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Lecture 9 : *Injection Lasers*

1. **Injection laser** : also known as a laser diode, or diode laser, is a semiconductor device that produces coherent radiation (in which the waves are all at the same frequency and phase) in the visible or infrared (IR) spectrum when current passes through it.
2. Injection Laser is used in optical fiber systems, compact disc (CD) players, laser printers, and remote-control devices.
3. Laser diodes differ from conventional lasers, such as the helium-neon (He-Ne), ruby, and gas types, in several ways **:**

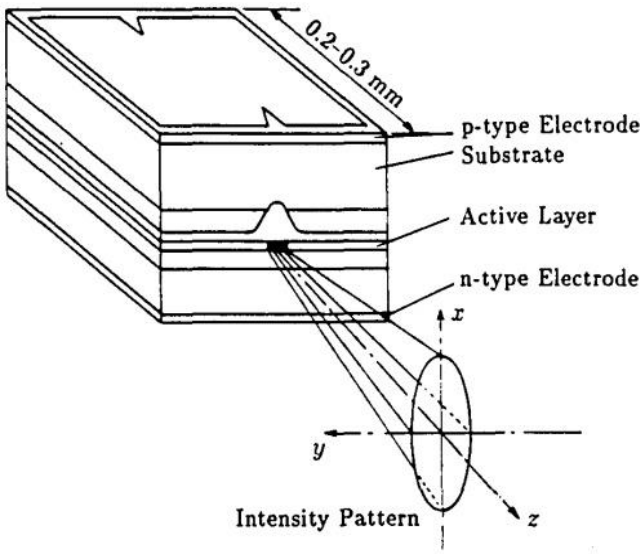
- **Small size and weight**: A typical laser diode measures less than one millimeter across and weighs a fraction of a gram, making it ideal for use in portable electronic equipment.

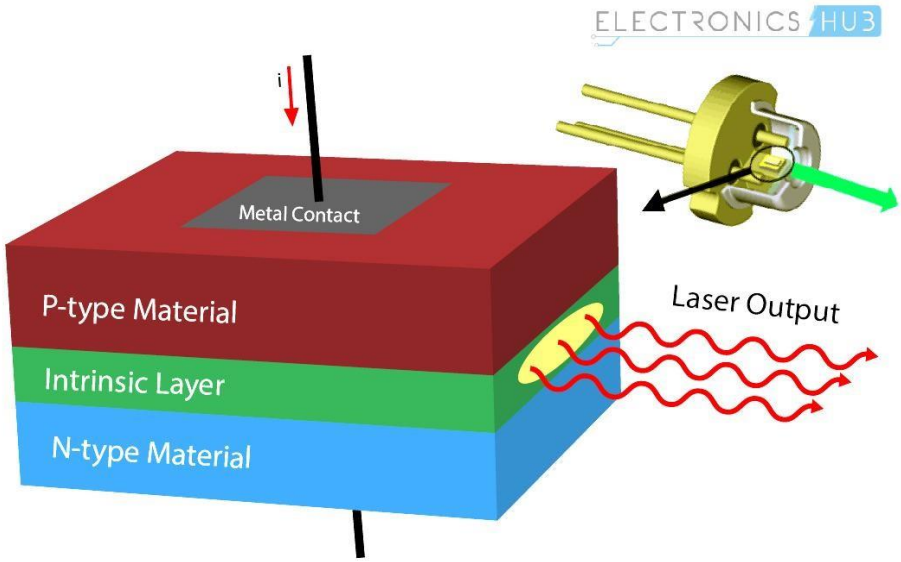
- **Low current, voltage, and power requirements:** Most laser diodes require only a few milliwatts of power at 3 to 12 volts DC and several milliamperes. Therefore, they can operate using small battery power supplies.

- **Low intensity:** A laser diode cannot be used for spectacular purposes such as burning holes in metal, bringing down satellites, or blinding aircraft pilots.

Nevertheless, its coherent output results in high efficiency and ease of modulation for communications and control applications.

- **Wide-angle beam:** A laser diode produces a "cone" rather than a "pencil" of visible light or IR, although this "cone" can be collimated using convex lenses.





LASER DIODE CONSTRUCTION

4. What are the differences between injection laser and LED ?

injection laser (laser diode) differ from LED in that :

(1) Laser has optical cavity in order to provide the feedback of photons.

(2) Laser has narrow line-width on the order of 1 nm (10 Å) or less which is useful in minimizing the effects of material dispersion.

(3) Lasers are more powerful. They can **produce high output power in fiber optic communications**. The laser source is useful for relatively high power i.e. more than 20 mW is available.

(4) Laser has faster speeds than LEDs, and they can also transmit light farther with fewer errors.

(5) Laser are much more expensive than LEDs.

Optical Modulators

1. An optical modulator is a device which can be used **for manipulating a property of light – e.g. a laser beam**. Depending on which property of light is controlled, modulators are called intensity modulators, phase modulators, polarization modulators, spatial light modulators, etc.
2. Modulating the output power of a laser diode can happen in two ways:
   (1) **by changing the signal input/driving current or**
   (2) **by alternating the continuous wave output after the light is generated**.
   (3) **In laser modulation, the current or voltage varies with time to modulate the output signal from**