



# Light Emitting Diodes (LED)

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## Why in News?

The **Royal Swedish Academy of Sciences** made a statement declaring that while incandescent light bulbs illuminated the 20th century, the 21st century would be illuminated by LED lamps.

## What are Diodes?

- A diode is an electronic component about **5 mm wide**. It has two points of contact, or terminals, called its **anode** and **cathode**.
- A diode's primary purpose is to allow current to flow in only **one direction**. It achieves this using a **P-N Junction Diode**.
- The P-N junction occurs at the interface of **p-type** and **n-type** semiconductors.
  - The **positive side** of the **semiconductor**, known as the **p-side**, **possesses an abundance of holes**.
  - The **negative side** of the **semiconductor**, referred to as the **n-side**, contains an **excess of electrons**.
    - **Electrons are 'places' inside atoms that carry negative charge.**

## Note

- **Electrons:** An **electron** is a **subatomic particle with a negative charge** that can exist either bound to an atom or in a free state.
- **Hole:** In a **PN junction**, "**holes**" refer to the **absence of an electron** in the **valence band** of a **semiconductor material**.
  - When an electron from the **valence band** moves to a **higher energy level (conduction band)**, it leaves behind a **vacancy** in the valence band, known as a hole.
- **Band Gap:** The **band gap** is the energy difference between the **highest occupied** and the **lowest unoccupied** electronic states in a material.

## What are Light Emitting Diodes (LED)?

- LEDs are **semiconductors** that can emit light when an electric current passes through them.
  - Inside the diode's p-n junction, the electrons have more energy than the holes. When an electron meets and occupies a hole, it releases energy into its surroundings.
- The **Nobel Prize in Physics** for **2014** was granted to **Isamu Akasaki, Hiroshi Amano** and **Shuji Nakamura**.
  - Their achievement was recognized for the invention of efficient **blue light-emitting diodes**, a breakthrough that paved the way for the creation of **bright and energy-efficient white light sources**.
  - **Red** and **green diodes** existed for a while, but the **lack of blue light** prevented the creation of **white lamps**.

## What are the Difference Between Light Emitting Diodes (LED) and Liquid

## Crystal Display (LCD)?

LCD	LED
<ul style="list-style-type: none"><li>▪ LCDs primarily use fluorescent lights.</li></ul>	<ul style="list-style-type: none"><li>▪ LEDs use light-emitting diodes.</li></ul>
<ul style="list-style-type: none"><li>▪ Fluorescent Lights are usually placed behind the screen in LCD</li></ul>	<ul style="list-style-type: none"><li>▪ Light Emitting Diodes are positioned either behind the screen or along the edges.</li></ul>
<ul style="list-style-type: none"><li>▪ LCDs tend to be thicker and exhibit lower energy efficiency in comparison to LEDs.</li></ul>	<ul style="list-style-type: none"><li>▪ LEDs are thin and use less energy.</li></ul>
<ul style="list-style-type: none"><li>▪ LCD has a narrower viewing angle than LED.</li></ul>	<ul style="list-style-type: none"><li>▪ LEDs have a wider viewing angle than LCD.</li></ul>
<ul style="list-style-type: none"><li>▪ LCD uses mercury and is harmful to the environment.</li></ul>	<ul style="list-style-type: none"><li>▪ LED uses no mercury and is environmentally friendly.</li></ul>

## UPSC Civil Services Examination, Previous Year Question (PYQ)

### Prelims

**Q1. With reference to street lighting, how do sodium lamps differ from LED lamps? (2021)**

1. Sodium lamps produce light in 360 degrees but it is not so in the case of LED lamps.
2. As street lights, sodium lamps have a longer lifespan than LED lamps.
3. The spectrum of visible light from sodium lamps is almost monochromatic while LED lamps offer significant colour advantages in street lighting.

**Select the correct answer using the code given below.**

- (a) 3 only
- (b) 2 only
- (c) 1 and 3 only
- (d) 1, 2 and 3

**Ans: (c)**

### Mains

**Q.** The Nobel Prize in Physics of 2014 was jointly awarded to Akasaki, Amano and Nakamura for the invention of Blue LEDs in the 1990s. How has this invention impacted the everyday life of human beings? (2021)