

**CL44\_Q1. Distinguish between homo-junction and hetero-junction semiconductor lasers.**

**Ans:**

Homo-junction semiconductor lasers:

- i. A homo junction semiconductor laser is the junction between differently doped layers or regions of same semiconductor material having equal band gaps.
- ii. The homo junction lasers are not very efficient and require a very high forward current density.
- iii. It is not used in communication system due to its high divergence.
- iv. It operates at very low temperature.

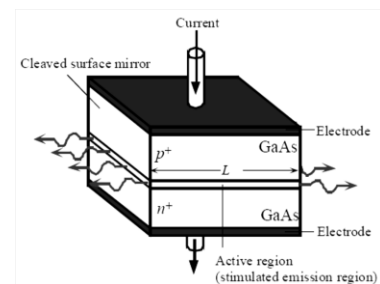
Hetero-junction semiconductor lasers:

- i. A hetero junction semiconductor laser is the junction between different layers or regions of different types of semiconductor materials.
- ii. The hetero junction laser is highly efficient and requires less current density as compared to homo junction laser.
- iii. It is used in the communication system.
- iv. It improves the confinement of light and electrons for a diode laser to operate in pulsed mode at room temperature.

**CL44\_Q2. Elaborate on how “population inversion” is obtained in semiconductor laser.**

Semiconductor lasers use heavily doped direct band gap semiconductors like GaAs which is the active medium. The heavy doping results in an extremely thin depletion region and, moves the Fermi level of the n type into the conduction band and the Fermi level of the p type into the valence band. This result in the presence of electrons and holes in the “depletion region”, however they are not in a favourable state for recombination.

When the PN junction is forward biased with a large forward current, which is the energy pump, large number of electrons in the n side and holes in the p side are in



a favourable state for recombination in a narrow and generation of photons in the depletion region. This emission is of the stimulated type.

**CL44\_Q3. Explain the factors that are responsible for the higher efficiency of double heterojunction devices.**

**Ans:**

The factors that are responsible for the higher efficiency of double heterojunction devices are

carrier confinement: double hetero structure diode has two junctions which are between two different band gap semiconductors (p-GaAs-smaller band gap and AlGaAs- wider band gap). This will confine the injected electrons and holes to a narrow region about the junction and establish required concentration of charge-carriers for population inversion.

Photon confinement: The n and p type AlGaAs on either side have lower refractive index when compared to the active layer. This will act as an optical waveguide increasing the photon concentration and the probability of stimulated emission and hence reduces the number of photons lost travelling off the cavity axis.