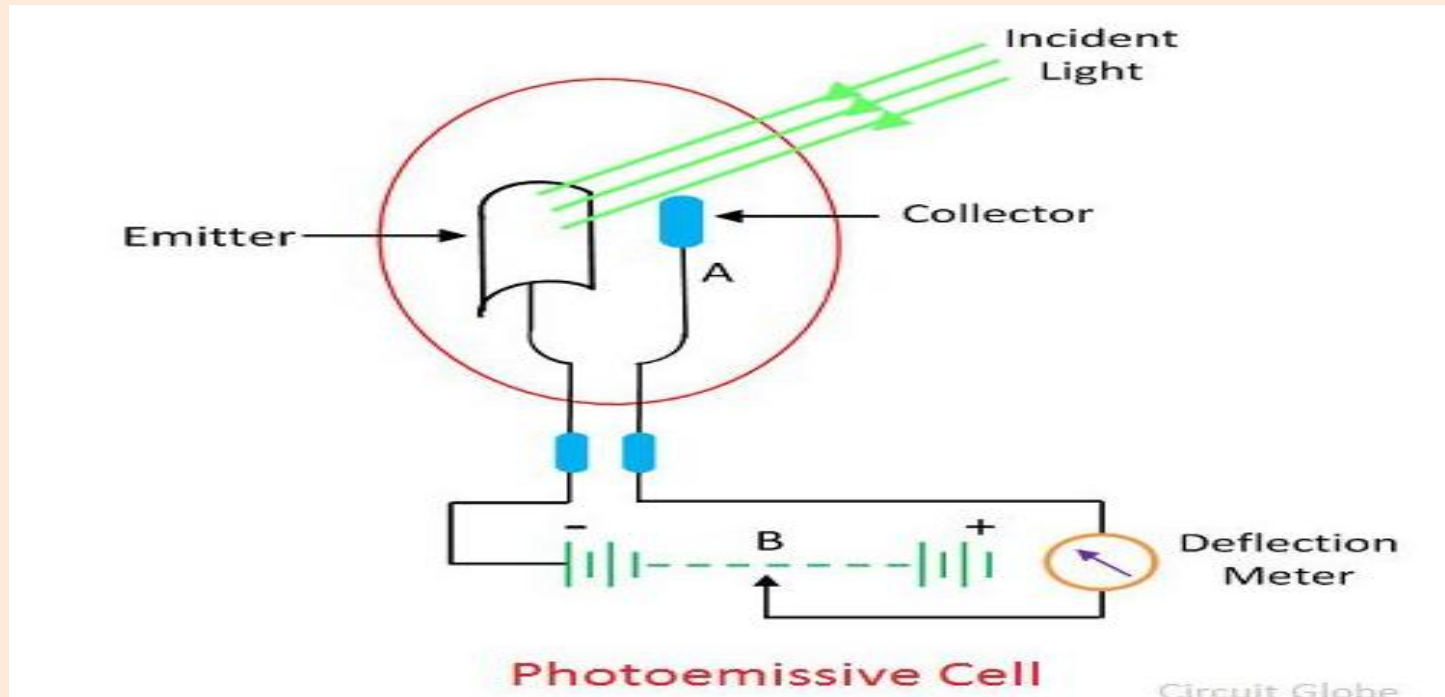
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Classification of Photoelectric Transducers:

The photoelectric transducers are classified into following ways.

Photo-emissive Cell

The Photo-emissive cell converts the photons into electric energy. It consists the anode rode and the cathode plate. The anode and cathode are coated with a Photo-emissive material called caesium antimony.



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- When the radiation of light fall on cathode plates the electrons starts flowing from anode to cathode. Both the anode and the cathode are sealed in a closed, opaque evacuated tube. When the radiation of light fall on the sealed tube, the electrons starts emitting from the cathode and moves towards the anode.
- The anode is kept to the positive potential. Thus, the photoelectric current starts flowing through the anode. The magnitude of the current is directly proportional to the intensity of light passes through it.

Photoconductive Cell

- The photoconductive cell converts the light energy into an electric current. It uses the semiconductor material like cadmium Selenide, Ge , Se, as a photo sensing element.
- When the beam of light falls on the semiconductor material, their conductivity increases and the material works like a closed switch. The current starts flowing into the material and deflects the pointer of the meter.

Photo-voltaic cell

- The photovoltaic cell is the type of active transducer. The current starts flowing into the photovoltaic cell when the load is connected to it. The silicon and selenium are used as a semiconductor material. When the semiconductor material absorbs heat, the free electrons of the material starts moving. This phenomenon is known as the photovoltaic effect.

Photocells

- A photocell can be defined as; it is a light-sensitive module.
- This can be used by connecting to an electrical or electronic circuit in an extensive range of applications like sunset to sunrise lighting that mechanically turns on whenever intensity of light is low.
- These are also used in other applications like intruder alarms and also automatic doors.

Photocell Construction

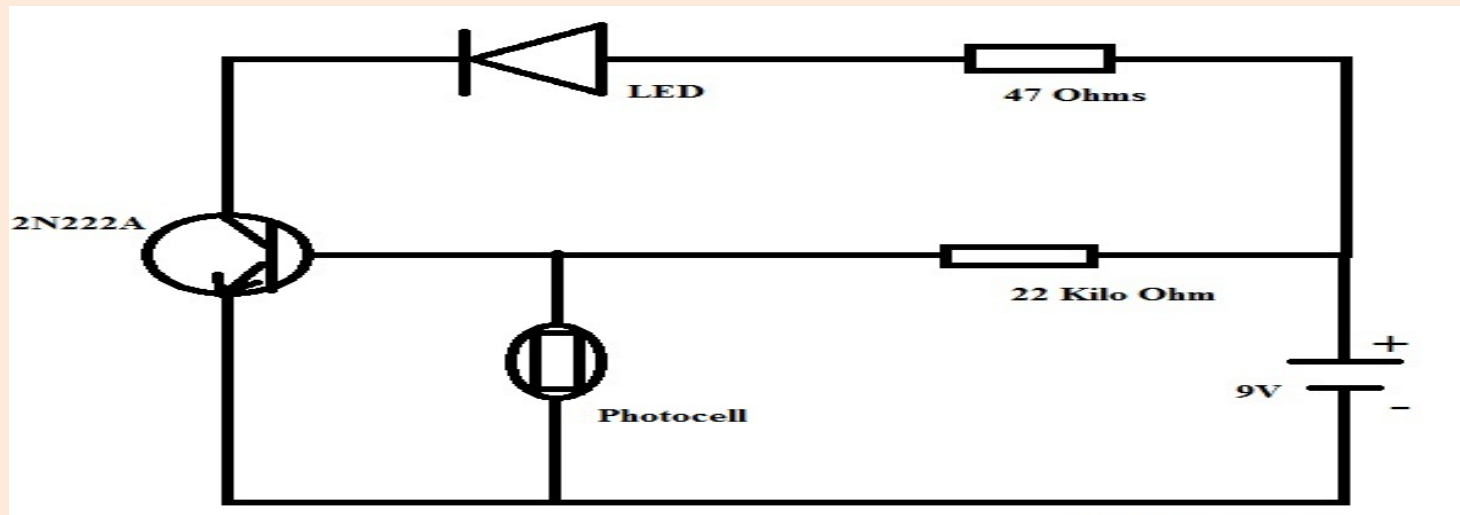
- The construction of a Photocell can be done by an evacuated glass tube which includes two electrodes like collector and emitter.
- The shape of the emitter terminal can be in the form of a semi-hollow cylinder.
- It is always arranged at a negative potential.
- The shape of the collector terminal can be in the form of a metal which can be arranged at the axis of the partially cylindrical emitter.
- This can be constantly kept at a positive terminal.
- The evacuated glass tube can be fixed over a nonmetallic base & pins are offered at the base for exterior connection.

Photocell Working

- The working principle of a photocell can depend on the occurrence of electrical resistance & the effect of photoelectric. This can be used to change light energy into electrical energy.

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- When the emitter terminal is connected to the negative (-ve) terminal & collector terminal is connected to the positive (+ve) terminal of a battery, the frequency radiation will be more than the material's threshold frequency in the emitter, and then photon emission will occur.
- The photon electrons are involved in the direction of the collector.
- Here the collector terminal is the positive terminal with respect to emitter terminal. Therefore, the flow of current will be there within the circuit.
- If the radiation intensity is enhanced, then the photoelectric current will be increased.



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Types of Photocells

- Photocells are available in different types
- Photovoltaic
- Charge-Coupled Devices
- Photo resistor
- Golay Cell
- Photomultiplier

1) Photovoltaic Cell

- The main function of a photovoltaic cell is to change the energy from solar to electrical. A usable current can occur whenever photons beat electrons over the cell into a high state of energy.

2) Charge-Coupled Devices

- A charge-coupled device can be used by the community of scientific because these are very consistent & exact photo sensor. When the charge generated by photo-sensitive sensors can be used to examine a variety of things from galaxies to only molecules.

3) Photo Resistor

- LDRs are one kind of sensors devices whose resistivity can be reduced with the sum of exposed light. The camera light meters & several alarms utilize inexpensive photo resistors in their applications.

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4) Golay Cell

- A Golay cell is mainly used to sense IR radiation. A blackened metal plate cylinder is filled with xenon gas on a single end. IR energy which falls over the blackened plate will heat-up the gas within the cylinder & twist the elastic diaphragm over the other ending. Here, the motion is used to find out the energy source's output.

5) Photomultiplier

- The photomultiplier is a very sensitive sensor. The unclear light can be multiplied by 100 million times.

Applications of Photocells

- The applications of photocells include the following.
- Photocells are used in automatic lights to activate whenever it gets dark, and the activation/deactivation of streetlights mainly depends on the day whether it is day or night.
- These are used as timers in a running race to calculate the runner's speed.
- Photocells are used to count the vehicles on the road.
- These are used instead of photovoltaic cells & variable resistors.
- These are used in lux meters to decide the light intensity.
- These are used as switches as well as sensors

Assignment Questions

- State different types of photoelectric transducers.
- Describe with the diagram the operation of a piezo-electric transducer.
- State the differences between photo-emissive, photoconductive and photovoltaic cells.
- Explain with a diagram and construction the operation of a photocell.

Conceptual Questions

- Photoelectric transducers consist of _____
 - a) 1 transducer
 - b) 3 transducers
 - c) 5 transducers
 - d) 10 transducers
- Photoconductive transducers produce output
 - a) due to change in inductance
 - b) due to change in light
 - c) due to change in resistance
 - d) due to change in temperature
- Commonly used photo emissive material is _____
 - a) gold
 - b) opium
 - c) tellurium
 - d) cesium-antimony

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- In photo emissive transducers, electrons are attracted by _____
 - a) Cathode
 - b) Anode
 - c) Grid
 - d) Body
- LDR's are also called _____
 - a) Photo voltaic cell
 - b) Photo resistive cell
 - c) Photo emissive cell
 - d) All of the mentioned
- Photo resistive cells are _____
 - a) Active device
 - b) Passive device
 - c) Insulating device
 - d) None of the mentioned

THANK YOU