

## UNIT - 3

### OPTO ELECTRONIC DEVICE

#### Electron emission:-

The libration of electrons from the metal surface is called electron emission. If sufficient energy is given to metal so that free electrons librated from the metal surfaces.

#### Types of electron emission:-

- 1] Thermionic emission by heating bulb (29) (photo diode)
- 2] Secondary emission
- 3] Photo electric emission (light or heat) (photovoltaic)
- 4] High field emission

Application:-  
1] Used in X-Ray tube  
2] Used in Industries

#### Application:-

1] Used in electron multiplier.  
2] In Cathode ray tube (CRT)  
3] Used in television set  
4] Used in photocells  
5] Used in photo voltaic cells

- Application:-  
1] Used in photo tubes.  
2] In photo camera.  
3] Photoelectric emission:- The process of libration of electrons from metal surface by applying light energy is called Photo electric emission.

Application :-

- 1] Used in photo tubes
- 2] In photo Camera
- 3] In television

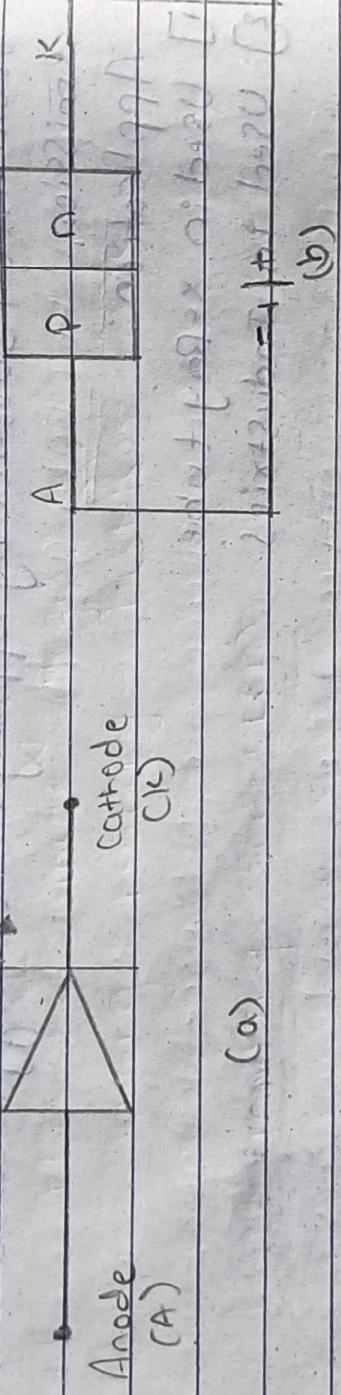
### 4] High field emission :-

The process of liberating of electrons from metal surface by applying strong electric field (high voltage) is called High field emission.

Application :- Used in electron microscope.

### \* Photo Diode

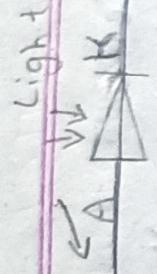
Light



A photo diode is reverse biased Semiconductor diode in which reverse current increases with increase in intensity of light at the junction.

A photo diode is two terminal P-n junction diode. It is always operated in reverse bias condition.

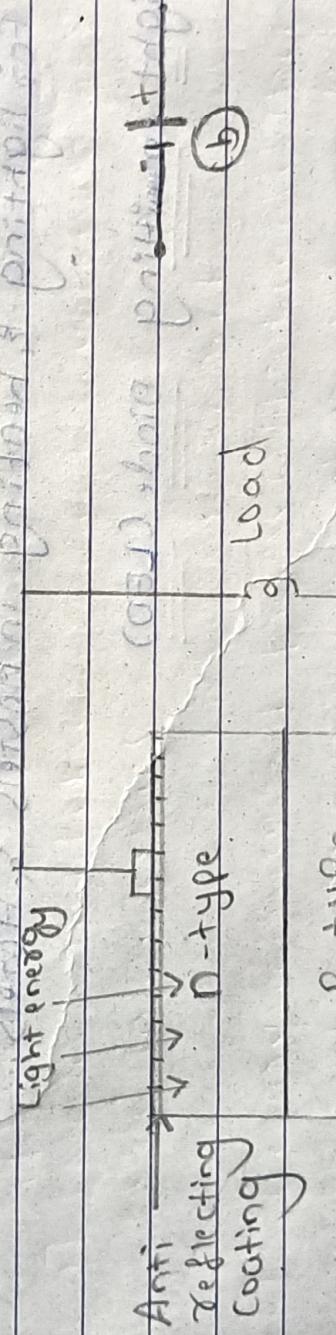
Fig (b) shows the construction of photo diode the glass lens is fixed over the junction through which light is incident on the junction when no light incident (Dark) Reverse current is zero. When light intensity increases Reverse current increases



### Applications of photodiode

- 1] It is used to detect both visible & invisible light.
- 2] Used as Light intensity meter.
- 3] In optical fibre communication.
- 4] In High speed data transmission.
- 5] In Control system.
- 6] In Frequency oscillator.
- 7] Used in complex alarm system.
- 8] Used in automatic Switch fix street light.

### Photovoltaic cell [Solarcell]



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A class is given over the device through which light falls materials forming p-n junction -body of solar cell. It consists of P-type & N-type semiconductors. Above figure shows the construction of a solar cell. Photovoltaic Cell converts light energy into electrical energy.

is incident on the P-N Junction

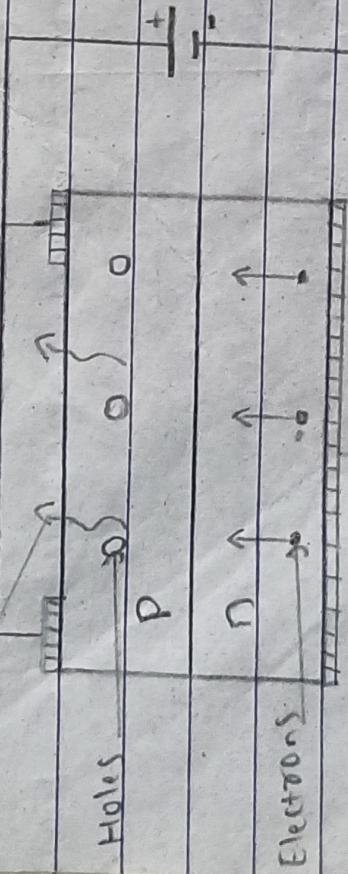
when light is incident on the cell. The hole electron pairs are created. The electrons move into the N-type material & holes move into the P-type material. A potential difference is developed between P & N type material the load is connected across the Solar Cell. Current starts flowing through the load.

### Applications of Solar Cell

- 1] It is used as Automatic Street light.
- 2] Used in Satellite & Space vehicles.
- 3] In Calculators & wrist watches.
- 4] Used in emergency light.
- 5] In traffic Signals & telephones.
- 6] For battery charging.
- 7] Lighting in remote villages.
- 8] For lighting & heating in hostels & Hotels.

### Light emitting Diode (LED)

Light



Light emitting diode is forward biased in Junction Diode. which emits light when Supply is given. The emitted light may be visible or invisible. LED is made of Semiconductor

materials like gallium phosphide or gallium arsenide

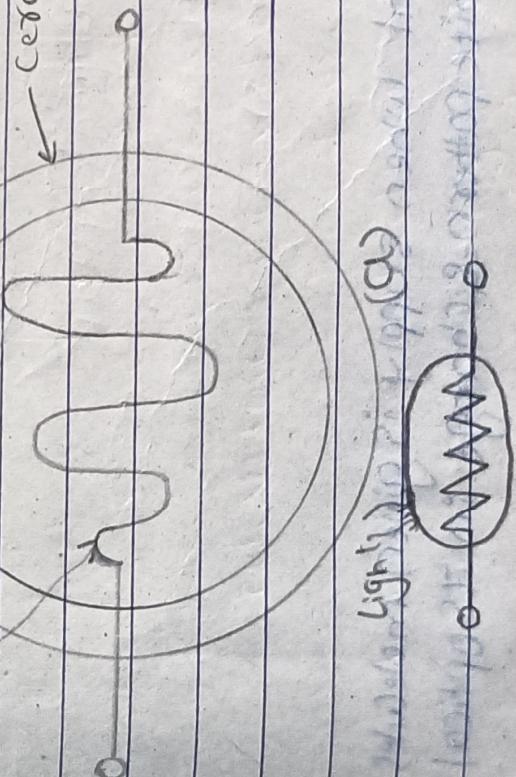
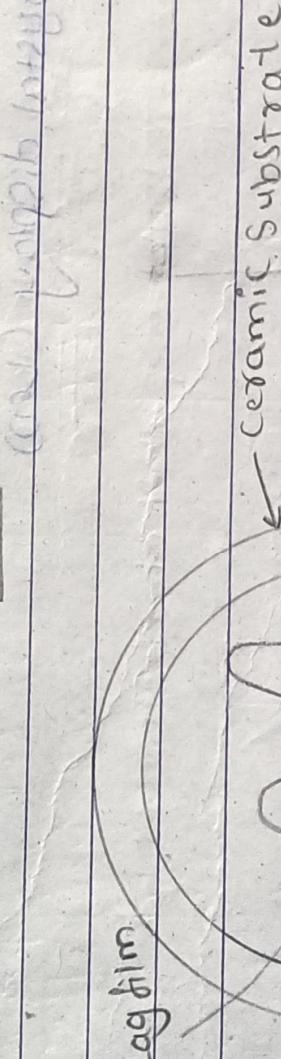
Working:- When LED is forward biased as shown in figure the electrons from N type material move into the P-type material & combine with holes. When recombination takes place electrons release energy in the form of light & heat.

### Applications of LEDs

- 1] LEDs are used in optical communication.
- 2] Used in remote control.
- 3] Used in Alphanumeric display.
- 4] Used in Seven Segment display.
- 5] Used as power supply indicators.
- 6] Used in measuring instruments.
- 7] Used in burglar alarm & CD players.
- 8] Used in audio video instruments.

### Light dependent Resistor

Zigzag film  
of CDS



Light (a)

Symbol

Symbol

Light dependent Resistor (LDR) is a two terminal Semiconductor device whose resistance depends on the intensity of light. It is also called photo resistor or photo conductor.

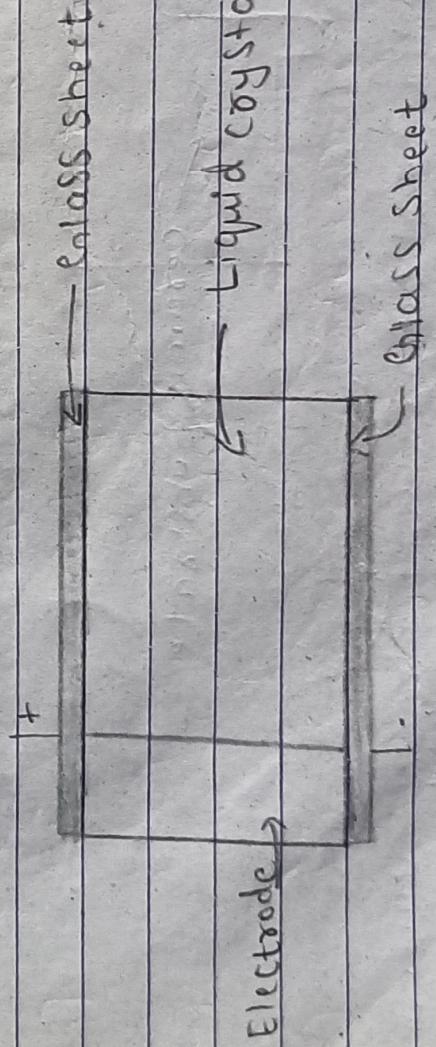
Working:- It works on the principle of Photo conductivity when light falls on the LDR, conductivity increases because electrons absorbs the light energy. As intensity of light increases Conductivity also increases.

The basic material used to manufacture LDR are Cadmium Sulfide, lead Sulphide, Cadmium Selenide.

### Applications of LDR

- 1] LDR are used to detect Smoke & flame.
- 2] used to detect Infra red light.
- 3] used in burglar Alarm.
- 4] used in light operated relay.
- 5] used in Street light operation.
- 6] used for measurement of Intensity of light.

### Liquid Crystal display (LCD)



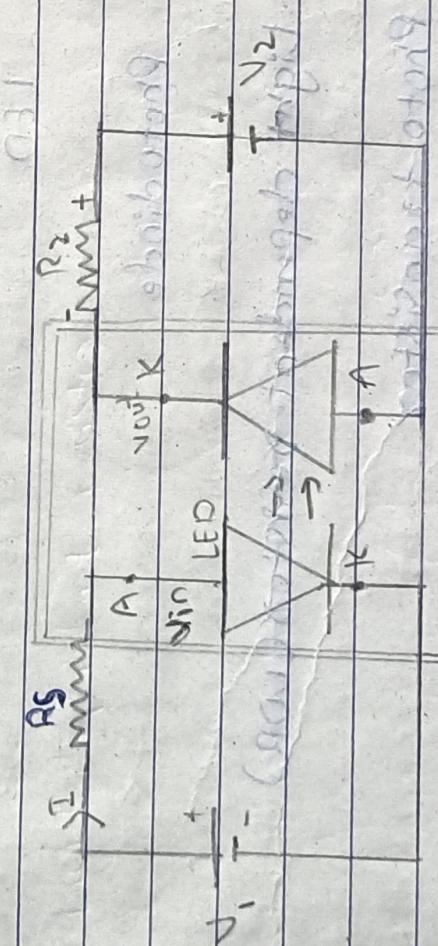
Liquid Crystal is a material. When Supply is given molecules are arranged in a definite pattern & change in its optical properties.

Figure shows the construction of LCD. It consists of very thin layers of liquid crystal sandwiched between glass sheet two electrodes are connected for external connection. When the crystal is energised the molecules of crystal gets aligned & these force light through the molecules & reflected.

### Applications of LCD

- 1) Used in seven segment display
- 2) In telephones
- 3) In panel board display
- 4) Calculators, pages, wrist watches.
- 5) Alphanumeric display.
- 6) Portable instruments.
- 7) For forming the pixels on the screen of television, laptops, cameras.

### Opto coupler or opto-isolator



An opto coupler (also called opto isolator) is a device that uses light to couple signal from its input to output.

Working:- Figure shows LED, photo diode opto coupler. The LED is on the left side & photo diode is on the right side.

When LED is energised current flows through the LED.

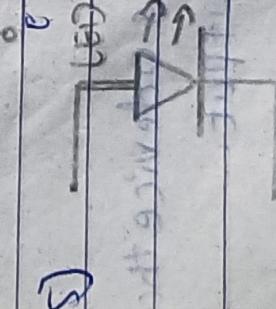
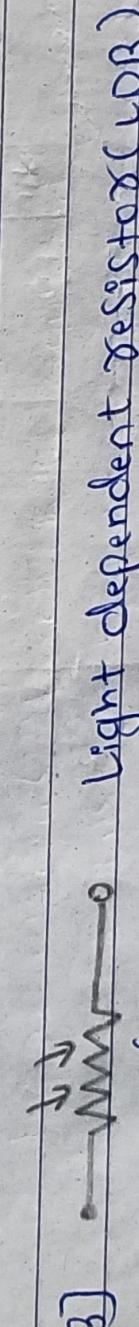
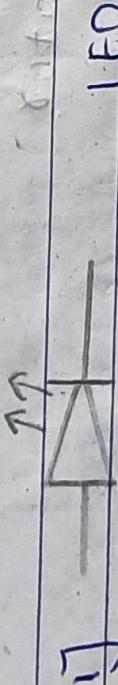
The LED light hits the photodiode & sets up reverse current through the resistance R<sub>2</sub>. The voltage across the photodiode is given by

$$V_{out} = V_s - I_R s$$

### Applications of opto-isolators

- 1] It is used to isolate the low voltage circuit from high voltage circuit.
- 2] It is used to connect the output of computer to external electrical circuit.
- 3] Used to control the speed of D.C. motor.
- 4] In driving circuit.

### Symbols of different optoelectronic devices



6] LASCR: Light activated Silicon Controlled Rectifier

# Different types of electronic devices with their applications

## Device

### Application examples

- 1) LED
  - 1] Seven Segment display
  - 2] Numerical display
- 2) LDR
  - \* Burglar Alarm
- 3) Photodiode
  - 1] Light detector
  - 2] Counting
  - 3] Photovoltaic cell
    - \* Satellite & space vehicles.
  - 4] Photo transistor
    - \* High frequency application
  - 5] Optocoupler/ optoisolator
    - \* To isolate low voltage circuit from high voltage circuit
    - \* Motors control
  - 6] LASCR

## The liquid LCD (liquid crystal display)

The liquid crystals are one of the materials having properties of liquid as well as solid crystal. Liquid crystal display do not emit or generate light but scatter or reflect externally generated light. Their ability to modulate light when electrical signal is applied has made them very useful in flat panel display technology. It consists of a layer of liquid crystal material sandwiched between glass sheet with transparent metal electrodes made of Titanium dioxide.