**Define Laser diode**

**Light amplification by stimulated emission of radiation** diode is a semiconductor device that produces coherent radiation with waves and frequency all in the same phase in the visible infrared spectrum when current passes through it.

**Working principles of LASER diode**

The laser diode works on the principle that every atom in its excited state can emit photons if electrons at higher energy level are provided with an external source of energy.

There are basically three phenomena by which an atom can emit light energy and that are**Absorption,** **Spontaneous Emission** &**Stimulated emission.**

**Absorption**

In absorption, the electrons at lower energy levels jump to higher energy level i.e. from valence band to conduction band when the electrons are provided with an external source of energy. Now, there are holes at lower energy level i.e. valence band and electrons at higher energy level i.e. conduction band.

**Spontaneous Emission**

Now, if the electrons in higher energy level are unstable then they will tend to move to the lower energy level in order to achieve stability. But if they will move from higher energy level to lower energy levels they will definitely release the energy which will be the energy difference between these two levels. The energy released will be in the form of light and thus photons will be emitted. This process is called spontaneous emission.

**Stimulated Emission**

In stimulated emission, the photons strike electrons at higher energy level and these photons are supplied from an external light energy source. When these photons strike the electrons, electrons gain energy and they recombine with holes and release an extra photon. Thus, one incident photon stimulates another photon to release. Thus, this process is called stimulated emission.

**Population inversion**

The density of electrons at energy levels is the population of electrons and it is more in valence band or lower energy band and less in the conduction band or higher energy level. If the population of electrons increases at higher energy level or the lifetime of higher energy states is long then stimulated emission will increase. This increase of population at higher energy level is termed as population inversion.

And this is the requisite state for Laser diode. More the population inversion more will be the electrons at higher and meta stable state and more will be the stimulated emission. The photons emitted are in the same phase with the incident photons. And these photons travel as a single beam of light and thus produce coherence.

**Applications Of Laser diodes**

1. Fibre optical communication system.
2. Barcode readers.
3. Laser Printing and laser scanning.
4. Rangefinders.
5. In medical fields in surgical instruments.
6. In CD players and DVD recorder.

**Comparison Of Laser Diode to LED diodes**

LASER diode light is essentially single wavelength (highly monochromatic), while, light Emitting Diode, light is mostly monochromatic (narrow energy spread comparable to the distribution of electrons/hole populations in the band edges.

LASER diode light is from “stimulated emission” (timed to be in phase with other photons, while, Light Emitting Diode light is from spontaneous emission (random events in time and thus phase).

LASER diode light has significantly lower divergence (Semiconductor versions have more than gas lasers though).