LED(LIGHT EMITTING DIODE)

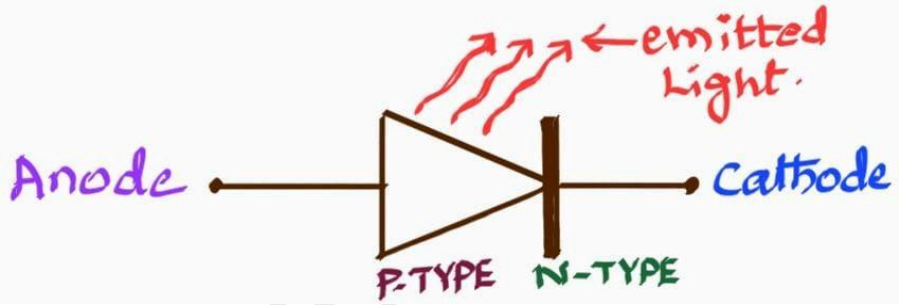
❖ Introduction:

- ❖ Nick Holonyak came up with an idea for a Light Emitting Diode in 1962.
- ❖ Light Emitting Diodes (LEDs) are the most widely used semiconductor diodes among all the different types of semiconductor diodes available today.
- ❖ LEDs are always forward biased and the safe voltage drop across an LED is in between 1.2 V to 3.2 V.& current ratings from 200 mA to 100 mA.

❖ Definition:

- ❖ A Light Emitting Diode (LED) is an optical semiconductor device that emits light when voltage is applied in forward biased.
- ❖ In other words LED is an optical semiconductor device that converts electrical energy into light energy.

❖ Symbol of LED:

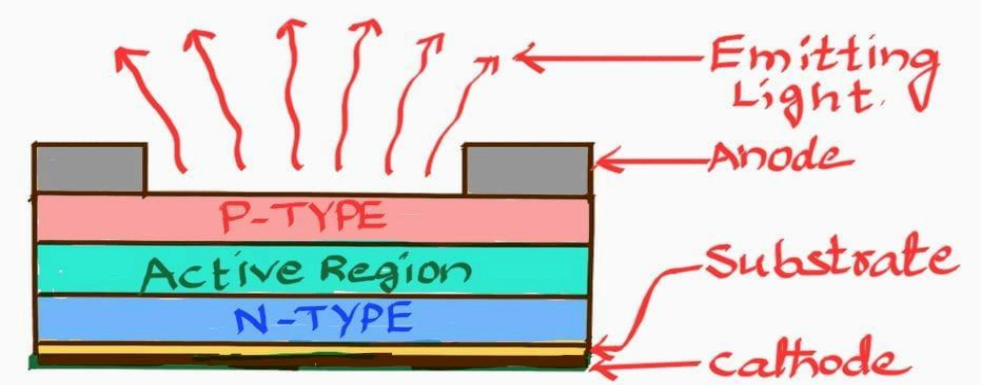


❖ Working Principle of LED:

- ❖ "LEDs operate on the principle of electroluminescence, a phenomenon where a semiconductor material emits light in the form of photons when an electric current passes through it".
- ❖ The photons of light energy released are approximately proportional to the band gap of the semiconductor.

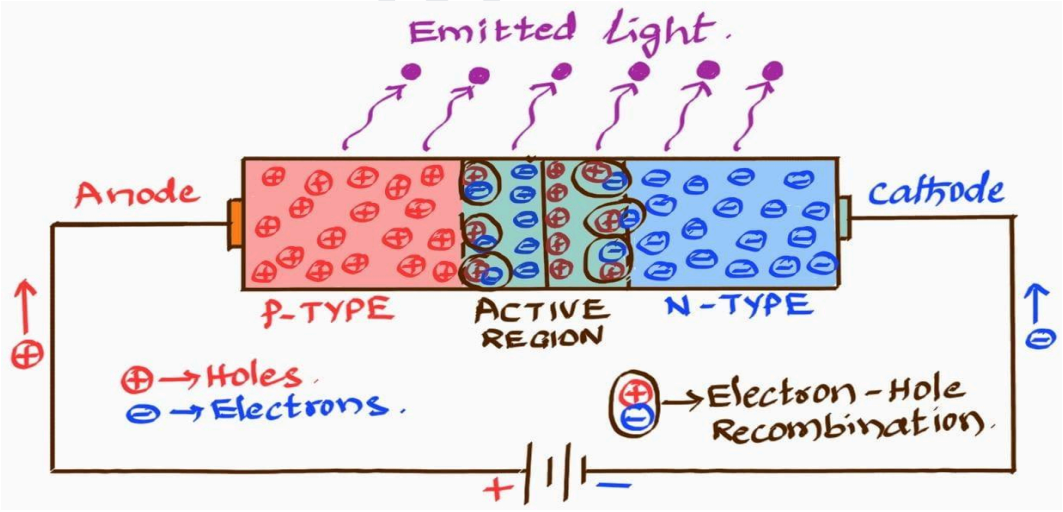
❖ Construction of LED:

- ❖ One of the methods used to construct LEDs is to deposit three semiconductor layers on a substrate.
- ❖ The three semiconductor layers deposited on the substrate are a P-type semiconductor, an N-type semiconductor and an active region that is present in between the P-type and N-type semiconductor layers as shown below.



❖ Working of LED:

- ❖ When the P-N junction is forward-biased, free electrons from the N-type semiconductor and holes from the P-type semiconductor are pushed towards the active region (depletion region). Due to this, the electrons move from the N-side to the P-side through the active region, and the holes move from the P-side to the N-side through the active region.
- ❖ As a result, the concentration of minority charge carriers increases rapidly at the active region boundaries, which then recombine with majority charge carriers near the active region.
- ❖ That means, electron-hole recombination takes place from the Conduction band and Valence band. During this process, energy is released in the form of light radiation, i.e., photons.



- ❖ The energy of light radiation depends on the strength of the recombination and the materials used. The emitted light is very small in intensity and is of the order of the microampere range.

- The energy released in the form of a photon is equal to the forbidden energy gap (Eg) and is equal to **hν**

  Eg = hν

- **Since** $\nu = c/\lambda$

  $Eg = hc/\lambda$ or $\lambda = hc/Eg = 12400/Eg$

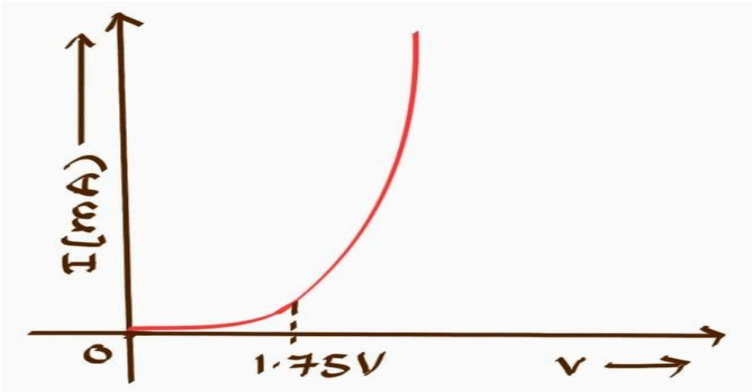
- **Where**: λ is wavelength of light

  c is speed or velocity of light = 3×10^8 m/s.

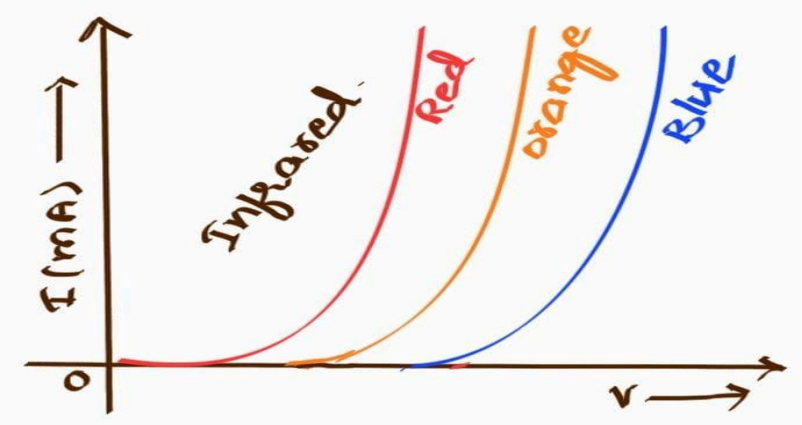
  h is planck's constant and

  $h = 6.625 \times 10^{-34}$J.S or $h = 6.625 \times 10^{-27}$ergs or $h = 4.14 \times 10^{-15}$ eV.s.

- **V- I CHARACTERISTICS OF LED:**
- The V-I characteristics of LEDs are similar to that of Si diodes in Forward Biased.



- The curve shows a typical diode characteristic, with a sharp increase in current after a certain voltage called threshold voltage.
- Generally, LED starts glowing at this voltage of 1.75V in Forward Bias.
- **IMP CHARACTERISTICS OF LED:**
- The important characteristic of the LED is colour.
- The I-V characteristics of LEDs for different colours are shown below.



❖ APPLICATIONS OF LED:

❖ The various applications of LEDs are as follows :-

❖ Burglar alarms

❖ Calculators

❖ Picture phones

❖ Traffic signals

❖ Multimeters

❖ Digital computers

❖ Digital watches

❖ Automatic heat lamps.

❖ Camera flashes

❖ Aviation lighting

❖ Microprocessors.

❖ Decorations.

❖ Video display

❖ Advantages of LED:

❖ Brightness of LEDs can be easily controlled by varying currents.

❖ LED's consume low energy.

❖ LED's are very cheap in cost and readily available.

❖ Smaller in size & light in weight.

❖ LED's have a longer life time.

❖ They can be turned on/off in less time.

❖ LED can emit different colours of light.

❖ LED's do not contain toxic materials like mercury.

❖ Disadvantages of LED:

❖ LED's need more power to operate than normal P-N Junction diodes.

❖ Luminous efficiency of LEDs is low.

❖ NOTE:

❖ LEDs are always Forward biased.

❖ When the LED is Reverse biased, There will be no emission of light.